

# The Story of the Digital Radio Mondiale/DRM

## Digital Radio Below 30 MHz

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### **Abstract**

At the end of the Cold War in 1989, International Broadcasting to Eastern Europe and the Soviet Union had reached its goal with the fall of the iron curtain. It was time for improvement of distribution quality on the Long-, Medium- and Shortwave Bands. Several new digital systems had been explored and finally it was decided to create a world-wide organization called Digital Radio Mondiale (DRM) to coordinate the development of a new digital broadcasting standard for the bands below 30 MHz. In 1994 a first draft document was send to the International Telecommunication Union (ITU-R). In 1998 the DRM Consortium was inaugurated in the Peoples Republic of China, and by 2003 at a World Administrative Radio Conference (WARC) in Geneva the new DRM standard was accepted and recommended by the ITU to all its 200 member countries. The first DRM receivers were shown at the Internationale Funk Ausstellung (IFA) 2005 in Berlin, and all important International, some National Commercial, and some Public Radio stations started DRM transmissions, mainly in Europe. In 2013 DRM below 30 MHz is well tested all over the world and ready to be implemented. Its standard has been extended to the RF Bands II and III under the name DRM+.

### **Initial Situation**

With the end of the Cold War between East and West the war in the radio ionosphere also came to an end, and listeners in the countries of the former Warsaw Pact could receive radio transmissions directly from the Western countries without intentional harmful interference (Jamming). While the journalists in our radio organizations had to adapt their programming to the new political situation in the countries of the former enemy, we engineers also had to find a way to improve the audio and reception

quality of our Long-, Medium-, and Shortwave transmissions. These transmissions were limited to 5 kHz audio bandwidth, and along with Ionospheric Interference and man-made noise, had a reception quality poor in comparison to local FM transmissions.

Satellite broadcasting for TV and Radio in sub-carriers was also still analogue, but our intended audience group could not afford to buy such expensive dishes and receivers. At that time two new operators offered two different completely new digital-radio-only satellite systems: WorldSpace in the USA, and MediaStar in Germany. While WorldSpace planned to operate three satellites in geostationary orbit to cover the whole world with different beams, MediaStar only intended to cover the Northern hemisphere using three satellites in highly elliptical orbits. Both needed us International Broadcasters not only as future customers but also as technical experts to develop the appropriate new satellite digital radio technology.

Also at the same time other new digital radio systems were under development: three different systems in the USA, financed by, and developed for the Commercial Broadcasters in the USA, and Digital Audio Broadcast (DAB) mainly for Europe and the Public Broadcasters. DAB was subsidized by the European Union under the title EUREKA147.

It was a very complex new situation for International Broadcasters and they decided to join their interests in a new working group called Digital World Radio (DWR). It had three subgroups: one for the political issues, one for program content, and one for the new technical challenges. I was at that time Chief Engineer at Deutsche Welle (DW) and was chairing the technical group of the DWR, and also chairing the Technical Committee of the EUREKA147 Consortium, called at that time the EuroDAB Satellite Module. Here our main interest was on one of the two satellite systems for the future use by International Broadcast, either WorldSpace or MediaStar. After some years of evaluation we concluded our work with a proposal to use both systems together with a black box in Europe to adapt to the terrestrial DAB system. Unfortunately this was not acceptable to the EuroDAB consortium as they claimed the L-Band for terrestrial broadcasting. Also WorldSpace insisted on their own proprietary system which was incompatible with DAB.

It also became clear that any satellite system was dependent on the good-will of the countries which were acting as gate-keepers for the uplink stations to the satellite. This dependency was unacceptable to most of us. For example, in the case of China, one of the intended uplink countries for WorldSpace, it was later proven that they continued jamming some of our shortwave broadcasts, blocked satellite broadcasting into their country, and even censored internet content.

WorldSpace and MediaStar eventually gave up their intention of satellite broadcasting, mainly for commercial reasons. And today the frequencies in L-Band are still unused for terrestrial DAB broadcasting in Europe since local Commercial Broadcasters are not interested in new digital technology, and don't have the commercial stimulus to invest in the implementation of digital broadcast in those bands.

Finally the development of a new digital system for FM and AM/MW broadcasting is well established, mainly in the US, but faces competition from two digital satellite radio systems: Sirius-Satellite Radio, and XM-Satellite Radio.

