DIGITAL RADIO IN THE BROADCASTING BANDS BELLOWS 30MHz

Ing. Marek Dvorský

Abstract: The paper deals with the problem of digitalising radio broadcasting systems at the frequency bands bellow 30MHz. There are introduced their great qualities and priorities beside present either analogue or digital broadcasting platforms.

Key words: digital radio, DRM, DAB, IBOC, HE-AAC, COFDM, long wave, middle wave, short wave, signal spectrum, guard interval, simulcast, single frequencies network.

1 INTRODUCTION

It seems that the time of radio broadcasting at Long Wave (**LW**), Middle Wave (**MW**) and Short Wave (**SW**) bands have already gone. The opposite is true – **LW**, **MW** and **SW** bands are before their renaissance. It is obvious that it cannot remain in classical analogue broadcasting method – amplitude modulation (**AM**) but there have to be used new digital modulation principles.

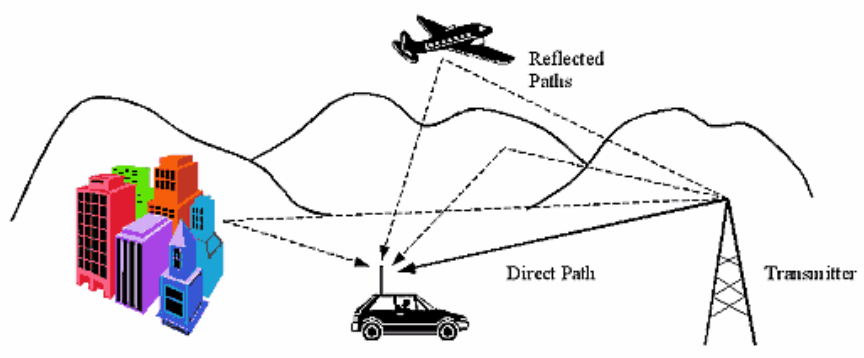
All of **AM** broadcasting operators, network operators, broadcasting research and development associations, including component and support technologies manufacturers, notified this problem. At international conference in Ghanzou, China 5th of April 1998 was approved an establishment of international platform for development and research digital radio broadcasting at **LW**, **MW** and **SW** named as "*Digital Radio Mondiale*" (**DRM**). There was sight an establishing document "*The Digital AM Memorandum of Understanding*". Than, in Netherlands 10th of September 1998 was an original document changed to ***DRM** Consortium Agreement*. At the same time was founded **DRM** association. In September 2001 ETSI (*European Telecommunications Standards Institute*) published technical specification of system for digital broadcasting "*ETSI-TS 101980: Digital Radio Mondiale, System Specification*", in which this system recommend for radio broadcasting bellow 30MHz. It needs to be mentioned that at the same time as was **DRM** being developed in Europe, The USA was working on similar system called IBOC by company iBiquity. Both systems were approved by ITU-R in October 2002 as "*Recommendation ITU-R BS 1514-1: Digital Sound Broadcasting Bellow 30 MHz*". Nowadays Consortium **DRM** have 90 members from 30 countries and more than 40 associated members. The group called High Frequency Co-ordination Konference (**HCCF**) presents the Czech Republic. **DRM** is broadcasted in more than 30 countries all around the word. While **DRM** currently covers the broadcasting bands below 30 MHz, the **DRM** consortium voted in March 2005 to begin the process of extending the system to the broadcasting bands up to 120 MHz. The design, development and testing phases are expected to be completed by 2007-2009. [1].

2 DRM BENEFITS

Launching **DRM** brings many benefits. Due to restricted length of this paper, there is just a short list of the most important ones.

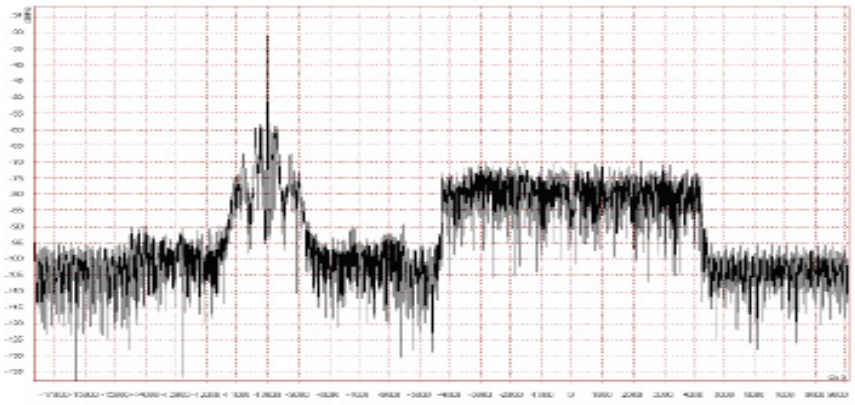
- The main benefit of **DRM** is based on characteristic wave propagation in bands bellow **30MHz**. Broadcasters are able to reach any places on the globe without a third party (using **SW** band).

