PUBLIC SERVICE COUNCIL

Nordic Radio Workgroup

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DAB facts 2019

Crucial problems and disadvantages with the digital system DAB for terrestrial sound broadcasting

Introduction

DAB was invented in Munich in the 1980's and was introduced in the UK, Norway and Sweden in 1995. Today there are only a few countries where the system is in regular operation and only one country - Norway - has (2019) adopted DAB as the main platform for national terrestrial broadcasting[1].

After a period of twentyfive years with experience of DAB (including its upgrade version DAB+) the system is still struggling for success. This verifies the strong global position of analogue FM broadcasting and the exceptionally fast growth of digital radio over the Internet. In view of the rapid uptake of smartphones it is clear that this development cannot be challenged by the DAB system. Consumers will rule on as long as a free market prevails.

The DAB system has so far not been introduced commercially in any free market country without government intervention, state subsidies and public funding.

Other aspects such as power and career positioning, lack of relevant knowledge, prestige or corruption might enable a technical system to be established in some countries. In spite of the technical or economic shortcomings of the system.

Such problems have been fully or partly concealed when the DAB system is presented to politicians responsible for media policy. The WorldDAB organisation, the EBU and other DAB stakeholders still have not told the true story.

In Norway, the DAB stakeholders were able to set and control the agenda for the political decision to replace national FM with DAB+. Even obvious problems were ignored and critical questioning was met by silence.

A decision to replace a broadcasting structure should be taken based on analysis of all available data. In this document we are presenting facts and analyzing problems related to the market and the listeners as well as technical problems.

[1] DAB+ is the upgraded version of the original DAB-system. In this document "DAB" indicates both versions.

A further technical overview and analysis was compiled in 2018-2019 by the *Public Service Council* experts desk in cooperation with broadcast engineers in Norway and Sweden. Additional specific problem points are listed and explained in the appendix.

MARKET ASPECTS

”DAB” does not stand for ”digital radio”

DAB ”Digital Audio Broadcasting” is the *brand name* of one of technical systems for distributing terrestrial digital radio. The other systems digital radio systems recognized by the International Telecommunications Union are *DRM (Digital Radio Mondiale)*, *HD Radio* (Mexico & the U.S.) and *ISDB-T* (Japan). Since 2013 China has developed its own digital radio standard CDR.

Digital radio is also in use in more than 30 via the digital terrestrial television system DVB-T2. In addition there is *digital radio* transmitted via satellites and cable.

The fastest growing expansion is via the Internet (fixed or mobile broadband) on 3G and 4G/5G LTE etc. When ”digitalization of radio” is mentioned in Sweden, France, the US and most other countries it relates to the expansion of radio on the Internet.

Few countries will make a transition from analog to digital radio

Today, you will find FM radio in all 220 countries. It is a world standard. No country has so far set a date for a total”switch-off” of FM. *Norway is still the only country closing down FM for national networks.* So far, DAB systems are operational in a limited number of countries in Western Europe and in Australia, but FM networks are running as before.

Denmark has expressed plans for public service and commercial national networks to switch to DAB, but keeping FM for local radio stations. *Finland rejected DAB in 2007 and* has allocated the VHF Band III (174-230 MHz) for exclusively broadcasting television signals (DVB-T2).

Sweden dismissed a transition already in 2005. In June 2015 the government again rejected a proposal to replace FM with DAB+ due to massive negative public and professional opinion including a consultation round and a dismissal by the National Audit. The decision was confirmed by all eight political parties in the Parliament in February 2016.

Among other countries which have recently decided *not* to replace FM with DAB are *Australia, Latvia, Hongkong, Ireland, South Africa and Spain.* DAB has earlier been rejected in *Canada, Portugal* and *Taiwan.*

The BBC has concluded (2018) that analogue radio, strongly driven by FM, remains the United Kingdom’s most popular, universal and reliable method of listening to radio. It accounts for 50% of time spent listening to radio in the UK, and is used by 70% of the population. The BBC has cancelled plans to switch off FM radio broadcasts and force millions of listeners to tune into digital transmissions. FM will remain as part of a 'hybrid' future and will operate alongside DAB and the internet.

Large area nations as *India, China, Indonesia, Brazil* and *Russia are expected* to opt for DRM rather than DAB. That system is applicable on all broadcasting bands from VHF to LF (including FM, short wave, medium wave and long wave).

No consumer demand for DAB radio

Presently there are DAB transmissions on a regular or experimental basis in approximately 30 countries. However, there are few countries where significant DAB listening figures have been attained (2018). Only *Denmark, Norway, Switzerland, the United Kingdom* and *Australia* have more than 10% listening on weekly basis. But in some countries - even with DAB networks with full national coverage such as Germany and the Netherlands - there is just a few percent DAB listening.

