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Frau
Mona Marina Powilleit

**Erfolgsgeschichte des DAB im
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Erfolgsgeschichte des DAB im Vereinigten Königreich Großbritannien und Nordirland

Autor/in:

Frau Mona Marina Powilleit

Studiengang:

Business Mangement

Seminargruppe:

BM14wM5-B

Erstprüfer:

Prof. LL.M. Markus Heinker

Zweitprüfer:

Herr Ole Wagner

Faculty of Media

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author:

Ms. Mona Marina Powilleit

course of studies:

Business Management

seminar group:

BM14wM5-B

first examiner:

Prof. LL.M. Markus Heinker

second examiner:

Mr. Ole Wagner

Bibliographic information

Powilleit Mona:

Erfolgsgeschichte des DAB im Vereinigten Königreich Großbritannien und Nordirland

Success story DAB in the UK

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Abstract

The popularity of digital audio broadcasting in different countries can be explained mainly by means of historical development. In this work, the general technical conditions are explained and the mode of operation is explained. In addition, advantages, disadvantages and alternatives are presented. After that, the development of the digital radio in Germany and the UK is compared with the current situation in order to show how the differences have led to a different distribution and acceptance of the medium.

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ii List of abbreviations

aacPlus	Advanced Audio Coding Plus
ALM	Arbeitsgemeinschaft der Landesmedienanstalten (Working community of state media institutes)
ARD	Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland (public broadcasting corporation of Germany)
BBC	British Broadcasting Company
CEPT	European Conference of Postal and Telecommunications Administrations
COFDM	Coded Orthogonal Frequency Division Multiplexing
DAB/DAB+	Digital Audio Broadcasting
DMB	Digital Multimedia Broadcasting
DRM	Digital Radio Mondiale
e.V.	eingetragener Verein (registered association)
FM	Frequency modulation
GmbH	Gesellschaft mit beschränkter Haftung (company with limited liability)
IBOC	In-Band-on-Channel
IDR	Initiative Digitaler Rundfunk (Initiative Digital Broadcasting)
IFA	International Radio Exhibition
KEF	Kommision zur Ermittlung des Finanzbedarfs der Rundfunkanstalten
kHz	kilohertz
km	kilometre
MHz	megahertz
MPEG	standard for the generic coding of moving pictures and associated audio information

SLM	Saxony media center
TPEG	Transport Protocol Experts Group
TV	Television
UK	United Kingdom of Great Britain and Northern Ireland
VHF	Very High Frequency

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1 Introduction

*"Radio has no future"*¹

With this statement from 1897 Lord Kelvin, a British scientist has clearly been wrong. In the last century, the medium of radio established itself as the first electronic mass media of all and is still used throughout the world by all the social branches to this day.² The radio is part of the everyday life and can be heard at any time of the day or night, and for numerous functions. Be it information, entertainment or distraction. It is a constant companion in the car and hardly a consumer can do without. The fact that the radio is still going so strong is perhaps due to the customary integration and casualness. It is a source of information as well as having an identification function. The radio also serves more and more as entertainment; it has developed into a secondary medium. Radio is a medium, which one can also enjoy, while dealing with other things, like driving, cleaning and eating.³

1.1 Motivation

Even before the beginning of the 21st century, the trend towards complete digitalization of the media was evident. With the Compact Disc (CD), computers and mobile phones, the use of digital technology in private households became commonplace, so that the future of digital transmission technology for the radio seemed not far away.

Of course the radio also changes. In addition to the classic or satellite-based programs, a multitude of internet-based services are increasingly being added. Nevertheless, it is important not to underestimate the range of the radio, because it remains one of the most used media. There is not a repression of the radio by new offers happening, but an extension.⁴

A large majority of people have remained loyal to the analog radio for a long time after its introduction. This is notable with regard to the ongoing modernization and digitization. Especially in media development, advances in digital technology and transmission in terms of picture, sound and writing have been a decisive driving force. Nevertheless, the digital age has not stopped on

¹ Zapatopi, 2008

² Cf. Krug, 2010, p. 14

³ Cf. ARD-Forschungsbericht, 2011, p. 617ff

⁴

the radio. Over the last 30 years, a number of digital broadcasting platforms have been developed, mainly in terms of capacity limits and analogue broadcasting.⁵

With the introduction of digital transmission technology for television, the radio remained the almost single electronic medium used by large sections of the population where the analogue reception path was still accepted. The use of the radio via digital reception channels has stagnated in Germany to date. With the latest developments in technology and increasing media convergence, the Digital distribution and the DAB+ transmission path allows the changeover to digital radio transmission.⁶

1.2 Research question and method

There are various digital transmission systems within the range of hearing technology that compete or complement each other. In this thesis the focus will be on the most widely known transmission standard digital audio broadcasting (DAB). Often the term digital radio is used as well. The digital radio has developed heterogeneously at a global level, which is why in this work the question is to be illuminated how the different historical development of DAB in two countries has influenced today's popularity. In particular, the differences between the UK and Germany are considered.

The first part of this work will mostly explain the theoretical basis on which this technology is based, to clarify its uses. Furthermore, the competition and advantages and disadvantages will be shown. To give an understanding of the implementation, the historical development and current situation of both the UK and Germany are described as well as the direct comparison between those two. The problems that happen with DAB+ and why there is no complete switchover yet will be discussed in chapter five. The conclusion in the end will also include a possible outlook on what might happen with DAB/DAB+ in coming years.

⁵ Cf. Gebhard, 1995

⁶ Cf. Cnet, 2011

2 Theoretical Framework

The theoretical framework is the structure of a research study. In the following section, the technical information and developments are used as a basis for further explanation.

2.1 Technical basis

Numerous inventions were necessary until 1906 the first wireless transmission of a radio signal was possible. The most important discovery was the electromagnetic waves. They are generated electronically by an oscillator and then superimposed with the information to be transmitted. The electromagnetic waves are a form of energy that unfolds invisibly. In a process described as modulation, the electromagnetic waves with the frequency of the radio transmitter, also referred to as the transmission frequency, are superimposed on the audio signal to be transmitted, which are then emitted by means of an antenna. On the opposite receiver exists also an antenna to receive the data. The resonant circuit located in the radio is variable and it is possible to capture different frequencies. After amplifying the electromagnetic waves, the sound signal is filtered out in the demodulation and fed to a loudspeaker. In particular, the inventions of the electron tube as well as of the transistor, which contribute to the amplification, were necessary. In the beginning, radios were built with electronic tubes and from 1949 on transistor tones could be built.^{7 8}

Radio signals can be transmitted via the frequencies of the short, medium and long wave via amplitude modulation.⁹ The frequency remains constant because of the modulation, while the amplitude of the carrier frequency changes. The waveband between 153 kHz and 279 kHz corresponds to the long wave in the analogue radio and was the first frequency band to be listened to at the beginning of the 1920s as wireless transmission. It reaches distances of about 2000 km. Until the end of the 1940s, the medium wave was the most important frequency range for radio programs. It stood for the analogue radio in the frequency range of 531 kHz to 1.611 MHz and has been improved due to the superior transmission quality through FM replaced. At a distance of 9 kHz 121 channels can be transmitted, which can be up to 150 km.¹⁰ The short wave

⁷ Cf. Ask Lubo, 2014

⁸ Cf. Aschermann, 2015

⁹ Cf. Kleinstuber 2012, p. 66ff

¹⁰ Cf. Kleinstuber 2012, p. 87

covers the frequency range from 3 MHz to 30 MHz. The areas between 5.8 MHz and 26.1 MHz are used for worldwide radio programs. Due to reflections in the ionosphere, the short wave can achieve the largest reach.¹¹

The frequency of the carrier oscillation changes as a function of frequency modulation depending from the incoming signal frequency.¹² The amplitude of the carrier oscillation remains constant. The ultra-short wave, short FM, denotes the analogue radio transmission in the frequency range between 87.5 MHz and 108 MHz.¹³ It is used since the 1940s for radio transmission. The range of the transmitters is small, but the transmission takes place in high quality. Since the beginning of the sixties the improved FM signal transmission has been implemented in Stereo. Besides the transmission of audio files there are also transmissions of information by Radio Data System, or RDS for short.¹⁴

Following the initiation of the DAB standard in the 80s as a European research project, the Norwegian Broadcasting Corporation launched the first DAB transmitter on the world market on the 1st of June 1995. BBC and Swedish Radio followed in September of the same year. Since the end of the 90s, DAB receivers are available in many countries. DAB can offer more radio programs over a spectrum than analog FM radio. In this case, it is more robust with regard to noise, since the reception quality only deteriorates when the signal strength drops below a critical threshold, while the FM quality also decreases steadily with a decreasing signal. Depending on the bit rate and audio material, the audio quality varies.