- The similar situation is at **LW** and **MW** bands. **DRM** is at these bands amazingly able to equally cover a complicated landscape such as hills and pits. What is more, a listener will need just a simple receiving antenna.



pic.1: multipath propagation

- **DRM** is robust against effects rising from ionosphere instability and multipath propagation. This causes a pleasant reception even in the complicated landscape or in vehicle. That is due to a type of modulation **COFDM** (*Coded Orthogonal Frequency Division Multiplexing*), that **DRM** uses. For multipath suppression is in addition used a Guard Interval GI. Moreover, **DRM** has an ability to change GI, regarding quality and robustness of reception signal, in 4 levels from 2,666 ms (for MW/LW broadcasting using ground wave) up to 7,333 ms (for a long distance SW propagation).



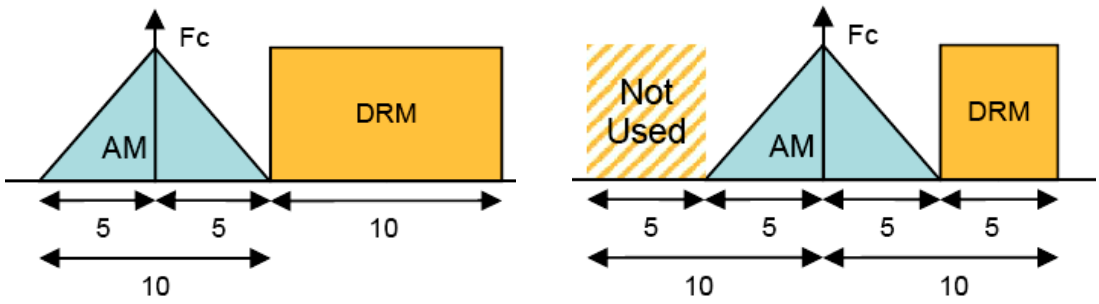
pic.2: simulcast spectrum of analogue AM (in left) and digital signal (in right)

- A further advantage of using GI is that with **DRM** can be realised a Single Frequency Network (**SFN**), which enable broadcasters to use one frequency for all transmitters in a broadcasting network. There is no interference between them and as a result, the final signal is composed and amplified.

- Furthermore, Digital Radio Mondiale needs **6÷9dB** less transmitting power to cover the same area as **AM** transmitter. This magnificent decrease amount of energy is caused by low level of Signal to background Noise Ratio (**SNR**). As a result, broadcaster will save great amount of money on electric energy that has logically also positive consequences in ecology.

- Consequently, **DRM** has an ability of a data channel such as in **T-DAB** (Terrestrial Digital Audio Broadcasting). Data channel can be used for transmitting additional information not only about what you listen in radio. Data channel can transmit such news, program guide, multilanguage information, weather forecast, pictures from traffic situation or just CD labels currently playing music. It can be either in text or graphics form (receiver has a graphics display).

- As it is not expected that **AM** broadcasting will be switch from day to day to digital, a special form of simulcast broadcasting has been developed. This special mode uses a narrow channel 4,5/5kHz for each technology. In total are used two normal radio channels of 9/10kHz (so in total 20kHz) see pic.3.