The promoters of DAB have never made public any market survey or analysis verifying consumer demand or any forecast pointing to a sustainable business model.
Overall the presented picture of market and its connected regulation is slanted.

A total sale of 70 million DAB receivers have been reported. However, this is cumulative since the launch of DAB radio in Europe in 1995. Here it should be noted that there are globally more than *6 billion* FM receivers and *2,5 billion* smartphones (2019). It is estimated that far less than 1% of the world population was listening to DAB radio in 2018.

Most stand-alone radio sets sold today have both DAB and FM receiving capabilities, some even combined with Internet connection capability. DAB-only receivers are not in great demand. Thus, the total sales figure for ”DAB receivers” does not reflex a consumer demand for replacement of FM radio. The market for stand-alone table or portable radio sets is gradually shrinking while listening to radio and music streaming by smartphones is booming.

After 25 years, DAB has not succeeded on the consumer market as a "new technology". It can be seen a solution in search of a problem - instead of a solution solving a problem.

EU regulation: Terrestrial digital radio will not be mandatory for all cars

The European Electronics Communications Code (EECC) is now including a provision that any radio equipment integrated in a new car which is put on the market for sale or rent in the Union shall be capable of receiving digital terrestrial radio broadcasting. This might be a step forward for the DAB system, but technical developments and capacity for mobile broadband on 4G and 5G might kill the whole setup. Also this regulation also opens for other systems as DRM and HD Radio.

It is explained that in case of technical regulations adopted by member states for the interoperability of consumer radio equipment, radio sets should be capable of receiving radio services provided via digital terrestrial radio broadcasting or via IP networks. Thus a <u>new</u> stand-alone in-car receiver should be equipped with FM and DAB <u>or</u> with FM and Internet radio. Terrestrial broadcast radio as DAB is not mandatory for Internet connected cars equipped with systems as Apple Play or Google Plays.

The EU provision only covers passenger vehicles and not busses and trucks.

Listeners are not asking for more terrestrial radio channels

A typical DAB + network can provide 40-60 national radio channels, but there are no market studies or research confirming the existence of such a demand for wireless radio.

Internet radio was not on the map when DAB was developed in the 90's. The same applies to the alternative methods of music distribution today such as iTunes, Spotify and the like. More than 90,000 digital radio stations are available on the Internet which will offer a much better choice and sound quality than DAB radio.

Receiving capabilities for DAB in smartphones not in sight.

Because of lack of global demand there is no DAB reception capabilities in modern mobile- or smartphones. On most mobile phones you can receive on-line a multitude of radio and music channels on a world-wide platform. Also there is often a built in FM receiver (especially in India and the US).

The global market for DAB radio is still far too small and probably will remain so for smartphone manufacturers to include DAB receiving capabilities. Nor are mobile operators interested to subsidize mobile phones with DAB+ as there is no sustainable business model.

DAB will not save money

DAB+ is cost effective if all the channels are used, but there are significant additional costs to administer and operate the program production for new channels (studio technology, personnel and royalties for music, etc).

There are no studies indicating any need for more public service channels. Nor have the commercial radio interests been able to prove that more channels can increase profits. On the contrary more channel available will probably strengthen commercial oligopolies by increasing control of the wireless space. Small operators will not have the resources to join the rather complex DAB transmission structure.

It is the consumers/listeners who will pay most of the bill for DAB by being forced to replace their FM-only receivers at home and in their cars.

DAB “free-to-air” will not cost less than Internet radio

To receive web radio you usually have to be a subscriber to an Internet service provider while receiving on-air radio is “free”. However, mobile broadband operators in some countries (the US, Finland and Sweden for example) recently opened for unlimited Internet access. You will not pay any extra fees for listening to streamed music such as Spotify or to radio online.

An audio stream will require approximately 35 times less bandwidth than a video stream (i.e. Netflix, Play). Compared to viewing television, online radio and audio pod listening costs can be disregarded on mobile 4G/5G and fixed broadband

DAB will not be an independent platform free from gatekeeper control

“Net neutrality” is an issue regarding Internet access. However, a third party will always be the operator of the transmission system also for a multiplex system as DAB/DAB+ and thus a gatekeeper being able to control access and set prices.

DAB is a less robust emergency alert system (EAS) than FM

The reliability and robustness of DAB+ is still untested as an exclusive platform for national and local terrestrial radio. The problem of insufficient coverage should have been addressed from the start; a DAB transmitter has less range than an FM transmitter.

Without emergency alerts via FM, all citizens of and visitors to a country will not be possible to reach by broadcast radio. Only half the population of Norway is in possession of a DAB receiver and most car borne visitors from abroad will rely on FM radio only.