### **First approaches for digital broadcasting**

When all this became clear I was approached by the transmitter manufacturers ASEA BROWN BOVERIE Cie. (ABB) from Switzerland and Telefunken Germany in late 1994 with the idea of digital terrestrial broadcasting in the bands below 30 MHz. After the end of the cold war the transmitter industry was not selling any high power AM- or SW-transmitters, and was looking into alternative technologies to make business to survive. It was the late Dr. Wolfram Schminke from ABB who approached several of us with the promising first results of AM transmissions with digital modulation. Also Deutsche Welle's network operator Deutsche Telekom, under the direction of Prof. Dietmar Rudolf, had developed a digital system for frequencies below 30 MHz. Later another development was presented by the US- International Bureau of Broadcasting (IBB) in cooperation with Jet Propulsory Laboratory (JPL). My first idea was to discuss the different approaches with the engineers of the EuroDAB Satellite Module which I was chairing. I got approval to present the idea to the EuroDAB Steering Board, of which I was a member, to represent the interest of International Broadcasters. The Steering Board was at that time chaired by a Canadian Chairman who didn't like the idea at all, and so it was rejected. It was clear that we International Broadcasters, even with support from the transmitter and receiver industry, as well as some research institutions, were not able to introduce a new standard on our own. This needed a global effort.

To understand the complexity of the introduction of a new broadcasting standard the following issues had to be considered:

- \* It should not be a regional approach by Europe, USA or Asia, but a global approach. For this the International Telecommunication Union/ITU, a sub-organization of the United Nations Organization/UNO, was the right body to use.
- \* To go to the ITU the support of the national signatories of the member countries of the ITU had to be reached. In most countries this is in the hands of the Agency, Commission, or Ministry for Posts and Telecommunications, who in general, had shown little interest in international broadcasting.
- \* The Telecoms were also organized in regional groups such as the Central European Post and Telecommunication/CEPT, who did not have International Broadcasting in their purview at all.
- \* In addition, the European Union was overseeing Broadcasting in Europe but with little interest in International Broadcasting.
- \* Also the ITU was taking care of all telecommunication matters, and broadcasting was only a small part of their work. International Broadcasting on shortwave was even a much smaller part of it.
- \* Broadcasting was organized in regional unions such as European Broadcasting Union (EBU), Asia Pacific Broadcasting Union (ABU), Arab State Broadcasting Union (ASBU), North American Broadcasters Association (NABA), Organizacion de Telecomunicaciones Iberoamericanas (OTI), Caribbean Broadcasting Union (CBU) and African Union of Broadcasting (AUB). All of whom were members of the

World Broadcasting Union/WBU. They were mainly looking after Television and Public Radio and devoted very little attention to International Broadcasting.

\* National Public Broadcasters such as the Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten Deutschlands (ARD) in Germany, British Broadcasting Corporation (BBC) in Great Britain and Telediffusion De France (TDF) in France had their own research institutions, such as the Institut für Rundfunk Technik (IRT) in Germany, BBC Research in the United Kingdom (UK) and Centre Commun d'Etude de Television et Telecommunication (CCETT) in France. As these were financed by the Public Broadcasters their interest in short wave, at least in Germany, was near zero and had to be activated!

\* New technical systems have to be standardized by at least one of the big standardization institutes such as the European Telecommunications Standards Institute (ETSI).

\* Most Western International Broadcasters were organized in DWR but in addition a subgroup of some European broadcasters was established under the name RADIO.E to follow the radio development in Europe. At that time DAB seemed to be the future system and RADIO.E had to make sure to be considered in national networks.

\* Finally, national bodies were created to coordinate all interests in digital radio. In Germany all players were part of such a group except Deutsche Welle, as the target area for DW was outside Germany. To the contrary the BBC World Service (BBC WS), Radio France International (RFI), and Voice of America (VOA) could participate as Germany was their target area. DW had to be registered under the German Ministry of Interior which was in charge of the budget.

The interrelation between all bodies involved was not clear at the beginning; at that time it was more important to have all big players participating, including the broadcasters, especially all International Broadcasters. The French/Swiss transmitter manufacturer Thomcast (former ABB) invited all interested broadcasters to Conflans-Sainte-Honorine near Paris and presented the test results with digital modulation on AM/MW transmitters and its plans on how to proceed. This was in early 1995 when the negotiations with WorldSpace and mediaStar as well as the EuroDAB-Satellite discussion were still going on. To our big surprise all agreed to proceed with the development of a digital transmission system in the bands below 30 MHz except the BBC WS. They were more interested in satellite radio and/or DAB.