A digital radio combines an audio compression system called MPEG (multimedia file) and a COFDM (Coded Orthogonal Frequency Division Multiplex) technology that allows it to eliminate interference. MPEG is mostly used to discard sounds that cannot be distinguished by the listener anyway. This drastically reduces the amount of information that is broadcasted and wraps up the remaining information efficiently. By eliminating the interference of bouncing radio signals COFDM technology ensures reliable signals. The mathematical process used to ensure the listener is able to recover the original sound splits the data across 1,536 different carrier frequencies. This makes

¹¹ Cf. Kleinstuber 2012, p. 110

¹² Cf. Fischer, 2010, p.266f

¹³ Cf. Sjurts, 2006, p. 613

¹⁴ Cf. Fischer, 2010, p.787

certain that instead of having to retune a set, the listener is able to use the same frequency across a whole country.¹⁵

Combining several services together as an alternative to having a different frequency for each radio station is called a multiplex. Multiplex describes a number of stations sharing one frequency and is a digital transmitter operated by a company.¹⁶

The biggest difference between FM and DAB is the type of signal transmission. While the signal is transmitted in a sinusoidal form during the analog expansion and can therefore assume any value in a defined range, DAB signals are sampled at certain time intervals and encoded into the digital units 0 and 1, so-called bits. The shorter these time intervals are selected, the more accurate the signal is imaged and the quality is better. The transmission rate is referred to as the data rate and is expressed in bits per second (bit / s).¹⁷ After sampling the signal, the data is reduced. Because the source signal contains more information than is required for the recipient additional capacities can be created for data reduction. Irrelevance and redundancy reduction makes the process possible. By means of irrelevance and redundancy reduction, the method allows a reduction of the data rate of the source signal by up to 90%.¹⁸ In the case of the irrelevance reduction, information of the signal which cannot be perceived by the receiver due to the physiological properties of the human auditory is eliminated and is thus irrelevant to the quality of the audio signal. Moreover, redundancy reduction results in suppressing multiple or existing redundant information. Through the above Reduction methods, a transmission of the output signal can be carried out with comparatively low data rates from 32 kbit / s to 384 kbit / s, without changing the perceptible quality of the sound. Decisive for the final data rate is the use of the signal. For high-quality stereo sound in CD quality is usually a data rate of 192kbit / s is used, while the news station with 96k bit / s in Mono sound.

By means of said source coding, the capacity of the frequency spectrum is massively expanded. Unlike the FM transmission, where each transmitter is each allocated a frequency DAB programs are bundled into one transmission frame, so-called multiplexes or even ensembles.¹⁹ The number of transmitters in multiplex results from the level of data rates of the signals. The higher the

¹⁵ Cf. Paul Denton, 2017

¹⁶ Cf. Rouse, 2005

¹⁷ Cf. Riegler, 2004, p. 48

¹⁸ Cf. Riegler, 2004, p.66

¹⁹ Cf. Gebhard, 1995, p. 55

data rate, the better the quality of the data, but the less space is available in a multiplex for more channels. The output signal of the DAB multiplexer, the transport multiplex, has a net-data rate of approximately 1.5Mbit / s. Thus, it makes the transmission of six high-quality stereo programs or up to three times as many programs in mono quality in a multiplex possible.²⁰

In the DAB transmission method, in addition to the radio programs, services can be transmitted. This is in the nature of digital transmission, since basically all kinds of information, such as text, image or video formats can be implemented into one digital data stream. Since this is a transparent transmission method, the additional capacities of the multiplex created by the data reduction are available for additional data services.

Because the transport multiplex is not a static but dynamic process, the data rates and the number of services can be matched to the requirements used. If, for example, a message transmission with a comparatively low data rate is emitted, the freed capacities can be used for data services.²¹ These can be displayed via a display and contain information about the current program, such as the name of the song and the artist of the current song piece of music or information on the weather situation, traffic reports and park-and-ride recommendations.

With COFDM, the digital information is not stored on a single, but on 1536 separate carrier frequencies with a carrier spacing of 1000Hz on a frequency band of 1.5MHz. This way, only parts of the signal and not the entire signal are damaged if something happens. Furthermore redundant bits are added to the reduced signals by means of channel coding. The additional bit sequences serve on the one hand as error protection but also to enable encryption of services. Transmission errors can occur when a single signal is applied to objects such as buildings, cars or mountains, and the echo signal is delayed in time to the direct signal on the receiver. One speaks of a multipath propagation of the signal. In classical FM radio, this phenomenon triggers interference, which results in an audible degradation of audio quality. Especially during the mobile reception, disturbances of the signal occur due to field strength dips, or disturbances caused by electrical signals. The multipath propagation is therefore advantageous for DAB transmission.²²

²⁰ Cf. Freyer, 1997, p.76

²¹ Cf. Freyer, 1997, p.76

²² Cf. Paul Denton, 2017

Due to the insensitivity to the multipath broadcast, the DAB stations can send the radio program in a single-frequency network. This means that a terrestrial broadcast network has a set of station locations and the program is broadcast over regional space. This means that the frequency of the transmitter no longer needs to be adapted to the location as is the case with the multi-frequency network of FM radio. Several stations can send their program together on one frequency. Local radio stations have, as with the FM, the possibility of having their program on their own, but this does not affect the overall capacity of a DAB multiplexes. Other stations from the region can be on the same frequency, since the transmission power, ergo the supply area of local radio stations, is limited. This is an advantage of DAB since the frequency resources are scarce. The whole process is shown in Table 1 below.