This threatens to become a catastrophic gap for information authorities. Today’s alarm system cannot be used any longer. It is clearly defined in the event of a disaster: When the sirens are heard radio should be turned on. This usually via the major radio channel. If this should fail, there are emergency transmitters.

The decision of the Swedish government in 2015 not to proceed with a transition to DAB+ was partly justified by security concerns, particularly with regard to the role of radio in the national emergency management. The government's view was that the current radio solution - FM network radio supplemented by Internet radioi - is secure, robust and well tested.

DAB is a problem for military requirements and for scientific research

Civilian radio and the military use the same frequency band 225-245 MHz. NATO has long ago claimed that band as its own when Norway decided to switch from FM to DAB and the communications authority (Nkom) allocated space for this.

With political tensions rising in Europe, widespread electronic warfare and major military exercises, the modern military depends on moving enormous amounts of data.
NATO can now demand control of the DAB frequencies that were defined as its primary area. NATO also wants to exert its rights in changes that can cause direct conflict between public radio stations and NATO’s military communication. This conflict of interest has been given more attention in Sweden, a non-NATO member, than in Norway.

DAB will be at risk to disturb not only military communications but also jam
EISCAT3D an international research infrastructure that utilizes radar observations and the incoherent scatter technique for studies of the atmosphere and near-Earth space environment above Arctic as well as for support of the solar system and radio astronomy sciences. Four EISCAT stations have been set up: in Norway near Tromsø and on Svalbard, Kiruna in Sweden and in the north of Finland.
Similar research activities are reported in South Africa.

In the VHF band EISCAT3D is using 230 MHz and has reported interferences from DAB signals in Northern Norway. (There is no DAB in Finland and Sweden).
This underscores the risks taken by allocating a mix of broadcasting with other communication activities in the same radio band (VHF III).

DAB is detrimental for small scale broadcasters

Public service radio is financed by household licensing or taxes. Commercial radio is paid by the consumers via the advertisement costs on products and services. In contrary to public service and commercial radio non-profit community radio stations in most countries will have to fund with own means for any on-air broadcasting. There are an estimated 25.000 community radio station in the world - all on FM.

Community radio (non-commercial local radio) is also broadcasting on DAB+ in Australia, France and Switzerland. However, this is made possible only by a significant annual government funding. In other countries DAB+ is regarded more than a threat than a possibility for community radio developments.

In a statement in Brussels 2013, the pan-European community media organisations AMARC Europe and CMFE strongly supported the retention of analogue FM.

…such a transition can be detrimental to both the individuals and organizations operating community radio stations as well as their listeners as equipment has to be replaced in both ends. For a future transition, DRM+ as a transparent and low cost system should be available for community radios in Europe, next to the more expensive and complex DAB+ system for some situations.

The association for local commercial radio in Europe AER in Brussels stated 2013 *that FM on band II remains an efficient, simple- to-use and free-to-air technology for the vast majority of radio stations across Europe. This efficiency relates to the business-model: it is actually an essential part of the main business model for commercially funded radio.* Thanks to the broad receiver penetration and the very high usage by the listeners the small bandwidth of 20,5 MHz is very efficiently used.

In its report (2018), the Swedish public service commission noted that DAB is not appropriate for local radio and believes that FM cannot be turned off until a solution for community radio is found. Similar conclusions have been reached in Denmark and the UK

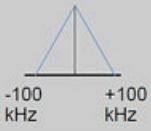
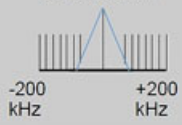
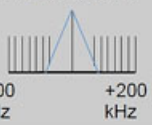
In *Norway* there was strong univocal resistance to DAB in a recent local radio consultation by the media authority. Among 55 consultation referrals, only the three national DAB stakeholders are against continued FM for local radio after 2021.

Outside large metropolitan areas there will not be any resources to run more than one community radio channel per village or town. The DAB "Small scale solution for local broadcasters" does not solve the prime problem of how to run a local multiplex efficiently with only one or two programs, the remainder of the multiplex being empty.