### **Narrowband Digital Broadcast/NADIB**

It was clear that without the BBC WS it was not possible to introduce a new transmission system on a global basis. On the other side it was also clear to the majority of the participants that a new system would offer many advantages against any satellite system and a more local DAB system. Therefor it was decided to continue even without the BBC WS. A new EUREKA project E1559 was launched under the name Narrowband Digital Broadcast/NADIB with the following partners: Thales Broadcast And Multimedia (former ABB/Thomcast)-France; SONY International (Europe)-Germany; Telefunken Sendertechnik GmbH-Germany; IRT- Germany; Fraunhofer Institut für Integrierte Schaltungen-Germany; TDF-CCETT-

France; Deutsche Telekom AG-Germany; Deutsche Welle-Germany; Teracom-Sweden; Radio France Internationale-France; AMC-Concept-France; Radio Nederland Wereldomroep-The Netherlands; and the University of Ulm-Germany.

After some preparatory meetings between these 13 partners the NADIB-project was officially launched in September 1996 and ended in January 2000. The final objective was to demonstrate the feasibility of digital broadcasting in AM frequency bands, document all improvement possibilities, and prepare the industrialization phase. The project comprised three steps: Requirements analysis and Compatibility study; Definition; and Integration and Tests.

The work was based on two different approaches: a multi-carrier system developed by the French company Thales, and a single-carrier system developed by the German company Deutsche Telekom. During the working sessions both systems were considered and the final decision which of the two was better suited was postponed until the end of the EUREKA project. Under the chairmanship of Thales there was great cooperation between all partners involved which enabled the work to go on very smoothly and constructively.

As NADIB was a European project it was limited to European partners only. However I reported to the DWR group about the progress. In September 1996 Dr. Robert L. Everett from the Broadcast Technology Division of the International Broadcasting Bureau in Washington. D.C., the technical body of the Voice of America, Radio Free Europe and Radio Liberty, contacted me about what was going on with digital AM in Europe, particularly in NADIB. We decided to invite Dr. Everett to a meeting in Conflans which took place on the 7<sup>th</sup> October 1996.

I would call this initial meeting the start of the transition from a Eurocentric to a global approach for the digitalization of the AM frequency bands, which later gave rise to the DRM Consortium. But it was still a very long and difficult way from October 1996 in Conflans/France to the creation of the DRM consortium in Guangzhou in March 1998.

### **The Road to DRM**

It was clear that we engineers could develop a new digital broadcasting system for the frequency bands below 30 MHz, but without the support from the various managements for the huge development and investment costs we would fail. As explained earlier some international broadcasters were organized in DWR: BBC WS, Channel Africa, DW, NHK Japan, Radio Australia, Radio Canada International (RCI), RFI, RNW and VOA. The meetings were open to other international broadcasters particularly from Eastern Europe and were called "Challenges", reflecting what was in front of us! As this group became too complex, some of them created the "Group of the Big Five": BBC WS, DW, RFI, RNW and VOA, which still exists today. The understanding of the five Director-Generals was excellent and thanks to Sam Younger/BBC WS, Dieter Weirich/DW, Jean-Paul Cluzel/RFI, Lodewijk Bowens/RNW and Geoffrey Cowan/VOA we got the support to create a global forum for the digitalization of the AM bands. Their next meeting was scheduled for the 28<sup>th</sup> November 1996 in Paris at RFI and it was proposed to have a first meeting of experts the day before on the 27<sup>th</sup> November 1996. Also a NADIB-meeting took place on the

26<sup>th</sup> November 1996 to make sure that the interest of this EUREKA-project and its partners were considered.

This meeting was hosted by RFI and it was well attended by 18 participants from broadcasters (RFI, BBC WS, DW, RAI, RNW, VOA), transmitter manufacturers (Thomcast, Telefunken, Continental), receiver manufacturers (Sangean, SONY), service providers (DT, TDF), Chip Set Manufacturers (Motorola) and University (Kentucky). It was chaired by Dr. Robert Everett-VOA and myself. The conclusion was to draft an invitation to a conference about the future of the digitalization of AM broadcasting. The invitation should go to all interested parties world-wide such as: private and commercial broadcasters, receiver-, transmitter- and chipset- manufacturers, broadcasting unions, ITU, regulators, regional organizations, press&media, IEEE, IEC, EACEM etc., advertising groups, universities and listeners clubs such as DX Clubs.