The upgraded version of DAB is called DAB+. Compared to the usual DAB signal it has a slightly better error correction especially in poor reception areas. While a DAB audio signal is encoded in MP2, DAB+ is encoded in aacPlus which helps making audio a lower bitrates sound better. There are virtually no other differences seeing as they both use the same transmitters and multiplex equipment. Any DAB+ radios can easily adapt to normal DAB signals, but DAB radios need to be upgraded to be able to encode DAB+.²³

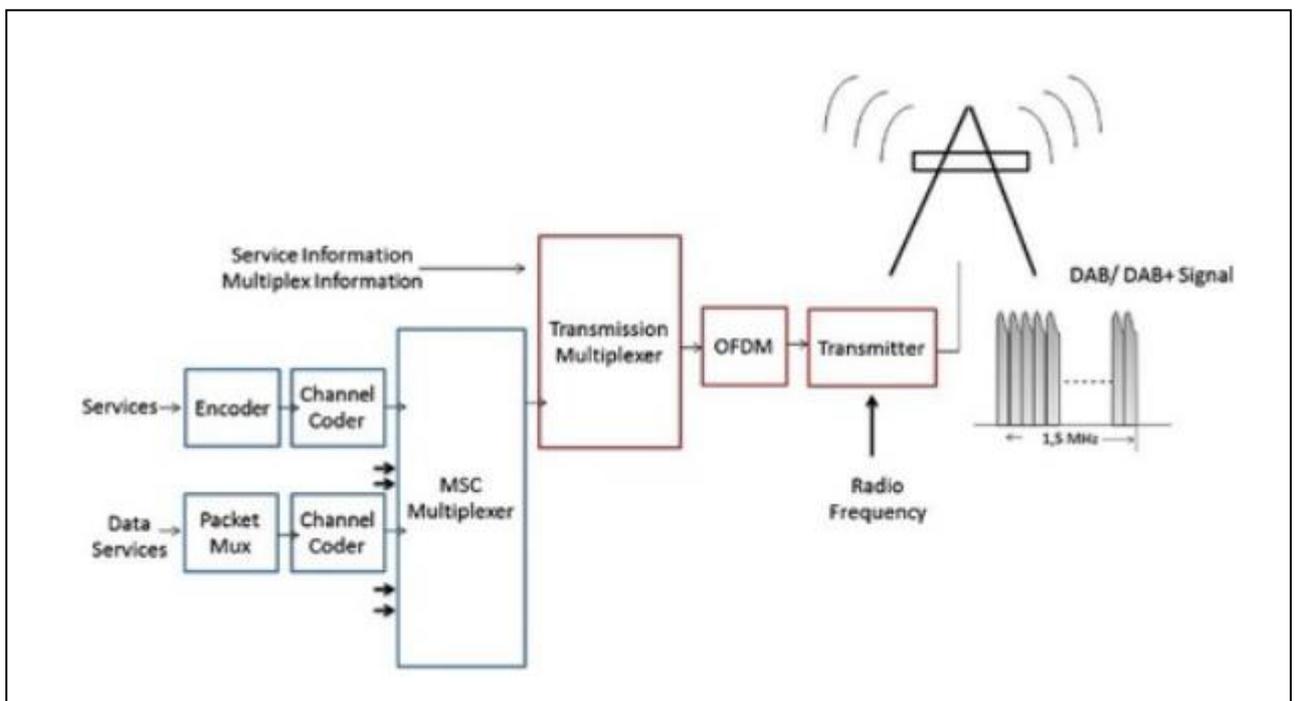


Table 1: Generation of DAB-signal

²³ Cf. Media.info, 2016

2.2 Alternatives

The DMB (Digital Multimedia Broadcasting) successor system was developed by Robert Bosch GmbH in 2006 and allows the transmission of video as well as audio and data service transmission.²⁴ It is mainly used for mobile applications via mobile phones. The technology used is basically the same as for the DAB system, only DMB additionally has an error protection codec and an innovative transport protocol.²⁵

Alternatives for digital terrestrial radio transmission are, in addition to DAB, the DRM system and the in-band-out-channel technology (IBOC). DRM was founded in 1998 to digitize the radio on short, medium and longwave. The advantage of this is that radio programs can be received from all over the world. Since, in comparison to the DAB, broadcasters do not have to broadcast their programs with other broadcasters in a multiplex, but continue to broadcast on their frequency, local and regional broadcasters can also broadcast their program. However, mobile reception is only possible to a limited extent and the method is incompatible with other terrestrial transmission systems. IBOC was introduced in 2002, which is a hybrid analog-to-digital transmission system. The listeners have the possibility to receive the radio program either in digital or analog form since digital signals are fed into the edge regions of the analog signal in order to improve the sound quality. However, this system is only suitable for the American market and is not used in Europe.^{26 27}

In the case of a satellite-based radio transmission as an alternative, digitally coded signals are transmitted from a radio station on the earth to a remote satellite, which are then radiated back into a region of the earth by a transponder and bundled. The advantages are the comprehensive coverage and the high sound quality. However, mobile reception is only partially possible and a small area supply is not feasible.²⁸

The Internet-based radio transmission differs from the above and has some special features. It is possible to broadcast a large number of niche programs and to pass on individualized content. In addition, the use and interactivity is

²⁴ Cf. Bayern Digital Radio, 2012, p 3

²⁵ Cf. O'Neil et al., 2010

²⁶ Cf. Kleinstuber, 2012

²⁷ Cf. Riegler, 2006

²⁸ Cf. Gebhard, 1995

interdependent and independent of time, thanks to bilateral communication. However, the cost of network expansion is very high.²⁹

2.3 Advantages and Disadvantages of DAB

The DAB system offers both advantages and disadvantages, which will be shown in the following Table 2.

Advantages	Disadvantages
Up to 24 Frequencies in a multiplex	High cost of network setup
Mobile reception available	High costs for local and regional broadcasters
Regional, local and national broadcasting	DAB devices incompatible with DAB+ (electrical scrap)
Interference resistance is very high	
Possibility to operate additional data services	
More choice of stations and content	
More information via screen	
No need to remember frequencies as sets are tuned by name	

Table 2: Advantages and Disadvantages of DAB

²⁹ Cf. Institut für Rundfunntechnik, 2014, p. 61

3 Germany

Before you can show concepts and differences, the historical development and the current situation of the DAB / DAB + transmission standard in Germany have to be shown.

3.1 Historical development

Germany played a key role in the development of DAB. In 1991 the association DAB-Plattform e.V. was established, which among other things contributed to the European development and standardization of the transmission system in the Eureka 147 research project. The association includes state media institutes, terminal manufacturers, research institutions, broadcast network operators, private and public broadcasters and ministries of the federal government and the states.³⁰ At the CEPT planning conference in Wiesbaden in 1995, the frequency ranges for DAB were defined. But since the frequency resources in the FM area were almost completely exhausted, alternatives had to be found. For this reason, the frequency bands VHF Band III and L-Band were agreed on all over Europe. The bands were divided into different frequency blocks, which were then assigned to the individual local regions.³¹

In the same year, the first DAB pilot project was used to test the acceptance of the system among suppliers and users, to gain experience in the area of dissemination technology and to check the organization. The first experiments were started in Baden-Württemberg, Berlin and Bavaria, where at that time the world's largest extended broadcasting network was available.³² Mecklenburg-Vorpommern, Lower Saxony, Hamburg, Bremen and Schleswig-Holstein did not use DAB pilot projects.³³ It can be seen that countries in the south of Germany have a much greater acceptance of the DAB technology, and that more northern countries have adopted a disinclined attitude, which can be attributed to the existing production capacities of equipment manufacturers of entertainment technology in the south.

In 1997 DAB launched its market launch at the International Radio Exhibition (IFA) in Berlin. The Prime Ministers of the states agreed to digitize this radio in the next ten years. Since, however, not all of them were satisfied with the

³⁰ Cf. Richter et al., 1999, p. 56

³¹ Cf. Freyer, 1997, p. 86

³² Cf. Matzneller et al., 2015, p. 38

³³ Cf. Heyen et al., 1999, p. 16

results of the test operations³⁴, the Mitteldeutsche Rundfunk stopped the DAB operation in 1998 and then restarted it in 2002 with a program.^{35 36} The regular operation was started in 1999, despite the different acceptance, and only one year later the Initiative Digitaler Rundfunk (IDR) presented the StartszENARIO 2000, which assumes that by the year 2010 a majority of the listeners will use digital radio. It is also explained that one could then phase out the analogue radio transmission between 2010 and 2015. This was a misconception because after 2002 the development of DAB was slow. Thus only one DAB ensemble was available in Berlin and the Brandenburg region. The private radio providers were opposed to the DAB system, as these hoped to be preferred by their commitment to FM innovations in the allocation of FM frequencies. At the same time, a hybrid transmission system was set up, but this was not implemented in the long term.

