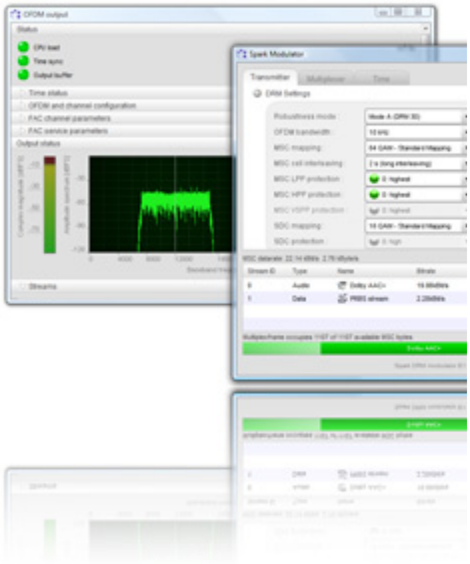
The Hitchhikers Guide to Digital Radio Mondiale (DRM)



What is DRM?

Since the first hour of radio broadcast almost all medium wave (MW) and long wave (LW) transmitters use amplitude modu transmission of audio signals. The modulation scheme as well as the small channel bandwith of 10 kHz limits the audio c reason why commonly speech signals are transmitted in these bands. In the end of 2003 the European Telecommuni Institute (ETSI) published the specification for digial radio broadcast at 30 MHz using a multi carrier technique called OFDM named Digital Radio Mondiale, abbreviated DRM. Concerning the channel bandwidth of 10 kHz the datarate of the streamed approx. 35 kBit/s for a single channel and 72 kBit/s when using two channels. Although the bitrate is not very high the a streams reaches or exceeds the quality of FM mono transmissions. The advanced audio coding standard (AAC) combir parametric stereo provide high audio quality at very low bitrates (e.g. 22 kBit/s). Beside AAC the DRM standard defines the codec to be used for transmitting speech signals at 4 kBit/s or less. Streaming raw data for image slideshows, HTML pages, by the DRM standard.

2 The DRM Transmission Chain

The DRM transmission chain is characterized by the three channels MSC (Main service Channel), SDC (Service Descrip FAC (Fast Access Channel).

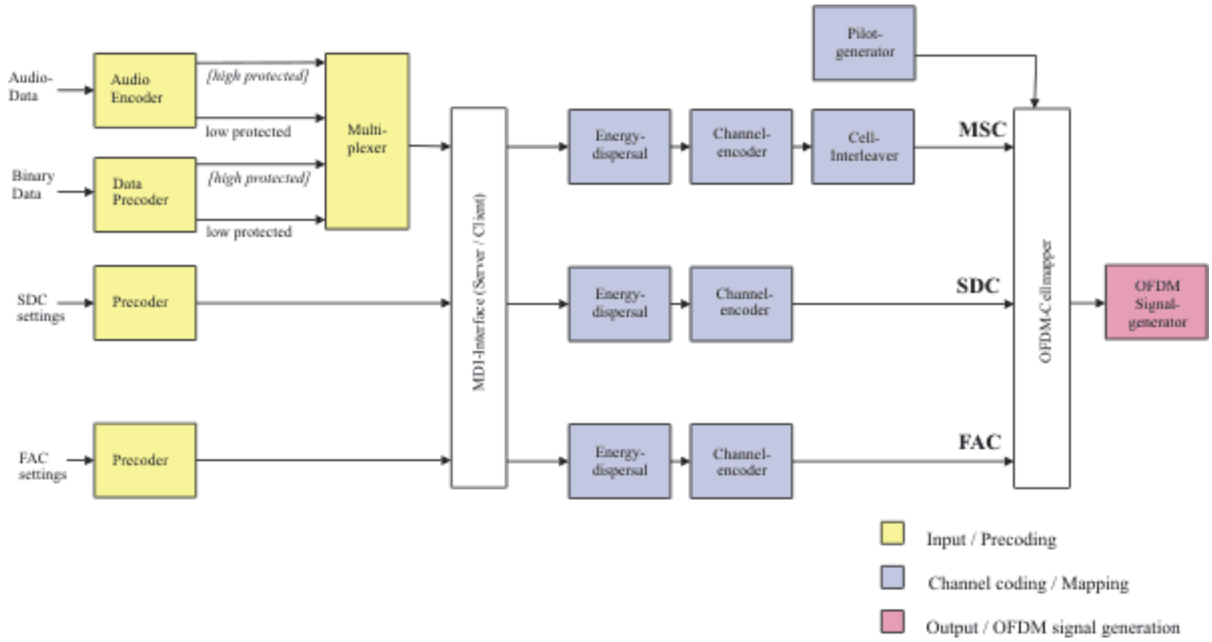


Fig. 1 *The DRM Transmission Chain [1].*

2.1 The Stream Multiplexer

The stream multiplexer generates a logical multiplex frame from the binary logical stream data which gets encoded by th transmission. The logical multiplex frame is split up in a high and low protected part accoding to the streams from which it DRM specification limits the maximum number of usable streams to four logical streams.

