Deutsches DRM Forum

Overview of the Technologies available for Digitalisation of Terrestrial Radio Broadcasting in Europe[1]

1 Analogue FM Radio has run out of Frequencies

The FM band (87.5-108 MHz) is home to a large number of radio programmes, and is still the main means of radio broadcasting in Europe.

However, the FM band is fully allocated and therefore cannot offer a basis for increased diversity in the radio broadcasting landscape, nor can it offer an increase in the coverage areas of the broadcasters already licensed.

Local radio as well as community and training media are the primary victims of this situation, as their coverage is often limited by strong interference from neighbouring transmitter stations on the same or adjacent frequencies.

Transmission capacity can be increased by digitalisation and this is a step already taken not only by European television broadcasters, but also by many public radio broadcasters and major private radio groups.

Although Internet Radio should also be considered as part of digitalisation, it differs from normal broadcasting by involving third-party telecom providers that charge listeners for fixed and mobile access to otherwise free-to-air programmes.

2 The Digital Radio Systems: DAB and DRM

The European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI) define two digital platforms[2] for terrestrial broadcasting of radio:

1. **The DAB system:**
   DAB, DAB+ and T-DMB for VHF band III (174-230 MHz)
2. **The DRM system:**
   DRM in OFDM Modes A-D (DRM30) below 30 MHz and
   DRM in OFDM Mode E (DRM+) for VHF band I (47-68 MHz),
   the FM band (87.5-108 MHz) and VHF band III (174-230 MHz)

These digital systems are complementary, are based on the same technology and offer identical features including simple web pages, text messages, rich multimedia, programme guides, slideshows and traffic information.

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[1] This document is an abbreviated version of the report „Considerations for the Digital Transition of Local and Regional Terrestrial Broadcast Radio in Germany“ issued by the Deutsches DRM Forum on 3 September 2013. For complete details including German case studies, please refer to the original document.

[2] https://tech.ebu.ch/digitalradio

The two systems are both standardised by ETSI, recommended by the International Telecommunications Union (ITU) for worldwide use, and are mutually compatible with the European frequency plans for broadcasting.

Together they offer a significant capacity increase compared to analogue FM in the number of programme channels that can be transmitted in a given geographical area.

2.1 Main differences between DAB and DRM+

The major difference between the DAB and DRM+ is the occupied bandwidth (1536 kHz and 96 kHz, respectively) and consequently their available transmission capacity.

DAB is most efficient when covering large areas with up to 16-20 simultaneous programmes on the same frequency, whereas DRM+ is can be equally efficient with just one or a few programmes covering a small area with a single transmitter.

Thus the DAB platform is very attractive for the large-area coverage required by public broadcasters and private radio groups.

By comparison, the smaller cousin DRM provides a more direct and individually scalable digital replacement for the existing FM broadcasts of regional and local community radio.

2.2 Main similarities of DAB and DRM+

DAB/DAB+ and DRM/DRM+ share many technical features:

- Non-proprietary ETSI standards with common interfaces
- European standards as well as recommended by the ITU for worldwide use
- The option of many transmitters sharing the same frequency within a Single Frequency Network (SFN)
- Mobile reception at high speeds
- Significantly longer range than an FM transmitter at the same radiated power
- Less sensitivity to interference due to the digital implementation
- The range of services that can be transmitted in addition to a radio programme is identical - simple webpages (Journaline), text messages/dynamic labels, rich multimedia, programme guides, slideshows, traffic information (TPEG), etc.

Both systems are in fact so closely related (see Table 1 below) that they can be processed on the same receiver architecture, given sufficient memory and computing power in the chipset.

This has already been proven in a study commissioned in 2012 by the German Media Authority of Rhineland-Palatinate (Landeszentrale für Medien und Kommunikation Rheinland-Pfalz - LMK). It was shown that with a commercially available USB receiver stick for FM and DAB (selling prince EUR 24.99) and minor software adaptations, DRM+ could also be received without modifications to the basic NOXON hardware.