TECHNICAL ASPECTS

DAB is limited to only one band in the frequency spectrum

The key characteristics of FM, HD Radio, CDR, DRM+, DAB+ and DVB-T2 Lite (ISDB-T excluded)

Parameter	FM	HD Radio	China Digital	DRM+	DAB+	DVB-T2 Lite
Frequency	87.5 MHz – 108 MHz Band II	55kHz - 1705kHz 87.5 MHz – 108 MHz	87.5 MHz – 108 MHz Band II	47 MHz – 68 MHz 87.5 MHz – 108 MHz 174MHz – 230 MHz	174 MHz – 240 MHz Band III	47 MHz – 68 MHz 174 MHz – 240 MHz 470 MHz – 860 MHz
Programs / Channel	1	1 to 4 (max)	1 to 4 (or More)	1 to 4 (max)	Typically 16	Typically 44
Data / Channel	RDS 1,2 kBit/s	Flexible Program Associated and Non Program Associated Data rates	Flexible Program Associated and Non Program Associated Data rates	Flexible Program Associated and Non Program Associated Data rates	Flexible Program Associated and Non Program Associated Data rates	Flexible Program Associated and Non Program Associated Data rates
Analog Simulcast	N/A	Yes	Yes	Yes*	No	No
Channel	200 kHz	400kHz	400kHz	96 kHz	1.7 MHz	1.7 MHz
BW Capacity	N/A	96/124 kBit/s	96 kBit/s-1.5 MBits/s	96/kBit/s	1.1 Mbits/s	3.5 Mbits/s
Modulation	Single Carrier FM  -100 kHz +100 kHz	Multi-carrier (up to 524) OFDM, 4 QAM  -200 kHz +200 kHz	Multi-carrier (up to 524) 4,8,16,32,64 QAM  -200 kHz +200 kHz	Multi carrier (106) OFDM, 4 or 16 QAM  -48 kHz +48 kHz	Multi Carrier (1536) OFDM, type DQPSK  -768 kHz +768 kHz	Multi Carrier (1536) OFDM, QPSK,16QAM,64QAM  -768 kHz +768 kHz

VHF band II is the current FM band and VHF band III is today used for DAB (radio) and DVB-T (television). DRM is the most complete system regarding frequency spectrum. Both HD Radio and DRM can be used on frequencies today used by most radio stations in the world; AM (long and medium wave) and FM. DRM30 can also be used on shortwave. DAB can only be used in Band III.

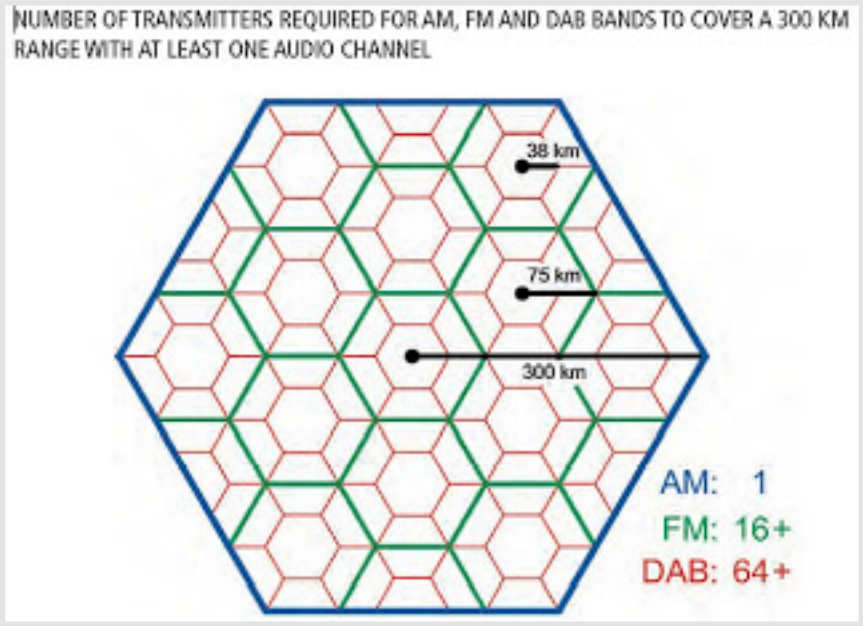
DAB is not ”utilizing the frequency spectrum better”

DAB has a particular spectrum (Band III), which is on higher frequencies than FM band (Band II), but DRM+ is more frequency efficient with a bandwidth of 100 kHz compared with the DAB multiplex 1.500 kHz. However, for a robust signal. good sound quality and space for meta data a bandwidth of 200 kHz is recommended for DRM+

FM transmissions have a better geographical reach than DAB

The higher the frequency the smaller the range. DAB operates in VHF Band III (174-240 MHz), while the FM broadcast in VHF Band II (87.5-108 MHz). The smaller the range = the greater the number of transmitters needed for coverage.

You will in principle need 64 DAB-transmitters to achieve the same coverage as 16 FM-transmitters which in turn are required to attain the same coverage as one medium wave (AM) transmitter *(See graphics below. Source: Teracom Denmark)*



British media authority Ofcom believes that it is very difficult and expensive to roll out DAB in Scotland and Wales, due to geographical reasons. As DAB fails to cover the entire population FM or DRM + must supplement. Together with being on a higher frequency DAB has difficulties to reach indoors and other difficult reception points.

