

1. Overview

DRM Digital Radio Mondiale supports a wide range of standardized data applications, allowing to transmit short and advanced text, program information, images, etc. in addition to pure audio programmes as known from analogue radio.

Basically all information given in this document is also contained in a comprehensive form in the current edition of the “DRM Introduction & Implementation Guide” (“DIG”). This document is available as a free download from the [drm.org](http://drm.encours.fr/wp-content/uploads/2012/10/DRM-Introduction-Implementation-Guide.pdf) home page: <http://drm.encours.fr/wp-content/uploads/2012/10/DRM-Introduction-Implementation-Guide.pdf>

This document also explains all the features generally available for the DRM platform and thus listed below as data applications, such as service signalling (station labels, programme types, programme language, etc.), i.e. alternative frequency signalling, emergency warning and alert feature, announcement support, dynamic reconfigurations, etc.

We highly recommend that the members of the Câmara Temática de Inovações Tecnológicas read the “DRM Introduction & Implementation Guide” to gain a deep and complete understanding of the open DRM standard and its capabilities.

2. Standardized and proprietary data applications

Besides the existing standardized set of basic data applications (see below), the open nature of the DRM standard allows the DRM Consortium as the maintainer of the technical specification to enhance and add functionality to DRM based on feedback and contributions from its members (including regulators, broadcasters, manufacturers and research institutions worldwide). Examples of such globally crafted enhancements currently under development and/or standardization are Diveemo (small-scale video service, see below) and Ginga (ISDB-Tb middleware to be enhanced for radio, see below). The goal of these standardized applications is that they are supported by all DRM-ready receivers and a majority of broadcasters actually provides such content on-air. To achieve this goal and to communicate clearly to both broadcasters and equipment manufacturers, the DRM Consortium has created the DRM Receiver Profiles document (which is available as a free download from the [drm.org](http://www.drm.org/wp-content/uploads/2012/10/drm_receiver_profiles.pdf) home page: http://www.drm.org/wp-content/uploads/2012/10/drm_receiver_profiles.pdf).

In addition, any broadcaster is able to transmit proprietary information on various protocol levels and transmission modes (such as synchronous/asynchronous stream mode, packet mode, enhanced packet mode, transparent file transmission, IP tunnelling, etc.) using an application ID from the range reserved for proprietary applications. There is no need to get any technical ‘license’ or authorisation from the DRM Consortium to put a proprietary service component on-air over DRM. But of course, in this case the operator of the service is responsible for providing

equipment that can decode this proprietary information. Examples for such proprietary applications would be public information panels located at public transportation service stops presenting and updating the current arrival times of the next buses/trains through DRM. Another example could be a regional chain of gas stations, which needs to regularly update the fuel prices and chooses to do this over-the-air as a small-capacity service component of a DRM broadcast (preventing the need for individual expensive land lines to every filling station individually).

3. DRM Services and DRM Data Applications

Several specific terms will be used in the context of this document. This clause shall help to clarify their exact meaning.

- A “**service**” is one particular audio and/or data programme (e.g. “FM Gold”), while a “**(data) application**” is the standardized technical specification for one particular type of content (audio, images, video, text, etc.).
- Services are built from one or more “**service components**”. For example, an audio programme with associated scrolling text would be composed of two service components, one of application type “audio”, the other of data application type “DRM TextMessage”.
- A “**DRM Service**” is the entity that is presented to the listener and thus can be ‘tuned to’. It is a mere virtual signalling entity. The actual content(s) of which the DRM Service is composed are carried as individual service components in the form of “**MSC Streams**” in the DRM broadcast signal (MSC: Main Service Channel).

A DRM broadcast consists of between 1 and 4 DRM Services, and between 1 and 4 MSC Streams. However, content carried in an MSC Stream may be referenced from multiple DRM Services simultaneously (thus sharing content in form of service components and preventing the need to transmit the actual identical content multiple times simultaneously within the DRM broadcast signal).