2.2 Fast Access Channel (FAC)

The Fast Access Channel is used by the receiver to obtain information about the OFDM signal properties and the SDC/MSC proper synchronisation and SDC/MSC interpretation a receiver reads the spectrum occupancy, carrier spacing and th information in the FAC datablock. The channel parameters, which contain the OFDM signal information, are transmitted eve with a block of service parameters. The service parameters may vary in a defined order according to the number of services The fixed coderate of 0.6 and the usage of 4 QAM encoding make the FAC very error robust. The complex QAM-cells are independently on 65 fixed carrier positions within a transmission frame. Hence, the bandwidth of the FAC is limited to 72 bi frame.

2.3 Service Description Channel (SDC)

The SDC contains the information needed for MSC decoding, like the multiplex frame structure, as well as other additional are transferred in a sequential list of data entities. Every data entity type has a unique number which defines its data stru coder uses standard mapping with either 4 or 16 QAM resolution and a overall code rate of 0.5. As well as the FAC, the SD and has got no high protected part.

2.4 Main Service Channel (MSC)

The MSC encodes the multiplex frame generated by the multiplexer and uses either 16 or 64 QAM with different mapping choose between standard mapping, symmetrical hierarchical or mixed hierarchical mapping whereas only the standard m QAM. If hierarchical modulation is used, every bit of a hierarchical multiplex frame is mapped on one complex cell quadrant QAM decoding of the MSC cells if the error rate is too high. For making the MSC even more error robust it is possible to use multiplex frame in a higher or lower protected data part. Usually the higher protected part is encoded using a higher code rat redundancy and hence, decreases the propability of bit errors in bad transmission scenarios. Cell interleaving of either 2 (short) additionally protects the MSC data against error bursts.

2.5 Transmission Frame

The biggest frame structure of a DRM system is a so called transmission super frame (TSF) which is made up from three tra The duration of a TSF is always 1.2 seconds and thus the duration of a transmission frame 400 ms. Transmission frames

well defined number of OFDM symbols which on their part contain the QAM cell information of the different channels. The nu
per symbol depends on the number of carrier frequencies and hence on the OFDM signal bandwidth as well as the used robu