A group of four was nominated to prepare the global conference: Dr. R. Everett-VOA, D. Bochent-TDF, P. Senger-DW and a representative from DT. Another group of five was established to propose the requirements for the standard.

Also the name of the organization was proposed by a small marketing group, on the suggestion of myself, and was accepted: Digital Radio Mondiale/DRM. Mondiale was taken for two reasons: 1. It is known in many languages and secondly the English word "World" was already occupied by DWR! When the 5DGs met the next day and agreed to support the organization of a global conference, DRM was on its road to become reality, fulfilling the request from the industry that broadcasters should take the lead.

The decision was welcomed in the working groups of the ITU and EBU where the same broadcasters together with other interested experts were already discussing a new digital broadcasting system below 30 MHz, based on the two European approaches and a proposal from VOA/JPL. The US proposal considered only short-wave frequencies and not medium-wave or long-wave. The latter band was not allocated to countries in the Americas and for medium-wave frequencies a proprietary digital system was already under development by the commercial broadcasters of the USA. Nevertheless NABA confirmed its interest in DRM for Short Wave.

Early in 1997 we got the very good news from Prof. Du Baichuan of the Chinese State Administration of Radio, Film and Television (SARFT) that China desired to participate in DRM, carry-out test transmissions in digital mode, and host the DRM Inaugural Conference. This decision by China was very welcome to the ABU, and both the Secretary General Ohm Kushu and the Chief Engineer Sharad Sadhu confirmed their active participation.

With the increasing global interest it was clear that we needed a neutral organization leading the development of the digital system. Neither ITU nor EBU or ABU were able to do this, NADIB was only for European partners and the international broadcaster's BIG5 was too small to handle it on its own.

Beginning in 1997 several meetings about further steps were taking place and it was proposed to accept the invitation from China, legally register DRM in Switzerland to be close to the ITU, and have the DRM Project Office at the EBU in Geneva. As an interim solution the management of the IBB agreed to

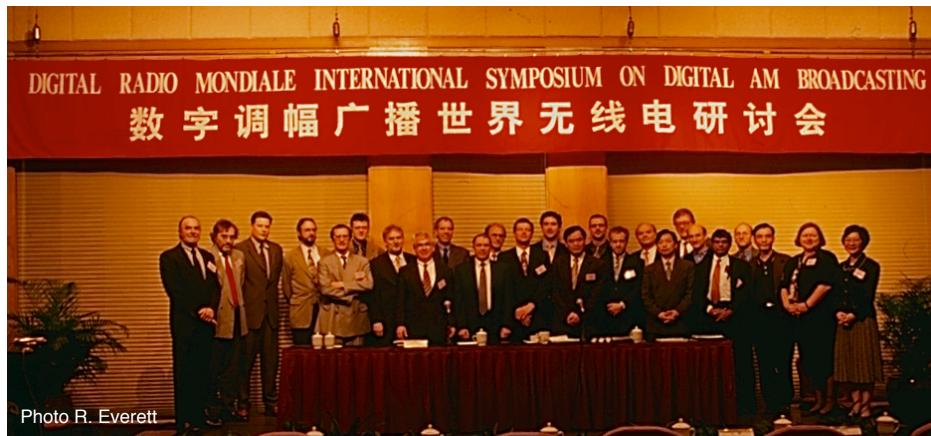
register DRM in Delaware and manage the interim office with Dr. Everett as Chairman, assisted by myself.

In parallel, many meetings of the ITU and EBU covered the subject with different points of view. The Radio-Sector of the ITU with its Director Jones and Secretary Dr. Giuliano Rossi were of great help and assistance. In April 1997 the EBU informed us that they would not support DRM in the EBU or in WorldDAB. This strange position was later resolved, and we also finally got their support and even had the Project Office there for some time. In addition the first chairman of the DRM Technical Committee came from the EBU: Ken Hunt.

The technical work in NADIB went on and it was agreed that once DRM was formally launched we would decide how to merge or at least cooperate between both organizations.

### **The Launch of the DRM in China**

After considering several proposals it was decided to have the DRM Inaugural Symposium from 1. to 6. of March, 1998 in the White Swan Hotel in Guangzhou, China, hosted by the Academy of Broadcast Science (ABS) of China. Twenty-one organizations indicated intentions to sign the Memorandum of Understanding (MoU), the basis for the inauguration of the DRM Consortium. Some of the 34 participants are seen on the picture below.