For instance, a DRM broadcast signal could present 3 different “DRM Services” to the listener, each with individual service label, globally unique service ID, programme type, etc. However, all 3 DRM Services could be linked to the same single audio content (service component) carried in a single MSC Stream, while each DRM Service carries an individual accompanying Journaline text service component (all 3 different Journaline service components being carried in a single MSC Stream in ‘Packet Mode’ configuration). In this example, whichever of the 3 DRM Services the listener tunes to, he would hear the identical audio content but see different Journaline text information. (Of course the configuration could be dynamically reconfigured at any time; for example the 3 DRM Services could all point to individual audio content after the reconfiguration now occupying 3 MSC

streams, while still presenting the same 3 DRM Services to the listener.) This information is explained in more detail in the DIG, for example in Figure 5.3.2: Relationship between DRM Services and MSC 'Streams'.

The relation between DRM Services and MSC Streams is explained in more detail including graphical examples in the DRM System Specification Annex M: MSC configuration examples. The DRM System Specification is available as a free download from ETSI: http://www.etsi.org/deliver/etsi_es/201900_201999/201980/03.02.01_60/es_201980v030201p.pdf

The MSC (Main Service Channel) carrying the upto 4 MSC Streams can flexibly be configured and re-configured during dynamic configurations to allow for a broadcast specific trade-off between content capacity and transmission signal robustness. The configuration of the modulation parameters defines the available overall MSC capacity of a particular broadcast signal - it is between 4,8 and 72 kbps for DRM30, and between 37,2 and 186,3 kbps for DRM+. The bitrate assignment for individual MSC Streams within the MSC can flexibly be specified with a granularity of 20 bps for DRM30 and 80 bps for DRM+, respectively.

The MSC configuration options and resulting content bitrates are listed in the DIG, table 5.3.2.

In DRM the signal over-the-air is encoded using COFDM modulation including sophisticated data correction mechanisms and a flexible configuration approach to trade-off capacity versus signal robustness. From a service layer perspective however, the underlying transport layer simply provides a bit pipeline of constant capacity: the MSC (Main Service Channel; along with two more signalling channels FAC and SDC). **Thus in DRM, there is NO restricting link between individual COFDM carriers (of the transport layer) and the MSC Streams (which are part of the service layer). Instead, the overall capacity of the MSC can freely be divided and assigned with a very fine granularity (20/80 bps) to the MSC Streams carrying the service component data.**

- An MSC Stream can be configured for **standard stream operation** (one service component occupying the full MSC Stream at constant bitrate), or using the **DRM Packet Mode**. An MSC Stream configured for DRM Packet Mode can carry upto 4 service components simultaneously, or upto 3 service components in case of the "Enhanced Packet Mode" (giving extra data protection through added forward error correction). The service components sharing an MSC Stream in Packet Mode configuration can flexibly and dynamically share the overall bitrate of the MSC Stream as required.
- An MSC Stream can carry content in various forms: As a **synchronous byte stream** (at constant bitrate, such as audio content), as a **asynchronous byte stream** (at varying bitrates, using the DRM Packet Mode), or in form of a sequence of **DRM Data Units** (each Data Unit with a defined but varying length; all data of a Data Unit being received without any error or the complete Data Unit being fully discarded otherwise; using the DRM Packet Mode).
- A DRM Service can consist of a single audio service component (with or without a DRM TextMessage service component). This configuration is called an "**Audio Service**". If the DRM Service consists of a single service

component of any data application type, it is called a “**Data Service**” (presenting only the data service without audio when tuned by the listener). Finally, a DRM Service can consist of an audio service component plus an additional data application service component, resulting in an “**Audio Service with PAD**” (Programme Associated Data).

- **Service ID {M – mandatory data}**

The DRM Service ID is a worldwide unique identifier assigned to every DRM programme. It enables the AFS mechanism (Alternative Frequency Signalling) and allows a receiver to find and identify the selected programme even if its frequency has changed. It is not used by the listener for service or programme selection, nor is it shown on consumer receiver displays.

It is the broadcaster's responsibility to assign a unique ID to each of its DRM services. The DRM Service ID values are typically assigned by national authorities. More information on the format of the Service ID can be found on the DRM web site

- **Service Labelling {M}**

The listener is informed about the tuned service by the name of the programme (DRM service label). The DRM service label is the primary programme identification and selection mechanism for the listener, while information about the current broadcast frequency or even the broadcast standard may not be disclosed at all by modern Digital Radio receivers. The DRM service label can be any free text, up to 16 characters long. All worldwide scripts are supported for broadcast (up to 64 bytes of UTF-8 encoded text), but the characters displayed by receivers will depend on those implemented by the manufacturer. If a station is known to its listeners currently by its AM or FM main frequency, this information could be sent as part of the DRM service label.