Cross-border listening will not be possible in neighboring countries

Because of limited transmitter reach reception will not be possible in cross border areas in neighboring countries. Therefore, national radio cannot be received internationally on DAB whereas AM, FM and Internet can. For example approximately half of the population in Norway is estimated to be able to listen to broadcast on FM from Denmark, Sweden, Finland and Russia.

FM is still a modern and robust technology

Today there is a wide range of modern and effective FM transmittesr even at budget level of around 3,500 euro for community radio. There are no signs that FM broadcasting will cease as long as terrestrial transmissions are overtaken by another dominant structure as Internet fixed or mobile broadband via via smartphones and Connected Cars.

Less demand for additional frequency space for sound broadcasting

There is plenty of spectrum for smaller FM radio stations in most countries except in the major metropolitan areas. In most places the FM band is not optimally utilized, but this can be improved by replanning the frequencies. This is costly, but a significant less costly method for listeners and society than a replacement of FM with DAB.

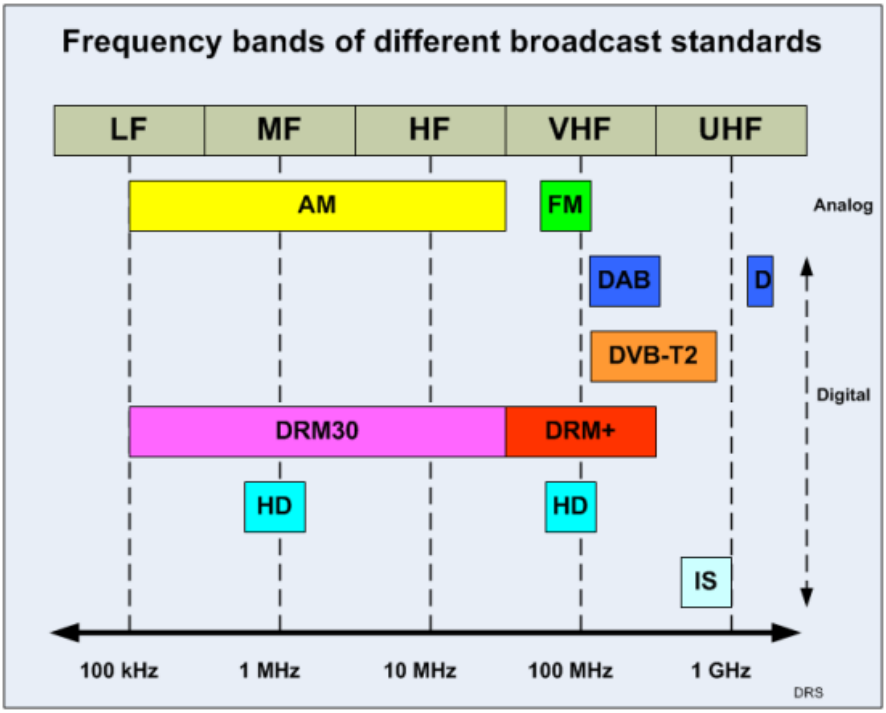
The FM band as well as lower frequency bands can also be utilized for digital radio technologies such as DRM and HD Radio. Thus, more channel space will be available.

Today, the online revolution has cooled the interest in expanding terrestrial broadcasting. Today, on the internet you can find more than 90.000 radio and music channels.

Alternative terrestrial digital radio systems can expand on lower frequency band

The frequency band VHF III (172-240 MHz) is used for both television (DVB-T2) and radio (DAB). This band will gradually become abandoned by television usage as future (DVB-T) broadcasting will be allocated on higher UHF bands. Other communication needs are now putting pressure on governments to also reallocate this band for military (NATO) purposes, emergency alert systems (EAS) and scientific purposes (EISCAT etc).

(picture: Digital Radio Sweden)



Without any further significant market growth for DAB radio in Europe within a decade DAB will probably not retain its allocated space in VHF band III. However, terrestrial digital radio will have ample space to expand on lower frequency band (below 108 MHz) on FM, shortwave, mediumwave and longwave (VHFI-II, HF, MF and LF). But then other European systems will be in question as DRM (DRM+ and DRM30), not DAB.

Terrestrial television has been digitized. Why not terrestrial radio?

A transition from analogue *terrestrial* television to digital (DTT) has been completed in most Western European countries. However, other platforms have been quite present for many years and have gradually taken over. For example in Germany, less than 5% of households receive television terrestrially (2018), while most households watch television mainly via cable, satellite or broadband (IPTV). In the U.S. only 17% of the households watch television via terrestrial networks.