DRM-Members at the DRM-Symposium in Guangzhou/China, from left to right:

Dr. L.R. Everett/IBB; M. Hate/BBCWS; D. Schill/FhG-IIS; Dr. K. Brandenburg/FhG-IIS; D. Bochent/TDF; R. Buchta/FhG-IIS; M. Pilath/DT; Prof. Rudolph/DT; Ch. Gill/BBCWS; P. Vasseur/Thales; P. Senger/DW; J. Hoek/RNW; M. Richards/Motorola; Dr. K. Wang/Sangean; St. Spradlin/Harris; A. Literati/RFI; R. Faulkner/Continental; Prof. Du Baichuan/ABS; J. Graaff/Telefunken; D. Ibanez/RNE; R. Wijemanne/ABU; P. Jackson/Merlin; L. Wei/Tecsun; J. Torkelson/IBB; B. Tseu/IBB.

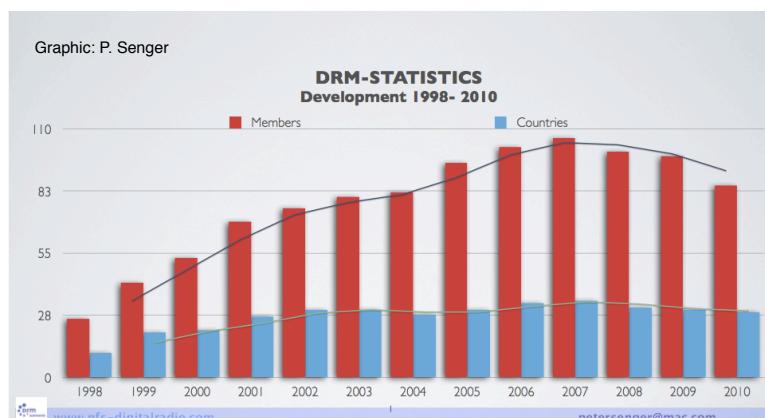
The symposium was very well organized by the ABS, Prof. Du Baichuan, and Dr. Everett. Many authorities from the Chinese Government and local administrations, as well as from Chinese broadcasters and industry attended. The highlight was the signing procedure on the 4<sup>th</sup> March 1998 in the afternoon, when each member signed the Memorandum of Understanding (MoU) in front of the meeting, stated the reason for joining the DRM and their expectations from the future standard for his organization. At the end of the ceremony twenty participating organizations had signed the MoU; one had to clarify some legal wording with its lawyers and signed later.

The next day the first DRM General Assembly (GA) and Steering Board (SB) Meetings took place and the constituency of such bodies as the Steering Board, Chairperson, and Committee Chairmen were elected. The GA elected the new SB out of 7 Broadcasters and Networkers, 7 Manufacturers and 4 Research Institutes (one seat kept open for later): ABS/China (ex officio); ABU; BBC WS-UK; Continental Electronics Corp-USA; DW-Germany; DTAG-Germany; Fraunhofer IIS-Germany; Merlin Communication-UK; RNW-NL; Retevision-Spain; RFI-France; SONY International-Germany; TCI-USA; Telefunken-Germany; Thomcast-France; VOA-USA; Harris Corp.-USA. At the first SB meeting in Guangzhou I was elected as Chairman of the DRM Consortium for the next two years, although the DRM was not yet legally established. Jan Hoek from RNW became Vice-Chairman and Treasurer, Mike Cronk-BBC WS Chairman of the Commercial Committee/CC and Ken Hunt- EBU Chairman for the Technical Committee/TC. With these elections the real work to build a world-wide consortium could be started.

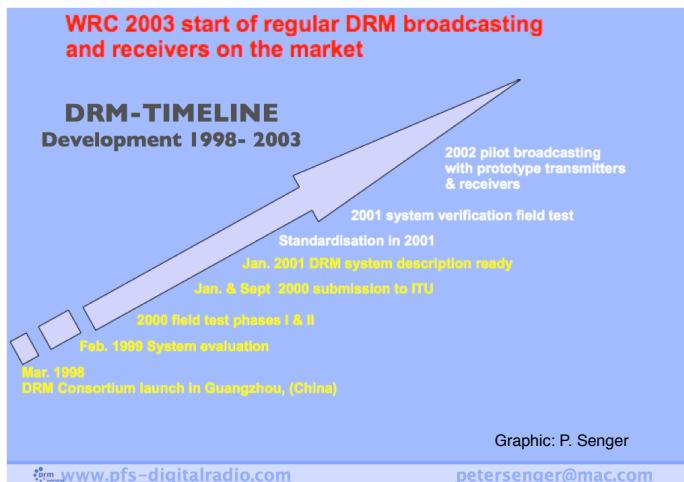
But before this the interim chairman of the Guangzhou meetings, Rukmin Wijemanne/ABU expressed his appreciation and thanks to Dr. Everett who did in the past an excellent job to come so far as to the creation of DRM. Also his employer the IBB had supported his engagement in this important process for broadcasters. For some internal reasons Dr. Everett had to resign later from DRM but all people who worked with him for the preparation of DRM will always remember him and his engagement for DRM.