- **Programme Type**

The selection of a service can be made by the genre of the programme, for example news, rock music or drama. The figure above shows Pop Music and below Finance/Business information, which could be information from the currency markets or stock exchange. DRM supports the optional signalling of 29 common programme types for audio

- **Service language**

The listener may be able to select the language of the programmes he wants to receive on the radio. In regions with many languages, this might be helpful to avoid tuning into services that cannot be understood. DRM supports the optional signalling of all languages worldwide by using their respective ISO language codes.

- **Country of origin**

The broadcast can optionally signal the country of origin for a particular DRM service. This information refers to the site of the studio, not a transmitter site. Thereby a receiver can enable the listener to scan for programmes originating from a particular country, for example to easily identify the national news programme whilst

on vacation. All countries worldwide can be signalled by using their respective ISO country codes.

- **Alternative Frequency Signalling**

Alternative Frequency Switching forms an integral part of the mechanism allowing the use of MFN's. The AF (Alternative Frequency) list is transmitted in the SDC part of the DRM multiplex and provides the receiver with a list of frequencies carrying the same programme or associated programmes.

There are two distinct modes of AF switching:

- **Seamless AFS:** the receiver re-tunes with virtually no break in audio
- **Generic AFS:** The receiver is directed to another transmission carrying the same service.

An example of 'generic' AFS might be a metropolitan FM service, carrying RDS, which points to a DRM frequency. Outside the metropolitan area the coverage might be extended by using one or more DRM transmitters so that a car receiver could switch from the FM service to the DRM service. The reverse process would apply on returning to the metropolitan area. Another similar application might be an international SW service transmitted from outside a country, but where a local relay was provided in the capital city of that country, using a Band II FM frequency.

In the case of the DRM AFS function, it is possible not only to transmit information about current frequencies carrying the same programme but also other frequencies, which will carry the same service at other times of day or in other regions of the world. This can be particularly useful for SW services, where different frequencies are required to provide service to a region at different times of day, due to diurnal propagation variations, or to different regions, because of differing propagation paths. In these cases the receiver can be equipped with data storage to ensure that the listener can select a programme service by name and allow the receiver to select the optimum frequency for that region and time of day.

AFS per DRM Multiplex and per Service

- **Multiplex-AFS:** synchronous/non-synchronous
- **Service-AFS:**
 - links to DRM30/DRM+, AM, AM-AMSS, FM, FM-RDS, DAB/DAB+/DMB, etc.
 - by Service-ID
- Including **schedules and regions**

Automatic frequency switching

when leaving coverage area,
or in case of **emergency alarm**

Single tuner background AFS scanning

- **Emergency Warning and Alert feature,**

The Emergency Warning Broadcast System (EWBS) uses the broadcast medium to alert public on emergencies. The system can be implemented on radio and TV both on digital and analogue systems. The operation involves sending of a specific code, EWS control signal, which is carried on the same broadcast channel

In the case of analogue broadcast this is a specially modulated audio signal which is carried on the radio or TV sound channels. For digital the EWS control signal is transmitted by multiplexing with the broadcast wave.

This signal, upon reception on an EWBS enabled receiver (radio or TV set), will automatically switch on (if on sleep mode), change channel or display on screen/ sound issuing an alert message.

These EWBS enabled receivers use a very inexpensive chip that is integrated on the receiver sets to enable the automatic wake-up function.

This is very important, as we experienced in the 2004 tsunami that an impending disaster message could be delivered during the night when people are sleeping and radio/TV sets are in sleep or standby mode.

- **Surround Sound 5.1/7.1**

In order to allow a trade-off between audio quality and number of services, the DRM system makes provision for three MPEG4 audio codecs (shown in Figure 6.2.1a). They vary in their field of application and bit rate requirements. AAC provides the highest quality, whilst CELP and HVXC require progressively lower bit rates but are designed for speech-only services. The performance of all three codec's can be enhanced by the optional use of SBR (Spectral Band Replication) coding.

The enhancements of CELP and HVXC with SBR are specific to DRM audio coding. All three encoders can operate over a range of bit rates, and consequently support a range of programme content – see Figure 6.2.1b below and the DRM standard [1].

In the 18/20 kHz DRM30 modes and DRM+ mode, the available data rate allows the possible use of MPEG 4 stereo-compatible 5.1 surround sound broadcasts.