pic.3: spectrum of simulcast broadcasting mode

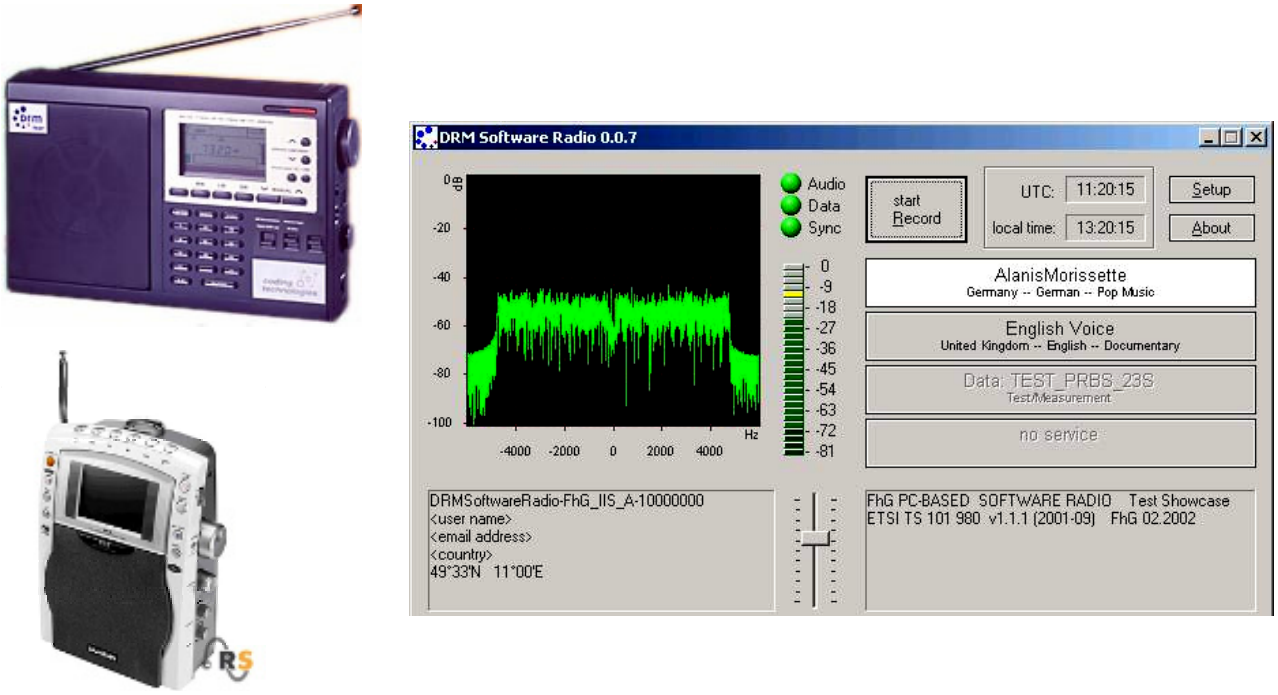
- Unlike digital systems that require a new frequency allocation (such as **T-DAB**), **DRM** uses existing **AM** broadcast frequency bands. Moreover, the **DRM** signal is designed to fit in with the existing **AM** broadcast band plan, based on signals of 9 kHz or10kHz bandwidth. It has modes requiring as little as 4.5kHz or 5kHz bandwidth, plus modes that can take advantage of wider bandwidths, such as 18 or 20kHz.

  - 9/10kHz normal broadcasting in mono
  - 18/20kHz two joined channels (stereo)
  - 4,5/5kHz simulcast mode

- The greatest advantage of **DRM** is a quality of sound, dynamics and signal-to-background-noise ratio, which is even better than in VHF-FM. The **DRM** system can use three different types of audio coding, depending on broadcasters' preferences. **MPEG4-HE-AAC** (*High Efficiency - Advanced Audio Coding*) audio coding, augmented by **SBR** (*spectral band replication*) bandwidth extension, is used as a general-purpose audio coder and provides the highest quality. **MPEG4 CELP** speech coding is used for high quality speech coding where there is no musical content. **HVXC** speech coding can be used to provide a very low bit-rate speech coder. It is used a bitrates of 8 to 22kbps (stereo 48kbps).

It can be clearly see that this technology brings great benefits for listeners, but on the other hand, there are still some problems to deal with. The biggest one is caused by increasing

demand for receivers, which are now missing on the market or are just presented by narrow choice that is often expensive (€300 and more). These receivers are often multifunctional **DRM**, **T-DAB**, **VHF-FM**, **AM** working at **LW**, **MW**, **SW** and **VHF**. Many amateur/hobby listeners interested in this technology use a software radio. The Software radio consists of an adjusted **AM** receiver, with converted 455kHz intermediate frequency (IF) to 10kHz, and a software application that is running on personal computer (PC), using a IF signal from a sound card. PC provides decoding and demodulation of **DRM** signal. The purchase price of this receiver is close to nil.



pic.4: examples of DRM receivers (in right software radio)

3 CONCLUSION

The modern digital broadcasting technology **DRM** brings great benefits as was roughly introduced. It is capable to overtake not only present AM broadcasting systems at **LW**, **MW** ant **SW**, but also **VHF-FM** (with **DRM Plus**). Even market research in CR says that ordinary listener is satisfied with a poor VHF-FM signal and is not willing to invest into a new technology. Fortunately, the situation abroad is different. Contemporary problems linked with this technology are caused by increasing demand for receivers that are now missing on the market or are just presented by narrow choice, which is often expensive. Accordingly, many chip manufacturers, who are addressing market, are catering for them and developing systems that will be able to switch between the varieties of bands that will be used around the globe.

References:

[1] DRM: Digital Radio Mondiale. Taken from WWW: <http://www.DRM.org>

[2] Gregora, Pavel : Radiokomunikace 2004. *Digitální rozhlas na středních,dlouhých a krátkých vlnách.* Pardubice : UNIT, 2004, s. 177-191.