In Bavaria the multimedia system DMB was tested in 2005, but this too could not be achieved. In 2007, the Arbeitsgemeinschaft der Landesmedienanstalten (ALM) clearly expressed itself in a decision for the DAB system as a distribution system for radio programs. DAB as a standard has not yet succeeded in spite of high investments of well over half a billion euros and efforts by the politicians.³⁷ The prices of the terminals were still too high and the technology was not yet fault-free, which is why listeners did not perceive any added value compared to the classic FM³⁸. The KEF subsequently rejected applications for the DAB program in 2009 and justified this, among other things, with the non-significant growth in the number of receivers. Due to the uproar of DAB supporters, they changed their minds and released a budget of 30 million euros by 2012. In August 2011, Media Broadcast was able to build up a new network of broadcasting stations and the DAB +³⁹. The Table 3 shows the increase of DAB-sets in German households during the years 2013 to 2016.

³⁴ Cf. Institut für Rundfunktechnik, 2014

³⁵ Cf. Richter et al., 1999, p.57

³⁶ Cf. Matzneller et al., 2015, p.38

³⁷ Cf. Kleinsteuber, 2012, p. 94

³⁸ Cf. Arbeitsgemeinschaft der Landesmedienanstalten, 2010, p. 41

³⁹ Cf. Kleinsteuber, 2012, p. 96f

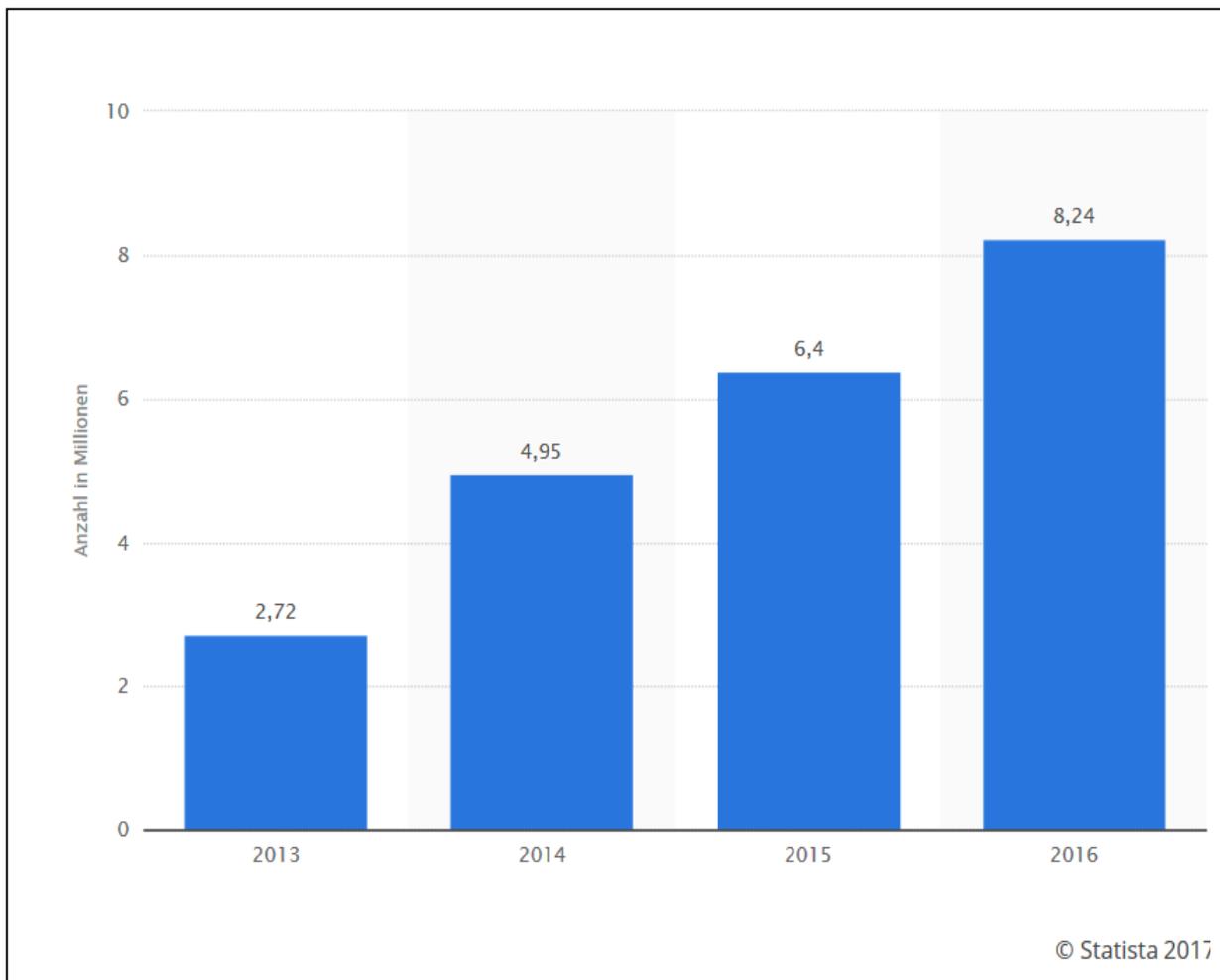


Table 3: DAB-sets in German households 2013-2016

3.2 Current situation

With the introduction of DAB + in 2011, the formation of a digital radio program launched its second phase. With the DAB + system, a national multiplex was implemented, with which programs could be received that have not yet been mapped to FM. This resulted in a value added by the customer in terms of content and music. The so-called Bundesmux contains four public programs and eight private broadcasters. In addition, additional data services such as TPEG can transmit current traffic information more efficiently in real-time. The national multiplex covers 63% of the area of Germany and 77% of the population have the possibility to receive it. Table 4 shows the programs included in the Bundesmux.⁴⁰

⁴⁰ Cf. WorldDMB-Forum, 2015, p.4

Public programs	Private programs
Deutschlandfunk	ERFPlus
DKultur	Absolut Relax
DWissen	ENERGY
DRadio DoIDeb	Schlagerparade
DRadio Daten	Sunshine live
EPG Deutschland	Radio BOB1
TPEG	KlassikRadio
	Radio Horeb
	MB datacast
	TPEG MM
	ECODyNIS Test

Table 4: Bundesmux Germany

In addition to the national multiplex, there are other nationwide and local multiplexes of the ARD and some private radio providers. DAB / DAB + is different in the individual federal states and the number of programs to be received varies greatly. Private providers can be found more in areas where the supply of DAB + is high, because it is more lucrative by higher advertising revenues. There is still a clear difference between and in the south of Germany, as far as DAB coverage is concerned. In Bavaria, for example, six localities have developed in addition to three country-wide multiplexes, so more than 40 programs can be received.⁴¹ The coverage in Bavaria is 96%.⁴² Baden-Württemberg and Rhineland-Palatinate also have local multiplexes. The cities of Berlin and Hamburg are top runners with 100% coverage. Mecklenburg-

⁴¹ Cf. UKW/TV Arbeitskreis e.V., 2015

⁴² Cf. Bayerischer Rundfunk, 2015, p.17

Vorpommern, on the other hand, has the lowest coverage with only 20%, as shown in Table 6. A total of approximately 74 million people are supplied.