An MPEG Surround (MPS) coder is available for mono/stereo compatible multichannel encoding. MPEG Surround is standardized in MPEG-D, ISO/IEC 23003-1 [10]. It describes:

- coding of multichannel signals based on a downmixed signal of the original multichannel signal, and associated spatial parameters. It offers lowest possible data rate for coding of multichannel signals, as well as an inherent mono or stereo downmix signal included in the data stream. Hence, a mono

or stereo signal can be expanded to multi-channel by a very small additional data overhead;

- binaural decoding of the MPEG Surround stream, enabling a surround sound experience over stereo headphones;
- an Enhanced Matrix Mode that enables a multi-channel upmix from a stereo signal without any spatial parameters.

Receivers without multichannel decoding support can decode the unmodified mono or stereo core signal. Hence, MPEG Surround (Spatial Audio Coding, SAC) is capable of re-creating N channels based on $M < N$ transmitted channels, and additional control data. In the preferred modes of operating the spatial audio coding system, the M channels can either be a single mono channel or a stereo channel pair. The control data represents a significantly lower data rate than required for transmitting all N channels, making the coding very efficient while at the same time ensuring compatibility with both M channel devices and N channel devices.

The MPEG Surround standard incorporates a number of tools enabling a number of features that allow for broad application of the standard. A key feature is the ability to scale the spatial image quality gradually from very low spatial overhead towards transparency. Another key feature is that the compatible decoder input can be made compatible to existing matrix surround technologies. All tools are grouped to cover certain profiles.

Receivers with a different number of output channels than the number of MPS target channels indicated by the SDC should still render the multichannel audio signal according to the available number of output channels (possibly at a reduced quality compared to the case where the number of target channels matches the number of output channels).

4. Standardized DRM data applications

Besides the transmission of pure audio signals (equivalent to an analogue radio system), the DRM standard also includes a set of well-defined data applications allowing broadcasters to create and provide simple and advanced text services, images including simple animations, electronic programme guide info, traffic updates, and even the provision of generic file sets.

All data applications standardized for DRM can be transmitted in all DRM configurations (i.e. DRM30 and DRM+), as the DRM service layer above the physical signal transport (using COFDM modulation) is identical and shared. However, due to typical bitrate requirements of each data application, broadcasters will typically choose to tailor their service offering to their specific broadcast situation. For example, text based applications (DRM TextMessages and Journaline) operating at lowest bitrates can be added to audio programmes in any configuration without affecting the audio quality, whereas the transmission of images at higher frame rates using the Slideshow application may not be suitable for low-capacity shortwave

transmissions.

- **DRM TextMessages** (scrolling text)
 - a. Name: DRM TextMessages
 - b. Type: Standardized DRM application (see ETSI ES 201980)
 - c. Technical characteristics: short text strings (max. 128 characters); passive consumption: screen updates triggered by broadcaster, no user-interaction; updates should be limited to one message every 20 seconds to prevent driver/listener distraction; supporting all classes of receivers as long as a simple text screen is available; Unicode (i.e. all character sets supported); carried as part of an audio service component in the same MSC Stream as the audio content (special case for this data applications), thus can only be provided as a PAD service; transmission capacity is fixed to 80 bps (DRM30) or 320 bps (DRM+)
 - d. Usecase: short text items that automatically appear on the receiver's screen; content typically focussing on information strongly related to the current radio programme (current song, artist, album, show name, etc.)
 - e. Operating range (FM, MW, etc.): no restrictions; can be broadcast with any audio service component
 - f. Service component linking: transmitted as part of the audio MSC Stream, thus cannot be presented as a stand-alone "Data Service" to the listener
 - g. Shared service linking: physically transmitted along with one specific audio MSC Stream, thus cannot be shared between audio service components (but of course the same audio service component including its DRM TextMessage component can be referenced from multiple DRM Services simultaneously)
 - h. Impact on linked audio: if an audio service component shall be accompanied by DRM TextMessages, the bitrate of the MSC Stream carrying the audio content must be increased by 80 or 320 bps, respectively, to maintain the identical audio quality
 - i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
 - j. Middleware: no middleware is required to decode this data application
 - k. Receiver requirements: simple text screen as a minimum; very low CPU load for decoding; designed to be implemented in all classes of receivers (from simple basic receivers to high-end multimedia and car receivers)
 - l. Broadcaster/Transmitter: supported as a default DRM feature by all major encoder/multiplexer solutions
 - m. Reception/CA: content is presented along with the audio signal, i.e. typically free-to-air as a regular broadcast; the DRM TextMessage application is not intended as a 'pager' service with individual receiver targeting; however scrambled Audio Services (using CA - conditional access mechanisms) would also include the DRM TextMessage content; CA allows to address small groups or even individuals (e.g. subscribers of a service)

n. Additional info: -

- **Journaline** (advanced text with backchannel)