	FM radio	DRM+	DAB
Programme channels	1 programme in HiFi stereo	Approx. 2-3 programmes (max. 4 services)	Approx. 16 programmes (max. 64 services)
Additional services	RDS	Simple web pages (Journaline), rich multimedia, programme guides, slideshows, traffic information, etc.	
Data rate	1,1 kbit/s for RDS	37-186 kbit/s	~ 1125 kbit/s (PL=3A)
Audio encoding	None (analogue)	MPEG-4 HE-AAC v2	
Frequency range	VHF band II (FM band 87,5-108 MHz)		
		VHF band III (174-230 MHz)	
Available transmitter network configurations	Single transmitter or Multi Frequency Network (MFN)	Single transmitter, Multi Frequency Network (MFN) or Single Frequency Network (SFN)	
Modulation	Analogue FM	Digital COFDM	
Bandwidth	390 kHz (Carson)	96 kHz	1536 kHz

Table 1: Transmission capacity of the FM, DRM and DAB platforms

3 Compatibility of Analogue FM and Digital Systems

3.1 Digitalisation of radio broadcasting in VHF band II (FM band 87.5-108 MHz)

The Electronic Communications Committee (ECC) of the European Conference of Postal and Telecommunications Administrations (CEPT) has found[3] that even if some FM frequencies were freed up for digital radio systems, the interference of digital radio systems with FM reception and aeronautical radio navigation services is so strong, that a parallel use of DRM+ and analogue FM in VHF band II (the present FM band) would not be feasible.

A case study report from the EBU[4] has reached similar conclusions.

Consequently, the FM band cannot be further developed with neither the existing analogue nor with a digital modulation scheme until all analogue FM use has ceased, at the earliest.

3.2 Digitalisation of radio broadcasting in VHF band III (174-230 MHz)

At the 2006 Regional Frequency Conference in Geneva (RRC-06), the entire VHF band III (174-230 MHz) was assigned to digital broadcasting and in much of Europe digital radio broadcasting is now having exclusive use of this band.

Unlike with the situation with FM in VHF band II, DRM+ transmitters can be coordinated in VHF band III[5] without any inference issues with the digital DAB networks already allocated to this band.

[3] http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP141.PDF
http://www.erodocdb.dk/Docs/doc98/official/zip/ECCREP141techn-suppl.ZIP
[4] https://tech.ebu.ch/docs/tech/tech3357.pdf
[5] Recommendation ITU-R BS.1114-7 (12/2011) “Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3000 MHz”,
Recommendation ITU-R BS.1660-6 (08/2012) “Technical basis for planning of terrestrial digital sound broadcasting in the VHF band”

4 Review of DAB for Local and Regionalised Radio Broadcasting

DAB is only suitable with certain limitations for local coverage areas or for digital distribution of individual broadcasters with different regional target coverage areas, even if a low cost infrastructure[6] with Open Source software could be provided:

- For the distribution of only individual radio stations in small heterogeneous coverage areas with few programme offerings, the transmission capacity of DAB is far too high (typically 16 different radio programmes on one transmitter). As the transmission capacity cannot be anywhere near filled, such use is not frequency efficient. Furthermore, for the supply of the same coverage area, the lower bandwidth and fewer channels of DRM+ means that it needs only about 10% of the radiated transmitter power compared to DAB, which also implies an economic advantage for DRM+.
- In many European countries there are not enough DAB allotments available to map all the existing local FM coverage onto DAB transmissions. Therefore, when using DAB for digital distribution of local broadcasters, a new structure would have to be implemented which would expand today's local coverage areas into common regional coverage areas.
- If the existing FM coverage areas and the coverage wishes of regional and local FM broadcasters must be taken into account as part of the digitalisation of all terrestrial radio broadcasting, it is clear that this will not be easy to achieve only with DAB taking the reasons above into account.

5 Review of DRM+ for Local and Regional Radio Broadcasts

DRM+ in VHF band III can provide an opportunity to support the digitalisation of terrestrial radio in addition to large-area DAB coverage, in particular for existing or new local and regional offerings that cannot use DAB efficiently.

Local radio broadcasters are known to be more than reluctant to offer their services via a digital system in addition to existing terrestrial distribution with FM. An incentive could be created on DRM+, for example, if a technical increase in range is seen as an economic advantage. This could also satisfy the demands for new terrestrial broadcasting frequencies from e.g. university campus radios, which can no longer be met in VHF band II.

In contrast to DAB, for which the conditions for the market (especially a regular programme offering, a business model for broadcasters with transmission services and available consumer receivers) are already given, such conditions must be still be created for DRM+.