The program offer shows strong differences in the supply between the individual Countries. There is the largest radio diversity in the radio market Bavaria. One possible reason for the success of the Bavarian DAB + local radios is the financial support of their media center BLM, which is not customary in every state. The interest of the private radio on the DAB + network is extremely low in the whole of Germany. In more than seven federal states the broadcasting of private-commercial broadcasters is missing. This includes, for example, the state of Saxony, where there is no financial support by the SLM, the Saxon media center. The discrepancy becomes clear with the program offer between FM and DAB +, especially for the private sector Stations in North Rhine-Westphalia. There, over programs are transmitted via FM. In the DAB + network, on the other hand, only two are the channels domradio and radio impala. After March 2014 the radio service changed by new entries and exits of different stations in the DAB + network.⁴³

On the other hand, there were a number of clashes In Bavaria, Berlin and Brandenburg. In addition to the airing of PureFM and "Mega 80s" in Bavaria, there were additional impressions of Hitradio Babelsberg and Radio B2 in Berlin and Brandenburg. The LiveRadio in Baden-Württemberg was switched off at the beginning of December, but eight new stations started⁴⁴. Baden.fm, Hitradio Ohr, Die neue Welle, Radio Regenbogen, Die neue 107.7, Donau 3 FM, Radio 7 and the music program Radio VHR FM were added +⁴⁵. Table 5 shows the stations included in the multiplex in Germany. The high station increase in Baden-Wuerttemberg is an exception. Ultimately, there is a density of stations in Germany though. Nevertheless, the digitization process is slow. The compilations of the WorldDMB forum on the international status of the Digital radios show that the coverage of the DAB + network compared to the United Kingdom.

⁴³ Cf. Gongolsky, 2015

⁴⁴ Cf. Die Landesmedienanstalten, 2014

⁴⁵ Cf. Dehn, 2014

Bundesland	Landesweite Multiplexe	Anzahl der Programme	Lokale Multiplexe	Anzahl der Programme
Niedersachsen	6D: NDR NDS	8 öffentlich-rechtliche	-	-
	11B: NDR NDS	8 öffentlich-rechtliche	-	-
	12A: NDR NDS	8 öffentlich-rechtliche		
Bremen	7B: Radio Bremen	6 öffentlich-rechtliche	-	-
Mecklenburg-Vorpommern	11B: NDR MV	8 öffentlich-rechtliche	-	-
Mecklenburg-Vorpommern	12B: NDR MV	8 öffentlich-rechtliche	-	-
Berlin/Brandenburg	7D: DR Berlin rrb K7	12 öffentlich-rechtliche	-	-
	7B: Berlin/BRBG 7B	2 öffentlich-rechtliche 13 private		
Sachsen	9A: MDR Sachsen	11 private	-	-
Bundesland	Landesweite Multiplexe	Anzahl der Programme	Lokale Multiplexe	Anzahl der Programme
Schleswig-Holstein	9C: NDR SH	8 öffentlich-rechtliche	-	-
Hamburg	7A: NDR HH	8 öffentlich-rechtliche	-	-
	11C: Hamburg	10 private		
Niedersachsen	6A: NDR NDS	8 öffentlich-rechtliche	-	-
Thüringen	8B: MDR Thüringen	9 öffentlich-rechtliche	-	-
Hessen	7B: hr Radio	6 öffentlich-rechtliche	-	-
	11C: DR Hessen	7 private	-	-
	11D: Radio für NRW	10 öffentlich-rechtliche 1 private	-	-
Rheinland-Pfalz	11A: SWR RP	10 öffentlich-rechtliche 1 private	12A: Radio EIT	2 öffentlich-rechtliche
Saarland	9A: DR Saarland	6 öffentlich-rechtliche 1 private	-	-
Bundesland	Landesweite Multiplexe	Anzahl der Programme	Lokale Multiplexe	Anzahl der Programme
Baden-Württemberg	11B: DRS BW	1 öffentlich-rechtliches 13 private	12A: LfK-Test	-
	9D: SWR BW N	9 öffentlich-rechtliche		
	8D: SWR BW S	9 öffentlich-rechtliche		
Bayern	10D: Bayern	4 öffentlich-rechtliche 5 private	9C: Augsburg	14 private
			10C: Nürnberg	14 private
	12D: Bayern	4 öffentlich-rechtliche 5 private	11A: Ingolstadt	12 private
			11C: München	1 öffentlich-rechtliches 17 private

Table 5: Multiplex Germany

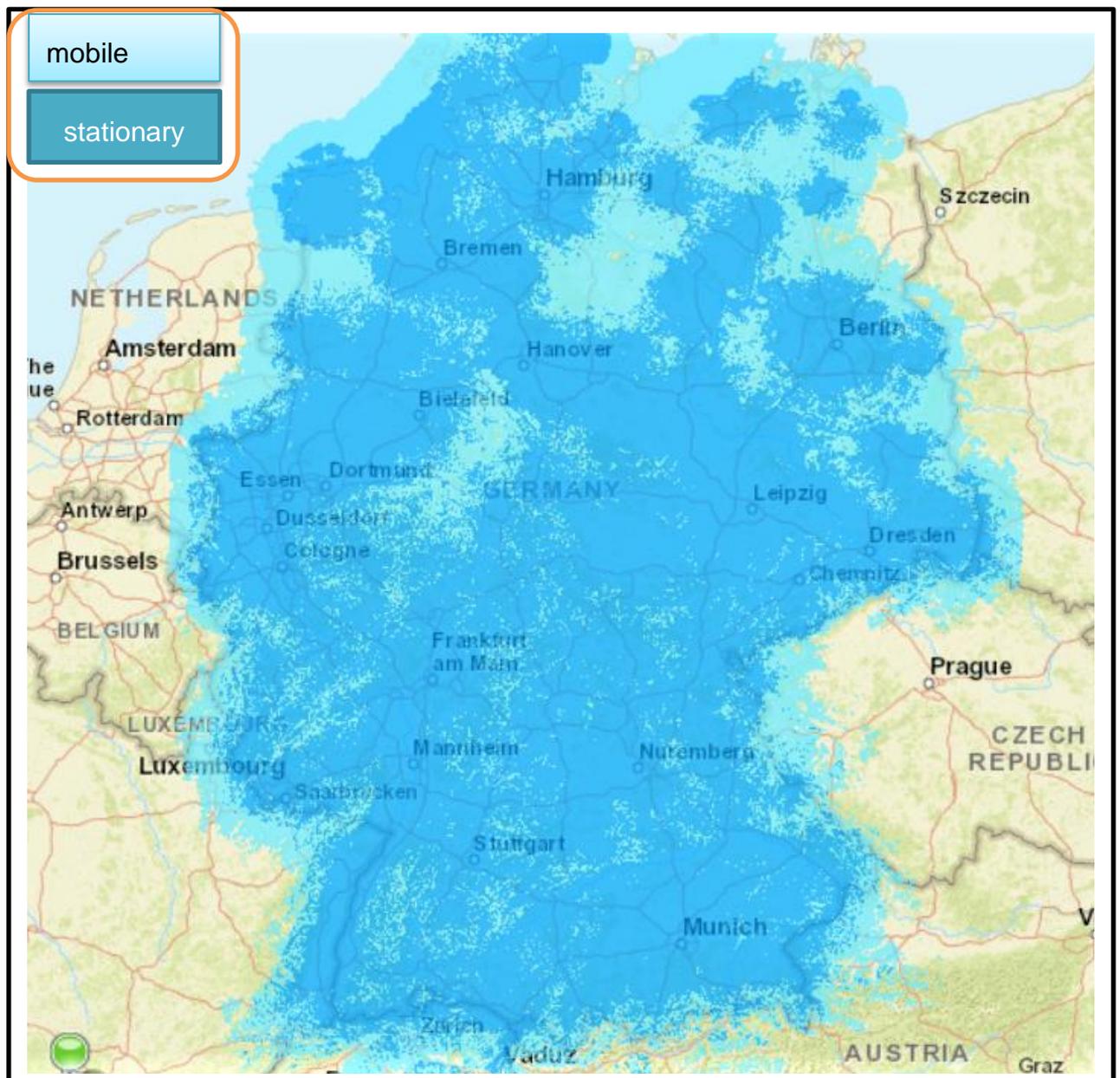


Table 6: DAB-coverage Germany

Despite solid DAB / DAB + coverage in Germany, the use of radio is by no means so high. According to the digitization report of 2016, 69.241 million people aged 14 or over in Germany receive radio of all kinds. Of this, 13.8% use DAB in 2016, which is a big step forward, since in 2013 only 4.8% used DAB. Also more equipment was sold and now every eight Germans in DAB + equipment. Even though much of the radio consignment is still passed through analogous paths, digitalization has made great progress. ⁴⁶The number of users

⁴⁶ Cf. Cf. Die Medienanstalt, 2016

who hear via cable or satellite is decreasing. Table 7 shows the radio reception in Germany from 2013 to 2016.