- a. Name: Journaline
- b. Type: Standardized DRM application (see ETSI TS 102979)
- c. Technical characteristics: text information pages (max. 4096 characters/page) accessible through a menu structure defined by the broadcaster; supporting all classes of receivers as long as a simple text screen is available; Unicode (i.e. all character sets supported); carried in DRM Packet Mode; typical bitrate between 200 bps and 2 kbps
- d. Usecase: designed to be cached in the radio set for interactive and immediate access by the listener to look-up relevant information while listening to a radio station; content can be program related (such as background information on a radio show, the list of last played songs, artist bios and song lyrics, etc) or program independent (such as contact information of the broadcaster's listener service, news, localized weather previews, sports reports and results tables, airport times, etc.); optionally supports geo-refencing of information (to enable search for locally relevant content, locate content on a visual map, or hand-over the position to a connected navigation system) and interactivity triggers (e.g. links to web URLs, phone numbers, SMS messages, e-mail, etc.); supports language indications, macros and pronunciation infos to enhance receiver-based text-to-speech engines e.g. for in-car environments
- e. Operating range (FM, MW, etc.): no restrictions
- f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
- g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
- h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
- i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
- j. Middleware: no middleware is required to decode this data application
- k. Receiver requirements: simple text screen and four navigation buttons as a minimum; very low CPU load for decoding; cache memory is optional but improves user experience; designed to be implemented in all classes of receivers (from simple basic receivers to high-end multimedia and car receivers)
- l. Broadcaster/Transmitter: supported as a default DRM feature by all major encoder/multiplexer solutions
- m. Reception/CA: designed for free-to-air broadcast services, not as a pager application; however, theoretically DRM's CA mechanisms (conditional access) would allow to limit the availability of the whole service component content or even individual Journaline pages to certain groups of listeners (e.g. subscribers) or even individual receivers
- n. Additional info: -

- **Slideshow** (images/animation)
 - a. Name: MOT Slideshow
 - b. Type: Standardized DRM application (see ETSI TS 101499)
 - c. Technical characteristics: transmission of a sequence of images (JPG or PNG format), optionally with limited animation elements (APNG format) in a backward compatible form (e.g. receivers without animation support at least present the first slide); image size typically 320x240 pixels; passive consumption: screen updates triggered by broadcaster, no user-interaction; updates should be limited to one message every 20 seconds to prevent driver/listener distraction
 - d. Usecase: designed to be presented by receivers which feature a colour graphics screen; content typically program or broadcaster related (such as album cover, studio cam, weather images and personality portraits during the news)
 - e. Operating range (FM, MW, etc.): no technical restrictions, but typically requires a considerable bitrate for this service component
 - f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
 - g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
 - h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
 - i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
 - j. Middleware: no middleware is required to decode this data application
 - k. Receiver requirements: requires a colour graphics screen and enough cache memory to re-assemble one or more images simultaneously; designed to be implemented in higher-end receivers
 - l. Broadcaster/Transmitter: supported as a default DRM feature or option by all major encoder/multiplexer solutions
 - m. Reception/CA: designed for free-to-air broadcast services, not as a pager application; however, theoretically DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content to certain groups of listeners (e.g. subscribers) or even individual receivers
 - n. Additional info: -

EPG - Electronic Programme Guide

- a. Name: EPG - Electronic Programme Guide
 - b. Type: Standardized DRM application (see ETSI TS 102818, ETSI TS 102371)
 - c. Technical characteristics: information about the services and programmes provided by a broadcaster or network (including station icons, etc.) and timing and content of individual shows over the course of the coming days; uses a binary representation of XML structures