### DRM Development until 2003

The interest of the media and broadcasters around the world grew very fast and DRM membership rose immediately after the Guangzhou meeting. The following graph shows the development until 2008 plus the two years later after I resigned from DRM and DW in March 1998. Interesting for me was the strong participation from Germany over all the years with the most members, the highest broadcasting hours using DRM technology, and the even most supporters!



Right from the beginning a very tight schedule was specified for completion of the DRM project. We anticipated that within five years we would accomplish not only the development of the new broadcast technology but the transmission technology and the standardization and even first mass production of DRM receivers on the market as well.



To achieve this ambitious goal many meetings of all bodies of the DRM consortium were necessary. Every year the General Assembly met once and the Steering Board met four times a year (at one of its member's headquarters to keep the costs low). Besides these administrative meetings the real work took place in two committees with their different Working Groups: the Commercial Committee, chaired by Mike Cronk, BBC WS and later Michel Penneroux/TDF; Output Requirements, chaired by Ross Faulkner, Continental Electronics; Marketing, chaired by Michael Pielath, DTAG; Implementation, chaired by Willi Tschol/ Thomcast; Political, chaired by Rukmin Wijemanne, ABU; Technical Committee, chaired by Ken Hunt, EBU and later Dr. Don Messer, IBB; Source Coding, chaired by Martin Dietz/FhG; Channel Coding, Multiplexing & Modulation, chaired by Markus Zumkeller, SONY Deutschland; System Evaluation, chaired by Dr. Don Messer, IBB; Field Test, chaired by Hans Linkels, RNW. The legal structure of the DRM Consortium was established by some legal advisers from DRM members under the Chairmanship of John Sykes from BBC Research. And as it was decided that English was to be the working language of the consortium, all Non-English-Speaking-Natives had to make sure that all texts were in line with their national language and laws. This was not easy and caused some interested organizations to withdraw from DRM, as was the case of the University of Kentucky with its very engaging Dean Douglas A. Boyd.

One special person should be mentioned who took the minutes of each meeting, typed them on thousands of pages and distributed them to the corresponding members: Margaret Cole (BBC WS). We were very lucky to have had her over all the years of my 10 years chairmanship and even after.

Besides the DRM Working Groups, the ITU-R SG10A, the HFCC (High Frequency Coordination Committee) and some Broadcasting Unions supported and coordinated the development of the new

standard. But to achieve an ITU-R recommendation, the results of real field tests had to be presented, which was yet not possible at the beginning of 2000. Also a final decision of the DRM Consortium about the three system proposals was not reached. Later the US proposal from JPL/VOA was withdrawn as it was similar but not as far developed as Skywave 2000 from Thomcast. The remaining two proposals from DTAG (single carrier) and Thomcast (multi carrier) were the only ones remaining, and it was finally agreed between DRM and NADIB to develop a complete new system based on both proposals and take the best solutions from both.

Neither of the two systems corresponds to the USADR IBOC-System (In-Band-On-Channel) for AM/MW but thanks to the newly created US-organisation iBiquity it was possible to sign a cooperation agreement which was unfortunately never activated. Both DRM and IBOC systems were later presented to and recommended by the ITU-R.

At the time of the WARC 2003 in Geneva the development of the DRM-system was finished, standardized with ETSI as ETSI TS101980 and presented to the delegates of the conference. The DRM consortium invited some 400 participants of the WARC to a reception to celebrate the beginning of a new era in broadcasting below 30 MHz. I had the honor to give the inaugural speech with a count-down to live DRM transmissions from a TDF station on Mont Saléve on the French-Swiss border.