Digital radio reception via the Internet is a trend in Germany, especially among young people and young adults. The usage behavior of the various Generations is therefore different. On the one hand, the program of conventional radio transmission still contains a strong editorial offer, while on the other hand the number of interactive offers on Internet radio is growing particularly the younger target group.

In Germany, the market is divided almost equally between private radio and public radio, with the private radio market being rather fragmented. This is an advantage of diversity, but at the same time also inhibits further development.

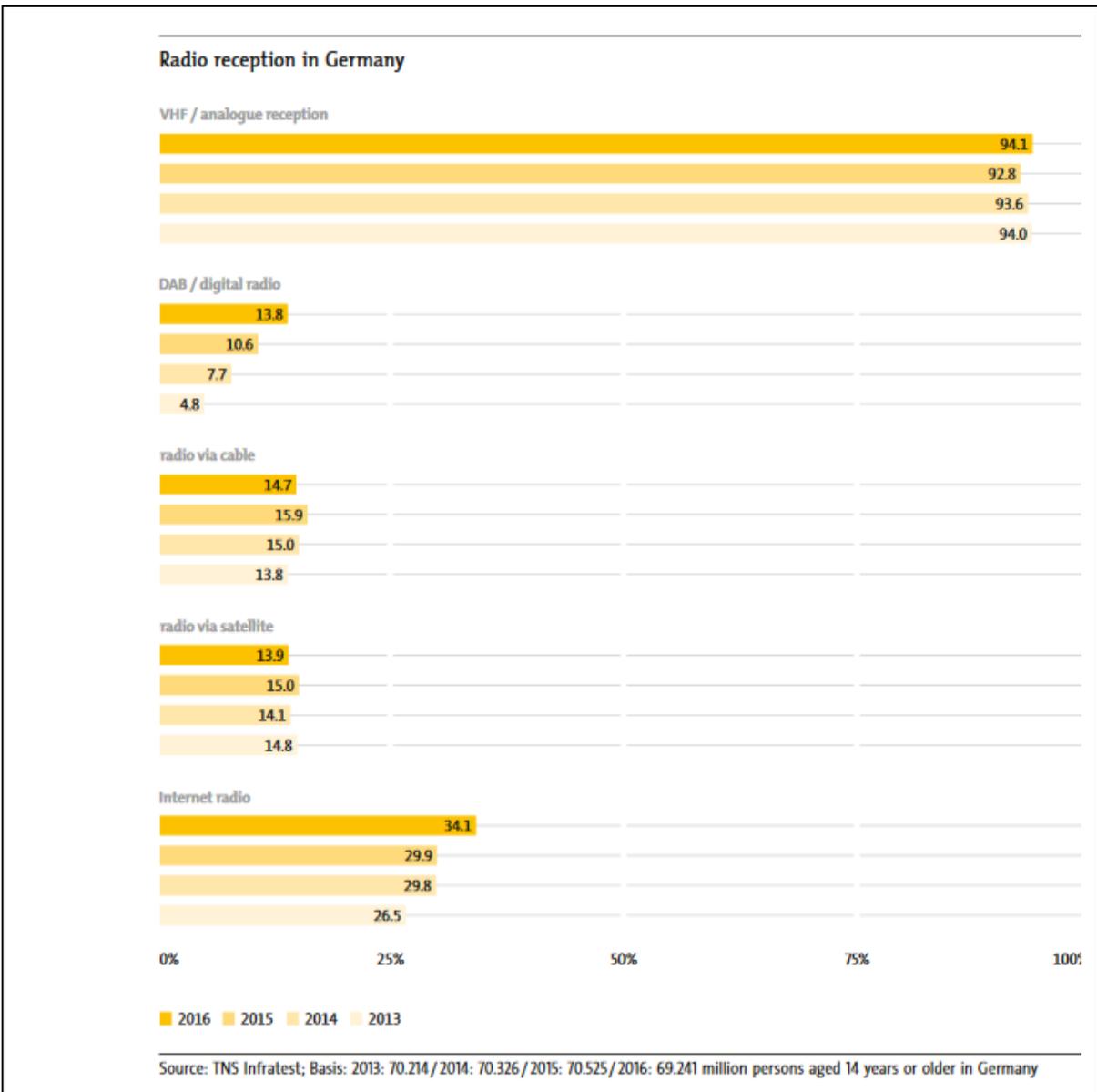


Table 7: Radio reception in Germany

4 United Kingdom

In the UK, the DAB standard, since its beginning, has been one successful development and the UK is currently one of the countries where DAB is strongly established and advanced.

4.1 Historical Development

The first attempt at digital radio transmission was begun by the BBC, which began the test transmissions in 1990. A network of four transmitters was set up in the London area in 1993, and BBC launched a public launch of the DAB in September 1995 with five broadcasters. Only four years later DAB devices were made public. The national commercial radio multiplex operator Digital One began broadcasting in late 1999⁴⁷. In 2000, the prices for digital radios were high and interest was still low, which led to only 24 stations in the UK. In 2002, BBC introduced five national DAB-only stations: 6 Music, 1Xtra, BBC 7, Asian Network, and 5 live sports extra.

In a state interim report of 2009 it was said that DAB is regarded as a priority transmission system and a changeover from FM to DAB will follow. Conditions for this are that 50% of the listeners hear digital, DAB of 90% of the population can receive on all traffic routes and the national coverage is comparable to that of FM coverage. This conversion should take place in 2015. In 2012 it was then announced that a changeover should take place sometime in 2015-2019, but a final shutdown date is still not fixed.⁴⁸

4.2. Current Situation

The national DAB coverage has been growing ever since the introduction, since the sending network has been greatly expanded. Currently, the United Kingdom has more than 400, with about 64 digital stations in London alone. 97% of the population is covered by DAB, with more than 58% of households being supplied by equipment (Table 8).⁴⁹

⁴⁷ Cf. British Broadcasting Corporation, 2013

⁴⁸ Cf. WorldDMB-Forum, 2015, p.4

⁴⁹ Cf. Worlddab, 2017

Select Country:	
United Kingdom 	
Key Information	
Status:	regular
Population:	64.1 million
Population coverage:	 97%
Services:	487 DAB, 8 DAB+
New cars with DAB/DAB+ as standard:	 87%
Total Sales (cumulative):	31,794,000 devices
Penetration by household:	 58%
Last update: 04.04.2017	

Table 8: DAB key information UK

The BBC acknowledged that they also want to advance in-car reception as part of a program to increase UK coverage.