- d. Usecase: designed to service as a programme guide just like a TV EPG; receivers may visualize the information as text on the receiver screen, allow the listener to search for specific shows, or even conveniently link with a receiver-specific recording/scheduling feature
- e. Operating range (FM, MW, etc.): no technical restrictions
- f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
- g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
- h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
- i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
- j. Middleware: no middleware is required to decode this data application
- k. Receiver requirements: requires at least a text screen and navigation buttons, and enough cache memory to re-assemble and parse the transmitted content
- l. Broadcaster/Transmitter: supported as a default DRM feature or option by all major encoder/multiplexer solutions
- m. Reception/CA: designed for free-to-air broadcast services, not as a pager application; however, theoretically DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content to certain groups of listeners (e.g. subscribers) or even individual receivers
- n. Additional info: -

Diveemo (small-scale video)

- a. Name: Diveemo
- b. Type: currently under standardization within the DRM Consortium
- c. Technical characteristics: small-scale real-time video streams with one or more audio tracks; flexible trade-off between higher frame rates or larger frame sizes
- d. Usecase: designed as a visualization application for long-distance education or information programmes, disaster information and instructions, etc.
- e. Operating range (FM, MW, etc.): no technical restrictions; was successfully demonstrated as a live broadcast based on double channel shortwave and mediumwave DRM transmissions
- f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
- g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
- h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration); however, will typically occupy the full MSC capacity of a DRM broadcast

- i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
- j. Middleware: no middleware is required to decode this data application
- k. Receiver requirements: requires at least a colour graphics screen and enough CPU power to decode and present video signals
- l. Broadcaster/Transmitter: not yet standardized
- m. Reception/CA: designed for free-to-air broadcast services, not as a pager application; however, theoretically DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content to certain groups of listeners (e.g. subscribers) or even individual receivers
- n. Additional info: -

TMC/TPEG (traffic information)

- a. Name: TMC (Traffic Message Channel), TPEG (Transport Protocol Experts Group; see www.tisa.org)
 - b. Type: general platform-independent technical standards; for TMC there is a DRM transport specification (see ETSI TS 102368)
 - c. Technical characteristics: traffic alerts and updates, mainly to be consumed by in-car navigation systems (machine-to-machine)
 - d. Usecase: optimize the navigation system's routing to bypass traffic congestions and road accidents
 - e. Operating range (FM, MW, etc.): no technical restrictions
 - f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
 - g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
 - h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
 - i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
 - j. Middleware: no middleware is required to decode this data application
 - k. Receiver requirements: mainly intended for car-based receivers with connected navigation systems
 - l. Broadcaster/Transmitter: available as an option for major encoder/multiplexer solutions
 - m. Reception/CA: primarily designed for free-to-air broadcast services, not as a pager application; however, DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content or even individual TPEG messages/message types to certain groups of listeners (e.g. subscribers) or even individual receivers
 - n. Additional info: -

MOT Transparent File Transmission (file/directory structure transmission protocol; incl. Broadcast Website)

- a. Name: MOT Multimedia Object Transfer protocol, MOT Broadcast Website
- b. Type: Standardized DRM protocol (MOT; see ETSI TS 301234) and application (see ETSI TS 1014981, ETSI TS 1014982)
- c. Technical characteristics: allows to transfer of individual files (MOT header mode) or complete file and directory structures to the receiver (MOT directory mode); transparently handles file metadata; operates in a data carousel mode with optional support for multiple priority classes; in MOT directory mode, ensures consistency of the components of a data set in the receiver at all times; MOT Broadcast Website defines a certain type of (web) content to be transmitted in the MOT carousel, optionally supporting individual startup HTML pages for different receiver classes
- d. Usecase: transmission of podcast directories, offline web content, etc.
- e. Operating range (FM, MW, etc.): no technical restrictions, but typically requires a very high bitrate for this service component
- f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
- g. Shared service linking: a single service component can be linked with one or more Audio Services (as PAD) and with stand-alone Data Services
- h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
- i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
- j. Middleware: no middleware is required to decode this data application
- k. Receiver requirements: Broadcast Website applications require a web browser as a rendering engine, plus various multimedia decoders dependent on the transmitted content; a theoretically huge amount of cache memory needs to be provided in the receiver for data re-assembly (no limitations specified); typically requires a PC based receiver (with graphics screen, pointer device or touch screen, etc.)
- l. Broadcaster/Transmitter: available as an option for all major encoder/multiplexer solutions
- m. Reception/CA: primarily designed for free-to-air broadcast services, not as a pager application; however, DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content or even individual MOT objects (files, HTML pages, etc.) to certain groups of listeners (e.g. subscribers) or even individual receivers
- n. Additional info: -

Ginga (middleware, integrating all of the above applications and adding user interface layout + timing + interactivity)

O Ginga é o middleware do Sistema Brasileiro de TV Digital e está sendo adaptado e implementado ao DRM pelo Laboratório de Sistemas Multimídia TeleMídia da PUC-Rio tendo um aluno de mestrado em tempo integral trabalhando

no projeto em conjunto com o time de mestrandos e doutorandos do laboratório sob coordenação do professor Luiz Fernando Gomes Soares.