A full description of the DRM-System can be found in the standard and a summary under [www.drm.org](http://www.drm.org). For us International Broadcasters DRM exceeds our expectations by far: The audio quality is similar to FM radio and can also be in stereo; additional data such as text or even pictures can be send in parallel to audio; speech encoders with very low bit-rates allow up to four audio channels of different content in one rf-channel; several different modes allow for different code rates to adapt the transmission to different propagation modes; coverage of large areas over long distances with near FM-quality broadcast on shortwave; covering of a whole continent like Europe with only up to three transmitters in synchronous

operation and finally much lower power consumption reducing the operational costs of transmitter stations. The DRM-System fits in the existing planing parameters of all three broadcasting bands below 30 MHz and can be used in adjacent channels to analog transmissions.

### **DRM Receiver Problems**

In 2003 we had daily 400 hours of DRM transmissions on the air and the membership rose to 80 from 30 different countries plus 20 supporters from around the globe. The future of DRM looked even brighter when the biggest commercial broadcaster in Europe, Radio Television Luxembourg (RTL) financed the first DRM-module for mass production of DRM receivers. This module was developed with the assistance of the DRM member BBC Research by a British company "radioscape" with a chip-set from Texas Instrument which was presented for the first time at the IFA 2005 in Berlin. Several different models with this multi-standard-module (DRM/DAB/FM/AM/LW/SW) were shown by different manufacturers, including car receivers. My company, DW, celebrated the start of DRM receivers in Europe with a huge reception for some one hundred people and we were all sure that DRM would be a success.

To our great shock the module did not fulfill the minimum receiver requirements and as it was later discovered, could even not be brought up to standard. After many meetings RTL decided in 2007 to stop DRM transmissions, mainly because of lack of availability of adequate DRM receivers. Nevertheless the consortium had at that time 106 members from 34 different countries, 66 supporters and 800 daily DRM-broadcasting hours from 34 different broadcasters on air. There was hope for alternative DRM-receiver modules and even Fraunhofer ISS finished the development of a dedicated DRM chip-set.

But the mass production of new technical equipment is very complicated. We finally understand that a perfect solution like the one from Fraunhofer ISS doesn't mean that the chip-set will be available. It needs high investment and risk to start chip-set production for a minimum of 10 Million chips per year. Nobody wanted to take this risk.

Even worse, big companies like SONY didn't invest in DRM receivers as long as smaller manufacturers like Himalaya from Hong Kong were not successful with at least some thousand DRM radios on the market. But those who first brought DRM receivers to the market had only the radioscape module available which didn't satisfy the technical criteria, and therefore the chances to sell the critical number of DRM receivers were very small. The late Mr. Wong Hong from Himalaya was a very strong believer in DRM radios but unfortunately also had to eventually give up the production of DRM receivers.

The most complicated situation was faced with the car industry. Every seven years they change their car models and only then they can include new technology, although some are able to consider new systems at half time after 3.5 years. The car radio manufacturers were ready to implement DRM in their existing models with DAB which was at that time entering the European market. But the car manufacturers required at least 20 different DRM broadcasters with 24 hours daily transmission in the whole of Europe. That requirement was out of the question, and is the reason why no car radio has DRM included up to now.

In another case, a reseller from UK ordered 2,000 DRM receivers with the "radioscape" module which were purchased in 2007 by a German Internet-reseller. Today in 2013 there are still 1.600 DRM/DAB/FM/AM receivers available for sale, and if nobody takes them they will be destroyed because of high storage costs.

### **New DRM-Markets**

While the DRM development in Europe came to a standstill, some other markets have shown great interest in DRM, mainly big countries with large territories such as India, Brazil, Mexico and importantly Russia and China. We organized meetings and conferences in those countries and I myself was every year in India at the Broadcaster Engineering Society (BES) of India. Only at my last visit in 2008 they finally had the budget available to start a huge modernization project of their terrestrial transmitter network to change from analogue to DRM technology. DRM-receivers will be developed in India and a new model from the Chinese manufacturer NewStar is already available. What is now needed are orders in the range of thousands to bring the price down.

China and Russia are still discussing DRM as are Brazil and Mexico.

In 2007 I organized a Pan-African DRM conference in Kigali, the capital of Ruanda, where DW runs a short-wave relay station. The conference was well attended and participants from Kenya, South Africa, Mozambique and other countries have shown great interest in DRM.

After my retirement in 2008 I was invited to Tehran to hold a DRM-symposium for the Islamic Republic of Iran Broadcasting (IRIB), the state-run broadcaster of Iran. Together with Transradio from Germany we had a very well attended conference and it looked like Iran would start shortly with mainly mobile DRM usage in their national car production. But political developments seem to have stopped all efforts and contacts have been cut.