The Swiss government has paved the way for the country to become the first nation in Europe to ditch DTT. The government has provided public broadcaster consent to switch off DTT by the end of 2019. And more countries will follow. And forests of rooftop antennas will gradually disappear.

Internet will become the dominant radio platform

There is no need to increase the wireless space for sound broadcasting.
There is space enough on the Internet for all radio stations, audio streaming services such as Spotify and podcasting.

More than a third of the world's population is connected to the Internet. Online, there is an ongoing increase of television and various film services. The need for bandwidth is constantly increasing and capacity expansion takes place all the time. In comparison with television, radio requires insignificant amounts of bandwidth.

2020 is said to be the year when LTE Broadcast will be in regular use for mobile broadband. It is a developed version of Multimedia Broadcast Multicast Service (eMBMS) today used in 4G networks to transmit data intense traffic including video to a mass audience - from unicast to broadcast mode.

In the telecom industry many believe that in combination with 5G LTE Broadcast in the future will replace radio and TV terrestrial broadcasting because the capacity for audio will be unlimited and for video almost unlimited.

Digital radio will not save energy

A digital transmitter is said to need less power than an analogue FM transmitter. However, if you replace a larger FM Transmitter with DAB + must also expect to deploy slave transmitter or "gap-fillers" to maintain the same coverage as before. New FM transmitters are much more energy efficient as they have very limited energy loss. A modern FM transmitter draws 70% less electricity than with an older type of analogue FM. A modern FM transmitter can probably be considered as energy efficient as a DAB transmitter.

But this does not apply to the receiver where the energy consumption is higher. So far, mobile phone manufacturers have not put DAB in their phones as this will draw 8-9 times more energy than a built-in FM tuner. Reports from Norway clearly confirm that DAB-receivers ”eats batteries” compared to FM-receivers.

See appendix for an additional listing of specific technical problems for the DAB systems.

The **Public Service Council** in Sweden is an independent non-profit think tank with the task of studying, defending and promoting the basic values of public service broadcasting. http://public-service.net

Sources: Facts and analysis presented in this document are based on contributions since 2005 by dedicated fact-finders and experienced professionals in public, commercial and non-commercial broadcasting as well as telecom authorities. This knowledge network is mainly based in Norway and Sweden, but also in Denmark, Finland, France, Germany, Belgium, the Netherlands, the United Kingdom, USA and South Africa. Comments are welcome info@public-service.net

DAB Radio Technical Problems

This technical overview 2018 by the Public Service Council experts desk in cooperation with broadcast engineers in Norway and Sweden. 29 problem points are listed and explained. (updated April 2019)

1. The efficiency of the DAB system is ridiculously low.

The inefficiency of a DAB multiplex depends most on the wider frequency bandwidth and the higher frequency range used. Also, the current weaker ERP output effect from the DAB transmitters, although it uses a very high input power for electricity consumption.

A DAB system is only economically efficient if you overbook and squeeze in more channels than the system is capable of, and then it still takes a lot of dB to handle the RF power and headroom.

You must distinguish between economic efficiency and the technical. Compared with FM stereo, however, the DAB system has some advantages but only with a maximum of three stereo channels per mux.

2. Poor efficiency of the transmitter

The poor efficiency of the DAB transmitters will require installation of super transmitters but with expensive operating costs. You must therefore compare standard DAB to a good FM or good DRM system.

There is a lack of documentation and in pure dB between broadcast power (ERP) and electricity consumption per transmitter (not per radio channel that economists prefer to compare with). Between FM-mono DRM+ and with DAB+.

3. Locked flexibility reduces full sound quality capability

The locked flexibility of the DAB+ multiplex (mux) structure reduces the number of radio channels in each mux automatically if full sound quality is required.

4. Lack of transmission technology

There is a lack of transmission technology - transmit diversity - which will reduce power demand. Other developed digital systems with more modern transmission features could therefore significantly improve coverage.

Especially DVB-T2 lite but also DRM30/DRM+ has a number of features that will enhance the robustness of transmission which DAB+ today is missing.

5. Limit of maximum bitrate

Limit of maximum bitrate in audio standard AAC punctuates the ability to provide full audio quality in AAC/He-AAC V2 audio encoding. Also VBR (variable bitrate) cannot be used in a DAB mux.

Referring to the internationally accepted listening tests on the subject under AES:
http://www.aes.org/e-lib/browse.cfm?elib=16969

6. PAD will limit sound quality

PAD (program associated data) with its extra data included in the audio stream, which is used for additional information is still allowed to take dynamic audio bitrate from the audio encoding, which further will limit the sound quality but this is beyond the listening test results.