- a. Name: Ginga
- b. Type: Currently under standardization, based in the standardized middleware specification for ISDB-Tb (ABNT NBR 15606-2, ABNT NBR 15606-5 and ITU-T H.761), with adjustments for the integration of standardized DRM application content and radio receiver specific user interfaces
- c. Technical characteristics: É utilizada a linguagem declarativa NCL que permite a sincronização no tempo e espaço de objetos de mídia audiovisuais e a linguagem de script LUA. O Ginga apresenta a possibilidade da interação nos objetos de mídia através de comandos do usuário. Adicionalmente pode ser utilizado um canal de retorno para enriquecer a experiência interativa do usuário e os serviços oferecidos. A norma do Ginga para o rádio digital está sendo desenvolvida baseada na norma do Ginga para receptores de TV Digital portáteis One-SEG: ABNT NBR 15606-5 - Ginga-NCL para receptores portáteis
- d. Usecase: Educação a distância, envio de capas de discos e descrição de músicas, anúncios multimídia de ofertas e promoções, serviços públicos, textos e descrição complementar à programação de áudio, entretenimento, envio de mapas e rotas guiadas, envio e instruções de emergência
- e. Operating range (FM, MW, etc.): no technical restrictions, but may require a considerable bitrate for contained multimedia elements
- f. Service component linking: physically independent from any audio service component due to the transmission in DRM Packet Mode
- g. Shared service linking: Ginga user interfaces may incorporate access to the DRM Services and audio/data/video service components from within the Ginga UI; the Ginga applications can be linked to one or more Audio Services (as PAD) and with stand-alone Data Services
- h. Impact on linked audio: no influence on audio service components (within the overall limitations of the MSC capacity under the current signal/COFDM configuration)
- i. Location of service (COFDM carriers): not applicable to DRM, since fully flexible/transparent (see clause 3 above)
- j. Middleware: Ginga is an established middleware standardized for ISDB-Tb, which in turn grants access and incorporates into its own UI the standard DRM service components listed above. There is a full feature open source implementation of Ginga-NCL by PUC-Rio which is already used in many commercial TVs and settop boxes.
- k. Receiver requirements: O receptor deve seguir a recomendação do receptor multimídia do documento “DRM Receiver Requirements” que especifica um receptor com uma tela mínima de 320x240 pixels e adicionalmente cinco botões de controle ou uma tela de toque
- l. Broadcaster/Transmitter: Will be available as an option for all major encoder/multiplexer solutions as Ginga uses the standard DRM Packet Mode

- m. Reception/CA: primarily designed for free-to-air broadcast services, not as a pager application; however, DRM's CA mechanisms (conditional access) would allow to limit the availability of the service component content to certain groups of listeners (e.g. subscribers) or even individual receivers
- n. Additional info: -

- **HECA Conditional Access**

The system operates independently of transmission protocols and broadcast media. Therefore it can be applied to almost any environment and protocol level. Scrambling complete multimedia data streams or single objects is possible.

Up to now HECA has been integrated in the following standards:

- DRM/MOT
- DRM/Subchannel
- TPEG/Service Component

HECA is the Conditional Access system specified for Mobile.Info, the future platform for traffic information. It has already been integrated into BMW and Audi prototype equipment. (from Fraunhofer IIS)

- **Pause and Rewind**

In addition to the multimedia services presented in this chapter, other features can also show the advantage of Digital Radio to the listener. For example the option to enable a receiver to pause and rewind a program is of high interest for consumers. With the single touch of a button the reception of the favourite station can be paused. Later on, the user can continue listening from the point at which he or she left the programme. Depending on the internal memory capacity and the data rate of the service, several hours of content can be recorded. When using an additional flash card memory the recorded programme can also be replayed on other radios supporting this feature.