Above all, in the UK the Radio market is supported by the publicly funded broadcaster BBC. The BBC is financed with a household tax of approximately 145 pounds per year and therefore sends advertising-free. The private market is shared by two companies, the Global Radio Group and the Bauer Media Group. BBC and the private companies are sharing the same number of listeners.⁵⁰

A big buildout is underway at the moment which includes doubling the number of local DAB transmitters which is set to bring up the local DAB coverage to FM

⁵⁰ Cf. Worlddab, 2017

equivalence in two years. That means over 162 new transmitters are used for the BBC to expand from 95% to 97% coverage and more transmitters for Digital One. The project is mostly set out to help improve the DAB expansion along the major roads and will bring 6,700km of roads into DAB coverage. That means nearly eight million more people will get local DAB. In 2016 the digital reach increased by 2.3 million listeners.⁵¹

While there are still stations using both FM and DAB frequencies, digital-only stations continue to grow and make up more than 30% of digital listening. It is increasingly common in the UK to have digital radios in cars. 86% of new cars come with DAB as standard and 2.3 million were sold in 2016 (Table 9). Over 6.5 million cars on the road are already able to receive digital radio. A survey by the AA breakdown cover provider found out that 91% of drivers listen to the radio, 22% have a digital radio and 81% of those are satisfied with DAB.^{52 53}

Meanwhile, there are also DAB + services in the UK but there is no plan to switch over to DAB + completely. Individual stations may change to DAB +, but DAB sets are available in more than half of households, and radios are reluctantly replaced. The national multiplex with DAB + capabilities sends Fun Kids, Magic Chilled, Union Jack and Jazz FM. All other services of this multiplex are, however, at normal DAB frequency.⁵⁴

⁵¹ Cf. BBC, 2010

⁵² Cf. Worlddab, 2017

⁵³ Cf. Britisches Ministerium für Kultur, Medien und Sport, 2012

⁵⁴ Cf. Medio.info, 2016

5 Comparison and Problems

5.1 Direct comparison

The digital radio is much more popular in the UK than in Germany. Due to the development of the last decades, there are also clear differences in the way the digital radio market is dealt with, which are listed in the following section.

The survey of quotas in Germany, for example, differs greatly from that in England. In Germany a massive telephone query is operated, in which randomly selected people are given a list of programs and then indicate which of these programs they heard in the last days. These interviews are conducted in four waves. In the UK, the survey works rather comparable with the German Television Quotation Survey. It selects representative test houses, which have to keep a diary of programs; the distribution channel is no matter. The figures are requested 50 weeks a year. The advantage of the British method is that no major promotions like in Germany have to be carried out, as the radio stations concentrate with their advertising measures on the time of the quota measurement. That's why there are fewer on-air sweepstakes or posters in the UK.⁵⁵

In the UK, cooperation on the market is made easier by the fact that there are only three major competitors, between private and public. Thus, a joint venture is used to standardize the channels, which make it easier for customers and to provide others with a good opportunity for the broadcasters to distribute their advertising. There is no such cooperation in Germany.

Great Britain is also of the opinion to lead radios like a young start-up company and bring constant innovations. These include flat hierarchies, space for experiments, feedback opportunities and team diversity. This corporate culture is still difficult to achieve at the moment in German radio.⁵⁶

5.2 Problems with DAB+

In order to promote digitalization, radio operators and consumers have to deal with fundamental obstacles. Since DAB + on the Market is not yet established, the experiences are both from the vendor's point of view as well as from the point of view of consumers. This results in a number of technical, organizational

⁵⁵ Cf. Westphal, 2013

⁵⁶ Cf. Westphal, 2013

or financial problems. In the following section problems of digitization are summarized viewed from the point of view of the radio providers.

The dual system divides the German Radio area into public broadcasters and private-commercial radio providers, whose sources of income differ greatly. The public radio is financed by a large part with the fees of the broadcasting. In the period from 2013 to 2016, KEF identified a financial requirement of 61.2 Million for the further development of digital audio broadcasting. For the ARD are 34 million Euro planned, a further 27.2 million euro for the Deutschlandradio. Participation in the cost of digitization is only for private organizers singled out by the state media institutions of some of the federal states.⁵⁷

In Germany, the largest survey on media consumption behavior is media analysis. Twice a year, this is analyzed by the work community media analysis. It is a merger of some 240 companies of advertising and media industry. Finally, the most important sources of revenue are advertising and sponsorship.⁵⁸

From a business perspective, the broadcasting of the radio program over DAB+ brings no advantages. The distribution of digital radio is primarily connected to costs. First, the revenue from the FM business needs to be spread over an additional distribution channel. On the one hand, the use of DAB + is too small, so no substantial increase in the range of the transmitter. On the other hand, the increase of listeners seems unlikely. In addition, there is no specific and meaningful coverage for the DAB + transfer path. Digital radio stations cannot be used for the reasons mentioned solely via the DAB + advertising market. For radio broadcasters, who distribute their transmitters via DAB +, this means, conversely, that the dissemination costs should be kept as low as possible. No clear statements can be made about the opportunity of DAB +⁵⁹.

The lack of marketing numbers in the digital radio also hinders the BBC entering into the German DAB + network. In Germany, the high number of owners is characterized by the private radio landscape. Through legal regulations it is the media policy and the Landesmedienanstalten succeeded in not giving any dominant position to individual radio owners. Establishing DAB + would break through the current market barrier and the new acquisition of other radio transmitters. The fear of private operators that a growing competition and thus lower advertising revenues would be the consequence could be the digital change. Some of the federal states are postponing their fixed shutdown date Of

⁵⁷ Cf. KEF, 2012

⁵⁸ Cf. Die Landesmedienanstalten, 2014, p. 159

⁵⁹ Cf. Fuhr, 2014

FM. The existing competition for digital radio is enormous. In addition to countless web radios, streaming and download platforms such as Spotify and iTunes are becoming increasingly popular.⁶⁰

In order to exploit a cost advantage of DAB +, all free multiplex channels would have to be used. The existing cost risk for local programs explains the small share of private local programs

Even at the beginning, the digital radio could not provide the consumer with any security in the continuation of the technology. Apparently, the lack of program selection made it difficult to introduce DAB. A change from analogue to digital radio is a major problem in contrast to the digitization of television in the foreground. There is no possibility of receiving digital signals from a household radio expand. Different from TV, where an additional device is used the existing radio must be replaced by an entirely new device. This appears to most consumers as not appropriate.

The persistently low use and the low possession of DAB + radios prevent the automotive industry to an increased integration of digital radio. Only a few manufacturers risk the serial integration of DAB + devices into their cars. Instead the majority often leaves the customer with the technical decision of equipment. There is a general mistrust of the technology. Thus, a DAB + market penetration through the automotive industry is excluded. Electricity markets have increased due to the poor reception of DAB + Presentation difficulties in their business premises. To counter this can use repeaters to receive a better DAB + signal in the branch offices installed. The increased complexity makes the introduction process of DAB + difficult and prevents the rapid increase of the positive image building. The cost of a digital radio has now reached the price level of analog radios. Accordingly, the price tolerance for the digital radio decreases. This limits the framework potential buyer and confirms the gradual growth of DAB + users.^{61 62}

⁶⁰ Cf. Die Landesmedienanstalten, 20

⁶¹ Cf. Fuhr, 2014

⁶² Cf. Dehn, 2014

6 Conclusion and outlook

Especially in the UK the digital radio was accepted and bought very quickly, because many stations are only digitally to receive. In Norway, FM will be switched off this year, and in Great Britain it will be ready in the next few years. In other neighboring countries, which soon want to switch off FM, the goal is that at least 50% of all listeners already listen to digital radio. Germany is still far away. DAB + does not yet pay for the private radios. Digital broadcasting costs money and this fee is worthwhile for advertising-financed channels only if a sufficiently large target group is reached. As long as this is not the case, it is not easy to switch, the private radios would break the revenues. An incentive for users would be more programs that are only digitally receivable. Opponents of the digital radio always claim that the mobile internet makes the digital radio superfluous. In the distant future this might actually be the case, but this is not yet foreseeable, because the mobile Internet does not even offer the necessary capacity in the foreseeable future.⁶³

Even at large events the radio cells are overfilled, the sensitive networks can fail. And soon more and more variables weigh on the Internet, cars drive autonomously and every mobile radio stream, a 5G high-speed wireless network would not be enough. Digital radio, on the other hand, always transmits without a capacity limit. Everyone is always reached. On TV the changeover from analogue to digital has worked quite simply by switch-off date. At that time, however, there was also hype around the new flat TVs and High Definition programs. Many people did not just want to switch to digital to have a better picture on the new TV. They were also willing to pay the extra money for the HD program. However, DAB + also has the biggest difficulties in the car market. Just barely 15% of all new cars have a digital radio. Help could come from the EU, for example by prescribing new cars across the EU to a digital radio - the discussion is still going on, because not all countries of Europe are ready to use the digital radio. Sweden will switch off DAB + again in the coming year and only stay with FM.