For DRM+, the following are key points that must be observed for a market entry.

5.1 Implementation of DRM in digital radio receivers

There are currently no digital radio receivers for DRM+ available on the market, nor would it make sense to produce receivers exclusively for DRM+. Because of the strategy to digitise terrestrial radio with both DAB and DRM+, it is considered

[6] http://opendigitalradio.org/index.php/Main_Page

necessary to bring receivers on the market that will receive both of these systems as well as FM on VHF band II.

The technical requirements for a cost-effective implementation of DRM+ in DAB radios are simple, low cost and easy to implement due to the system similarities between DAB and DRM+, and an identical receiver design (antenna, RF frontend) and chipset technology (MPEG-4 HE-AAC v2, OFDM, data services and Alternative Frequency Switching (AFS)).

A certain development effort would be required by the manufacturers of hardware-based receivers for the home entertainment and in-car markets. These manufacturers would have to be persuaded with plausible scenarios and strategies to incorporate DRM+ in their DAB receivers. Otherwise there is a risk that no DRM+ capable receivers would be available for the launch of DRM+. This would be detrimental for local radio broadcasters aiming to use digital distribution via terrestrial DRM+ to compete with the many on-air DAB offerings for which receivers already exist.

The framework for, and willingness of, the industry to adopt multi-standard DAB/DRM+/FM chipsets and receivers for the European market need to be clarified.

This would also encompass the inclusion of DRM (DRM30/DRM+) in the “Euro-Chip” initiative propagated by the German public-service broadcaster Deutschlandradio, the BBC and EBU for reception of DAB, DAB+, DMB, FM (band II) and AM bands below 30 MHz.

The "Minimum Receiver Requirements" of the WordDMB (DAB) and the DRM Consortium are already aligned, and thus allow easy specification of combo receivers with both DAB and DRM+ reception.

Furthermore, established manufacturers have already designed both their current and upcoming generations of digital radio receiver chipsets as multi-standard modules with both DAB and DRM+ support.

The regulatory framework for the implementation could be promoted through EU regulation.

5.2 Implications of increased coverage

If local FM broadcasters are distributed on large DAB transmitter networks that cover several local areas, the coverage area is increased considerably and a competitive situation is created with local providers from other areas.

Amongst other issues, this raises questions as to the scope of local radio licenses as well as the continued development of local and regional advertising markets, and the distribution costs for areas that are not relevant for a specific broadcaster.

Local distribution structures of commercial operators and community media could remain unchanged with a digital distribution, or they could be translated into larger coverage areas.

5.3 Expenditure for the broadcaster

A local radio broadcaster already distributing via FM will have an additional financial burden in order to distribute its programmes in parallel on a DRM+ transmitter infrastructure. These expenses for the broadcaster must be justified with additional income opportunities (e.g. greater technical coverage or additional offerings). For example, a reduction in infrastructure costs could be achieved if the broadcaster operates the transmitters itself, as it is permitted in many European countries.

An initial comparison between the distribution costs of DAB and DRM+ shows that with distribution of only one or two programmes, total network costs for distribution within a given coverage area are substantially lower with DRM+ than with DAB.

The technical concept required for a DRM+ transmitter infrastructure needs to be established, especially for the local service area. This would include a cost estimate, and a willingness and framework for the broadcaster to desire DRM+ distribution (either in addition to the existing FM transmission or as a separate distribution channel).

6 Benefits of using DRM+ in VHF Band III in Addition to DAB

The benefits for local FM radio broadcasters by taking the step into the digital world with DRM+ in VHF band III are manifold:

- Radio programmes with high technical quality (MPEG-4 HE-AAC v2, even in surround) and additional information services (Journaline, TPEG, Slideshow etc., also for new forms of advertising) with high availability (mobile and home) can be disseminated.
- Gaps in the FM channel coverage in the broadcaster's assigned license area can be filled with DRM+ transmitters working in SFN mode on the same frequency.
- A DRM+ transmitter requires lower power than for FM or DAB coverage to achieve a comparable range. The programming feed from the studio to the transmitter may also be realised with IP lines at low cost.
- The introduction of DRM+ in VHF band III will not require shutdown of FM transmitters in VHF band II. Thus useful listener coverage above and beyond that available with FM receivers may be realised by a local broadcaster with the simple addition of one or more DRM+ transmitters.
- The announced introduction of multi-standard digital receiver chipsets (DAB and DRM+) will facilitate an expansion with DRM+ in parallel to simulcast on analogue FM.
- The decision to discontinue analogue FM transmission and realise the increased efficiency of digital transmission would be taken by the broadcasters themselves.
- The development of DRM+ networks in VHF band III is feasible without extensive scenarios for usage and analogue/digital transition, and would not impact the expansion plans for DAB.