In 2009 I was invited to another conference planned by the Arab State Broadcasting Union (ASBU) to be held in Damascus in Syria. Also here political developments brought this to an end and the conference was later held in Tunis where Transradio represented DRM. I had presented DRM many times during my DRM-chairmanship in Tunis at the ASBU. The interest exists in many countries, especially in the Arab world, but it takes years until a decision is made. This is understandable as DRM will replace the oldest broadcast technology in the world which still has millions of listeners. And new technology must be accepted by the user, the listener. They have to buy the new receivers and they will buy only if they see an additional value with the new technology.

### **DRM highlights until 2008 - End of my Term**

In 2004 the DRM Consortium issued a Broadcaster User Manual (BUM) containing all important informations about DRM, and giving interested broadcasters a first overview about the system ([www.drm.org](http://www.drm.org)).

During a meeting in April 2004 in Hangzhou/China we noticed a great interest of Chinese broadcasters in DRM, even to the extent of having run test transmissions on AM/MW.

RTL presented a promotion video, distributed at IFA 2005, which very professionally gave information about their plans with DRM. At the end they envisaged three different language channels in German, French and English over Europe in DRM mode.

Jan Hoek (RN) resigned from the position as DRM Co-Chairman and Treasurer in 2006 after eight years, due to important new engagements at RN. Dr. Albert Heuberger from Fraunhofer IIS took over and also chaired the newly-created Executive Committee. The Project Office was expanded by the position of a business development manager, which position never came to be occupied.

Already in 2007, one year in advance of my retirement, at a meeting in Kingswood Warren the BBC indicated its interest in taking over the Chairman position in DRM. Most members found this would be the best solution for the Consortium, as the BBC WS was still a strong user of DRM transmissions. In addition the envisaged person was not an engineer but a business development expert. At the same meeting a series of new DRM receivers were shown in a presentation from Intempo, a British receiver manufacturer. Unfortunately these great ideas were never realized.

The BBC performed a DRM-AM/MW test in Plymouth which gave very good results. After the test the transmitter was switched back to analogue transmission.

Also in 2007 a MoU was signed between DRM and WorldDMB, the former WorldDAB to cooperate on common markets.

The ABU started yearly conferences about digital technology including DRM for its Asian/Pacific members in Kuala Lumpur and in New Delhi, I participated in most of them until 2008.

The DRM-TC reported the finalization of DRM+, the extension of the DRM system up to 230 MHz.

In March 2008 my final DRM meeting before retiring from both DW and DRM took place at DW's headquarters in Bonn/Germany. Also Anne Fechner (DW) quit after nine years as DRM-Project Officer. John Sykes from BBC Research resigned as well. Ruxandra Obreya from BBC WS replaced him and was later elected as new Chairperson of the DRM Consortium. The Project Office moved from Bonn to London.

DRM at that time had 105 members from 30 countries and 80 supporters from 22 countries.

Together with T.V.B. Subramanyam from Analog Devices India (ADI) I had prepared a presentation about a new DRM receiver with the famous "blackfin" chipset from ADI which purportedly would solve all our receiver problems. But once again, as was later discovered, this did not result in a workable DRM receiver.

The German DRM Forum reported about successful tests of DRM+ in Germany.

In my final words to the meeting I wished Ruxandra good luck and appealed to the spirit of togetherness between all members for a successful conclusion of DRM on the market. The members nominated me as the first Honorable DRM-Member.

## Conclusion

The original idea of developing a new digital transmission system for broadcasting bands below 30 MHz was carried out in the scheduled five years. This was possible thanks to the common spirit and enthusiasm of all members.

The envisaged number of DRM receivers on the market was not achieved! The reason is manifold, and in my opinion, only technical. If the radioscape module would have functioned properly we would have had the biggest commercial broadcaster, RTL, with three DRM channels on the air plus many DRM transmissions from the BIG5 International Broadcasters. The business experience of RTL and other who would have followed would have solved the marketing problems as of today. The request from the beginning of DRM to broadcasters and manufacturers to drive the market was fulfilled. The reason that it failed was not a marketing or business one, it was solely technical.

Today the Internet has taken much content from broadcasters and the BIG5 have switched off most of their DRM transmissions and some even gave up their stations. DRM might have other opportunities with other broadcasters in other parts of the world but one thing is for sure:

**THEY WILL RELY COMPLETELY ON A PERFECT WORKING DRM RECEIVER!**