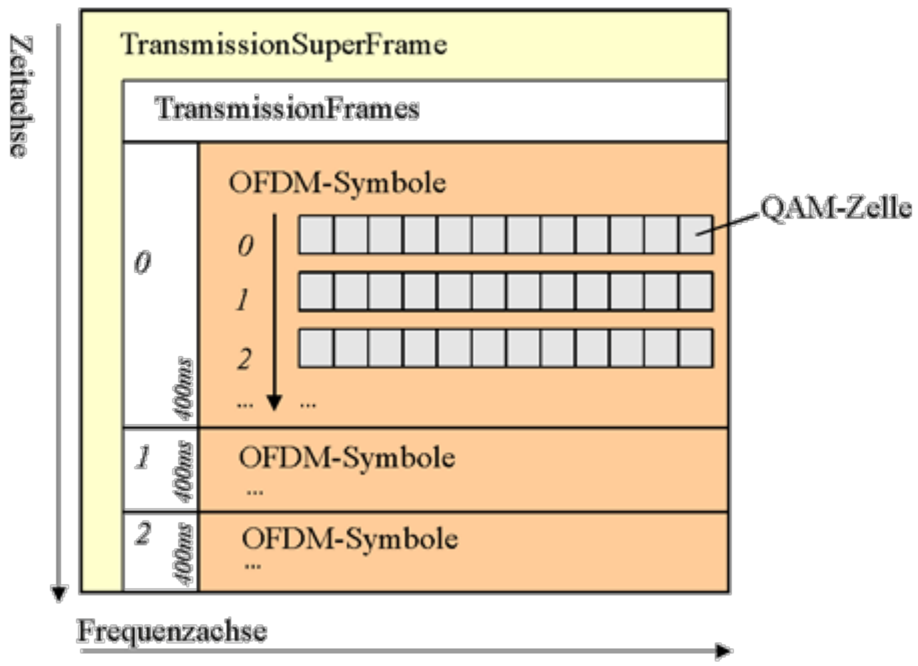


Fig. 2 *DRM Transmission Super Frame.*

2.6 OFDM Signal Characteristics

The procedure of cell mapping is defined by assinging an encoded bitsequence on a two dimensional coordinate system. Th cells are inserted into different OFDM symbols in a well known order. Aside from those, an OFDM symbol contains refer amplitude and phase which are called pilot cells. The receiver uses those references for channel eastimation, equal synchronisation. There are three different types of pilot cells generated by the pilot generator: time, gain and frequency refer are scattered within a transmission frame in time and frequency direction.
When an OFDM symbol is completly filled with QAM cells it has to be transformed into the time domain using a DFT. Before transmitted it is necessary to append a guard interval.

The OFDM output signal is described by:

$$T_{sym}(t) = \mathrm{Re}\left\{ e^{j2\pi \cdot f_{DC} \cdot t} \cdot \sum_{k=0}^{N-1} z_k \cdot e^{j2\pi \frac{k}{T_u}(t-T_g)} \right\}$$

f_{DC}	Intermediate frequency in Hz
T_g	Guard interval duration in sec.
T_u	Duration of an unguarded OFDM symbol
N	Number of carriers.

DRM uses the following OFDM parameters:

Robustness mode	T_u [ms]	Carrier spacing [Hz]	T_g [ms]	T_s [ms]	T_g / T_u	Number of symbols
A	24	41 2/3	2,66	26,66	1/9	15
B	21,33	46 7/8	5,33	26,66	1/4	15
C	14,66	68 2/11	5,33	20	4/11	20
D	9,33	107 1/7	7,33	16,66	11/14	24

E	2,25	444,44		0,25	2,5	1/9	40

2.7 Multiplex Distribution Interface (MDI)

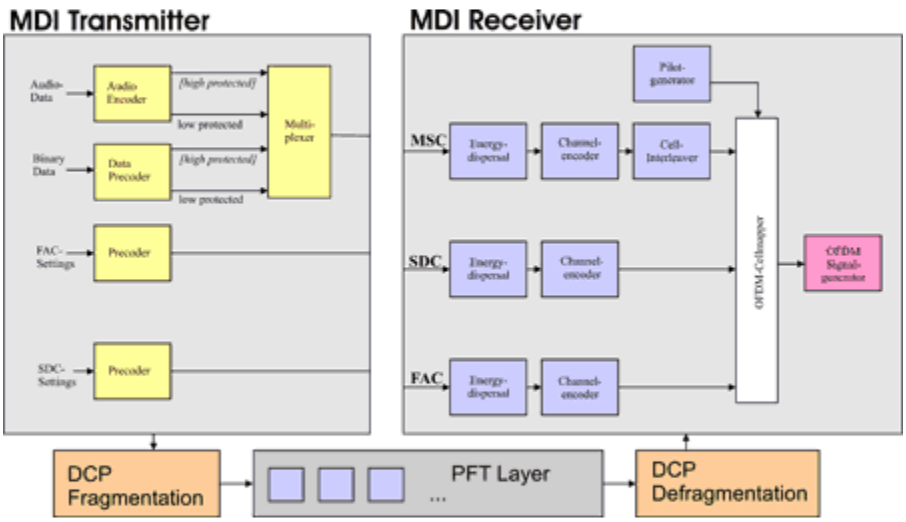


Fig. 3 The Multiplex Distribution Interface [2].

The MDI protocol allows a distanced spatial connection between the DRM content server and baseband modulator (M ethernet. Hence, the analog baseband signal can be generated very close to the transmitter and there's no need for connections which could add a lot of noise to the output signal. The precoded bits of FAC, SDC and MSC as well as some for the modulator are send in a DCP-PFT packet stream [3]. If ethernet is used as physical medium the used protocol on la TCP or UDP. The use of multicast allows to serve different MDI clients in one LAN with MDI packets.

3 References

- [1] ETSI ES 201 980 Digital Radio Mondiale (DRM) - System Specification
- [2] ETSI TS 102 820 - Multiplex Distribution Interface (MDI)
- [3] ETSI TS 102 821 - Distribution and Communications Protocol (DCP)

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