Any upper limit for databits rate in PAD is not in the DAB standard and can therefore be easily misused by for example news editors that quickly need to get data to listeners.

When the audio coding dynamically changes over time it deteriorates in resolution than the current listening tests have been able to show. The more radio channels broadcast in a DAB mux the greater the impact on the sound quality, PAD gets in the system.

7. Quantity will kill quality

Therefore, the limited capacity of each DAB mux automatically prioritizes a quantitative culture in comparison to a quality culture. The quality of sound and also for design are the losers today. This will go in the opposite direction to what the music services like Spotify and Tidal are aspiring for.

8. Hybrid DAB-FM also an alternative

Hybrid FM and DAB are not mentioned at all in the document, rather hybrid between DAB and Internet data. A hybrid solution between an updated FM network and the other digital radio systems solves both sound quality dilemma and reception dilemma in practice in the receivers

9. DAB increases equipment costs for listeners

There is no mention of the gigantically high costs for the listeners being forced to purchase new DAB-able receivers versus the cost of expanding the FM networks. Or versus relying on a developed combined FM and Internet structure based mainly on mobile/smartphone reception (Example: Finland, Sweden and Latvia).

10. Absence of the EBU standard R128 and DRC

No mention of Loudness War and the absence of the EBU standard
R128 which in practice further destroys the sound in DAB+

No mention of the major loss of the important DRC (Dynamic Range Compression) feature in DAB+ previously implemented in old DAB. If the DRC function had been maintained also in DAB+, it would have been easier to introduce the EBU R128.

11. No software updates

Software update is also missing in DAB+ networks.

12. Problems with the DAB stickers in cars

There are a lot of reception problems with the DAB sticker (converter) in particular, the incorrectly mounted receiver antennas inside the car compartment. Additionally, almost all of these DAB stickers works poorly for type of regional DAB+ broadcast. This, as fewer transmitters are used as normal, assist the reception within a SFN system broadcast area.

In particular, the lack of input in dB to the receiver is particularly noticeable of the reception problems with the receiving antenna on the front panel.

13. All channels in same basket is a security problem.

This is a major dilemma in the event of major crises and disasters, and even in the case of major technical faults in the networks as out of sync but also in the case of rough weather conditions.

14. Not enough base stations will limit SFN.

SFN (Single Frequency Network) cannot be utilized in a larger transmission area in full because there are too few DAB base stations. With more established base stations, these time problems will be reduced, but at the expense of the economy.

A radio system with a large coverage type FM or DRM+ can safely use the handover function between the transmitters. That's what the listeners do with FM, and as listeners today always do, and along with the diversity of antennas in the cars, it will give an extended and less disturbed reception in practice.

15. Power supply structure is complicated and expensive.

Alternative power supply will be difficult and expensive to install because a DAB network consists of more transmitter stations than for FM. Too short masts with fewer antenna elements mean poorer radio signal. And with weaker output effect. This together with the fact that the system itself is ineffective.

A crisis mode also reduces the amount of "man made noice”, thus making it possible to utilize the effective radio broadcasting of the FM-Mono system in a better way.Also you cannot shut down various radio channels in order to gain in electricity power during a major crisis.

At a general crisis diesel supply for so many base stations in a general crisis will be problematic and alternative power becomes extra expensive to install. Often, the roads involved in the transport of diesel to the sites are damaged in a crisis situation.

16. Sound quality and antennas

The sound quality has been tested in detail in AES and 3 channels have almost space in DAB+ and no more. Old DAB was able to deliver a good sound but the risk was great that you had problems if you as a listener did not install your own roof antenna. Since the great demand to cover mobile reception with DAB, the transmitter antennas have been vertical. Therefore, for a good result old VHF3 television antennas have not been usable.

17. High capacity shortage

Extension of type design and amount of audio channels has clearly been problematic in practice (higher bitrate is a must) because there is a high capacity shortage in the DAB system.

18. Full geographical coverage not possible

In reality, coverage with DAB is often poor where mobile networks today work perfectly. The difference is often dramatic and DAB coverage is missing in many places like:

- During airflights
- On the trains
- On the ferries
- Inside cars
- At sea off coasts
- In railway tunnels
- In car tunnels
- In deep located parking garage
- Inside shopping malls
- Indoors and in climate-smart villas especially in rural areas with extra efficient and climate-smart windows and also in house cellars.
- In the sparsely populated area

Here the FM Mono generally works better than DAB+, but far from as good as the mobile networks/Wi-Fi networks, so the combination of several technical systems in symbiosis is preferred.