6.1 Benefits of the digitalisation of all radio broadcasting

The digitalisation of radio with DAB and DRM+ coexisting in the VHF band III will release the potential for distribution of an additional bouquet of DRM+ radio programmes from regional and local radio stations in their original coverage areas.

This total offering, with a heterogeneous structure already known from the analogue FM band and with new programmes distributed only digitally, will support the digitalisation of the entire terrestrial radio landscape and offer an opportunity for a more rapid switch-off of analogue FM radio broadcasting.

The prerequisite for such a common scenario would be the opening of the market for digital radio with DAB as the preferred platform for large coverage areas and many national programmes, which in turn would facilitate the digital distribution via DRM+ for regionalised and local providers and should be planned well in advance.

7 The Future

Before the initiation of regular DRM+ offerings in VHF band III, it is still necessary to create the conditions for market entry. These relate in particular to the availability of a commercially acceptable broadcasting infrastructure and the availability of radio receivers in the consumer market capable of receiving DRM+ in addition to DAB, as well as the creation of an implementation strategy.

7.1 First step

To answer these questions, certain steps have already been taken:

- The Technical Committee of the German Federal State Media Authorities (TKLM) has developed a Technical Report under the auspices of the LMK, which accurately deals with the subject matter described in this document and which was approved at the “Direktorenkonferenz der Landesmedienanstalten“ (Conference of Directors of the Media Authorities) meeting on 16 April 2013.
- There are multiple signals from the European region concerning the implementation of DRM+ for local radio. The Community Media Forum Europe (CMFE) and the "World Association of Community Radio Broadcasters" (AMARC-Europe) have approached the EU Commission with a recommendation to use DRM for local digital terrestrial radio.
- In its Recommendation 138 of February 2013, the European Broadcasting Union has recommended e.g. the rollout of digital terrestrial broadcasting in Europe (R138 "Digital Radio Distribution in Europe") and that DRM should be used where DAB coverage is not feasible, with a deadline for the switch-off of analogue terrestrial radio.

7.2 Further steps

The following questions in particular should be clarified (a suggestion as to who should deal with each issue has been included).

7.2.1 Regulatory conditions for the coordination of DRM transmitters

In Germany, the *Deutsches DRM Forum* will procure the precise regulatory conditions for DRM+ transmitter coordination from the BNetzA (Federal Network Agency).

The *DRM Consortium* should initiate a Technical Report to clarify this issue.

7.2.2 Preparedness and framework for production of multi-standard chipsets and radios

The *DRM Consortium* should clarify the industry interests and framework to bring multi-standard chipsets and receivers onto the European market that can demodulate both DRM+, DAB and analogue FM transmissions.

The *DRM consortium* should require the inclusion of DRM (DRM30/DRM+) in the ”Euro-Chip” initiative propagated by Deutschlandradio, the BBC and the European Broadcasting Union for reception of DAB, DMB, analogue FM in band II and AM below 30 MHz.

The industry needs a statement from the regulators and broadcasters about the future introduction of DRM to complement the DAB offerings in Germany and rest of Europe in order that future digital receivers based on multi-standard receiver chipsets can be designed and commercialised accordingly.

7.2.3 Preparedness and framework for the providers of DRM broadcasts

The *DRM Consortium* compiles information concerning DRM-related activities in Europe and makes it available on a continuing basis. The *Deutsches DRM Forum* in Germany and other organisations (e.g. the CMFE and AMARC) can contribute to this effort.

7.2.4 Market conditions for DRM

The *DRM Consortium* should determine through a market survey under which conditions DRM+ can gain acceptance in the European marketplace, and how a market introduction can be promoted considering the DAB rollout. This should be done in cooperation with other organisations such as the *Deutsches DRM Forum*.

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