Already at the introduction of DAB + a shutdown of FM was intended. The requirements of digital radio as a substitute for the analogous distribution are up

⁶³ Cf. Dedecek, 2017

to but not today. The use of DAB + is too low. Due to the still incomplete DAB + network coverage digital radio to the analog radio does not offer a comparable good reception. Even in 2016, after the rough completion of the expansion, there is a risk remaining reception disturbances due to the low transmitter radius in congested areas. In addition, low winners' maintenance is one of the reasons for the low number of listeners and one of the largest barriers to DAB+.

A series of deferrals of the FM switch-off date to the year 2025 give Information about a longer-term Germany-wide delay. Thus FM will persist until at least 2020. The obstacles presented cause a stalled situation that can only be solved by a subsequent change. Hereinafter possible scenarios for solving the problem are being investigated. The market conditions are decisive for the development of digital radios; even legislation in the broadcasting system can be adapted to the market. These represent merely a pulse factor for the further development of digital radio. Planning the unification of divergent transmission media, a more intense debate with the FM system is not provided for the time being. The image build-up is an ongoing process that is progressing slowly. Through the increased use of repeaters in business premises or the realization of marketing campaigns, the consumer will be used to the technology in a longlasting process. This makes for a growing awareness of DAB + provided. The use of LTE as a possible digitalization alternative to DAB + is still technically and financially impossible to implement. For one thing the costs for the construction of the mobile receiving network and the construction costs of DAB + The data capacities would be too high. In addition, the access to the Internet is initially payable and tied to a mobile operator. This results in an advantage for the user of the digital radio. The costs remain regardless of the amount of use constant, while the price with the used data capacity by LTE is variable.

The sale of a new, hybrid radio could increase the attractiveness of DAB + for the Consumers. Nevertheless, the price of the terminal must be reasonable and made through a good marketing strategy. New channels and program structures could also lead to a significant change of the DAB + image. Above all, a simultaneous arrival of several channels with special-interests programs in the consumer a new need with the attractiveness of the supply. In the end, the analogue radio is preserved.

Because of the economic advantages that DAB + offers, the digital radio remains the chance to continue persisting. The digital radio is ultimately not the transmission path to abolish FM completely. In a predominantly market - oriented society, the need for the consumers, whose interest in buying digital

radio is first created got to. The entire radio landscape is still in one Upheaval. Laws increasingly lose their scope due to the increase new and converging media products on the market. The Internet offers the consumer beside Music streaming and information, television or games platform is the largest selection of entertainment offerings ever. This extends the alternatives to the radio and will continue to evolve in its diversity. For the digital radio, the situation will be competing with the growth media formats continuously.

The private stations will continue to depend on the FM radio in the near future, Due to the high range; it is an attractive advertising platform and thus the economic basis for private radio broadcasters.

In order to answer the research question definitively, DAB has developed significantly differently in the UK and Germany and will continue to take different paths in the future. DAB is much better accepted in the UK by early marketing and publicity and it is also given by the government much more attention to that system constantly improves. In Germany, the development was initially blocked by private individuals and the government as they did not convince the population in time. That is why a lot of stations and stations could be built in the UK much earlier. Due to the introduction of the DAB +, a new opportunity will also be built at the German radio market, but it will be increasingly difficult to obtain complete coverage thanks to further technical advances

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vi **Attachement**

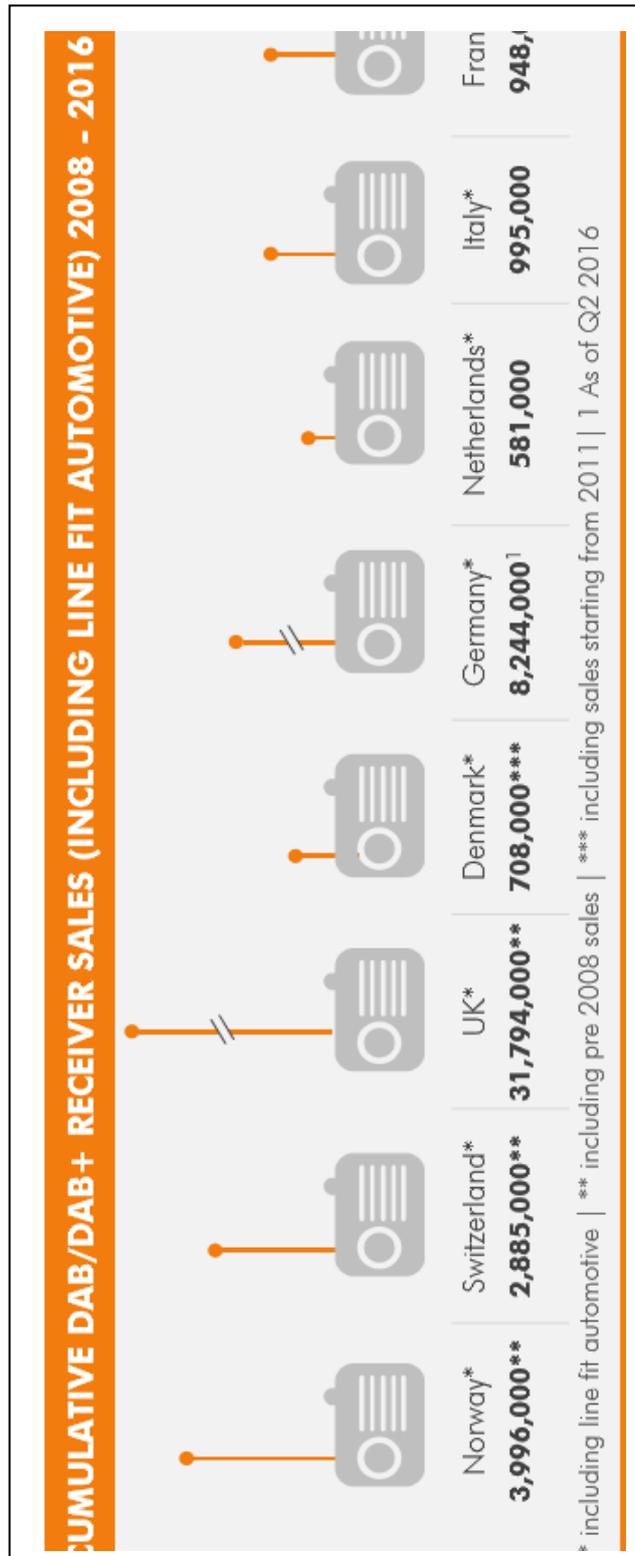


Table 9: DAB Receiver Sales UK

vii Independence declaration

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Mona Powilleit

Ort, Datum

Vorname Nachname