This will be a dramatic problem in a terrestrial radio network exclusively DAB depended (as in Norway)

19. Loss of emergency break-in system in order to interrupt broadcasts

A break-in system is a solution for interrupting on-going transmissions in road tunnels or any other public area where people needs to be notified in case of emergency, like fire or accidents.

For analogue radio, like FM, the principle for a break-in is to shut down the broadcasted signal in the tunnel, and replace the transmitter with an emergency transmitter carrying the emergency messages. Since FM is analogue, this doesn’t require any synchronization or other mechanisms to trigger an emergency message.

Unlike FM, DAB is far more complicated due to the fact that DAB radio uses a digital technology and cannot use the same principals as for FM since a car receiver will mute if it looses the original signal, even the shortest interruption will cause a switch over failure.

20. Surround sound is problematic

Surround sound is theoretically possible in DAB but falls out of practice due to the technical capacity deficiency in the DAB system and lack of receivers.

Receivability with a central speech channel in the center (3.0) is thus also impossible to put into practice in DAB+

21. DAB signals bouncing on aircraft.

The DAB SFN guard band is too short, which means direct excitation of the DAB signal in some difficult areas where odd terrain applies. (DRM and DVB-T2 Lite have great advantages here).

At airports, listening problems may occur if you install too few DAB transmitters in the network. This is because DAB signals from transmitters farther away from the network than the guard band is capable of are bouncing against the aircraft and down to the receiver while receiving a signal of a closer DAB transmitter. The long-range DAB signal acts via the aircraft as a local interference transmitter.

In Germany, there are problems just when you can receive long-distance DAB transmitters at some elevations, while a nearby DAB transmitter is shaded by a type of mountain mass. In Norway, 2-3 high-altitude transmitters could work together rather far out to sea in fishing waters and beyond the guard band's function. The transmitters function more and more as disturbance transmitters for each other. However at sea, you cannot establish additional DAB transmitters.

On the coastline an FM transmitter is in general able to reach double the distance than a DAB transmitter.

22. The transmitter structure is not expanded.

The transmitter structure is also not expanded due to purely economic and practical reasons. Too expensive to install according to the Wiesbaden model.

If you botch here, you'll get more and more reception problems in time.
If you expand then it becomes more of an economic issue. Therefore, the digital system must be extra efficient as type DVB-T2 Lite or DRM+.
The quantity can be offered in urban areas and via mobile networks in an easier way.

23. Outdoor signal is weak, sensitive and deceptive

The level of reception with DAB outdoors is good as for other digital radio systems, but a generally the weak signal is sensitive and deceptive (the digital cutting edge).

24. Spectral band replication (SBR) problem.

In very difficult reflexes and at low bitrate on the sound, the DAB signal tends to drop the SBR pad (discovered by IRT Germany).

The sound then switches between full audio frequency range and a band-limited audio. The lower the bit rate used for the audio coding, the more cut-off of treble part (tweeter).

25. Problems with weak and uneven input.

F/S (full scale) click sounds. Big problems with weak and uneven input. The clicks are extremely strong and energy-efficient and can cause discomfort at high listening levels as in headphones.

With modern fault protection like in DVB-T2 Lite, DRM30/DRM+ and even mobile broadband, you can avoid these clips.

As with FM there is also no de-emphasis in the DAB listening that reduces the energy in the tweeter at reception disturbances.

26. Complicated reception adjustments

It's hard to receive DAB in some places if you do not have a great deal of antenna knowledge and are almost a hobby DX-er, which is not common.

27. High battery consumption is a security risk.

Battery consumption for DAB receivers are significant higher than for FM receivers. This will risk major security problems in case of crises. Crank powered or small solar cells are not enough here.

A single, portable FM radio can be 10 times more power-intensive than a DAB + receiver. An old FM radio with big batteries than more secure against power shutdown

28. Signal distribution f0r DAB transmitters not robust enough.

Alternative and secure signal distribution to the transmitters are missing for DAB but is already established for FM networks.

FM with a digital ballast (relay), the signal goes on longer and is safer due to the frequency bandwidth and transmission frequency. Therefore, it is also possible to change the reception frequency of FM to feed other transmitters, thus increasing safety. Operating these main transmitters is possible with alternative power as the above mentioned is possible.

Although even if the entire distribution system is down-and-out, FM will function smoothly with its relay-distributed 1717transmission system. Tomorrow, even with full digital FM audio quality and the furthest out of the FM network.

29. Discussion about combining different radio systems is lacking.

There are no discussion about combining the different radio systems to one common system for the benefit of the radio listeners. Where the systems intersect and offer the listeners the best of several options.

Example: Updated FM system with Internet and DVB-T2 Lite as well as DRM30/DRM+ integrated as a single radio system.