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Innspill til høringsmøte om digital radio 6.10.2009

IKT-Norge takker for innkalling til høringsmøtet den 6.10. Vi har tidligere spilt inn en rapport om DAB vs. DAB+ til departementet.

IKT-Norge har fremstått som en kraftig motstander av DAB, men det er viktig å understreke at vi **ikke** er motstander av digitalisering av radiomediet. Vårt synspunkt om at DAB er feil valg som fremtidens radiostandard for Norge er uendret. Årsaken til det er at DAB allerede er foreldet og utdatert. DAB holder ikke mål som fremtidens radiostandard.

Når det er sagt må det tilføyes at NRK har vært pionerer i europeisk målestokk når det gjelder å digitalisere radiomediet, og skal ha ros for sitt pionerarbeid. Dessverre har NRK for sent sett at tiden er ute for DAB. Dette er beklagelig i og med at institusjonen har brukt flere hundrede millioner kroner på en radiostandard som svært få ønsker.

Samtidig viser dette at myndighetene må ta ansvar for valg av fremtidig digital radiostandard, det er alt for store samfunns- og forbrukerinteresser involvert til at markedet alene kan styre dette. Radio er vår viktigste kilde til kriseinformasjon og til trafikkinformasjon, det er derfor helt avgjørende at vi får en sømløs overgang til digitalradio, og at hele landet får tilgang samtidig. Modellen som ble benyttet til digital-TV, vil etter vår mening ikke kunne benyttes ved en eventuell slukking av FM.

Markedet har ikke trykket DAB til sitt bryst. Salget av DAB-radioer har vært svært lavt og det var en klar nedgang i salget i fjor. Rapporter IKT-Norge har innhentet nylig tyder ikke på at salget på noen måte har tatt seg opp. Det meldes snarere tvert imot om lavere interesse i sommer og høst enn hva som har vært tilfelle tidligere år. Derimot har salget av internettrbaserte radioer økt kraftig, og digitalradio må forvente sterk konkurranse fra internettradio og satellitt-radio i årene som kommer. Markedets manglende aksept av DAB er alvorlig og en fare for NRKs posisjon som allmennkringkaster. Flytting av enkeltkanaler som f.eks Alltid Klassisk har ført til lytterstorm mot NRK, til tross for at dette er en svært smal kanal. Markedet har ikke opplevd noen digital merverdi ved DAB i forhold til FM. Å innføre en tvangstegning av FM til fordel for en ikke ønsket standard

kan bli en svært stor politisk belastning. Vi snakker om mellom 15-20 millioner FM-radioer, som vil bli ubrukelige. Dette vil også medføre en betydelig miljøbelastning, som vil måtte medføre statlig støtte for å kunne ta i et mot et slikt enormt antall radioer i løpet av en kort periode. Returselskapet Elretur as som har ansvaret for denne type produkter i henhold til forskrift om EE-avfall vil ikke ha økonomisk rygggrad til å ta en så stor belastning alene.

En tvangs-slukking av FM kan ikke sammenlignes med en slukking av det analoge TV-nettet først og fremst fordi det bare var ca 30 prosent av befolkningen som ble berørt. Dernest at det ikke var nødvendig å skrote eksisterende TV.-apparater.

Når man skal vurdere den digitale radioens fremtid i Norge, er det også viktig å se på hva som skjer i våre naboland og Europa for øvrig. DAB er på sterk vikende front i hele Europa. Slik det ser ut nå kan Norge, England og Irland bli de eneste landene som sitter igjen med den gamle DAB-standarden. Det vil føre til et begrenset marked, lite produktutvikling og kostbare radiomottakere. I et konkurranseperspektiv er dette meget uheldig. Flere av de store radioprodusentene i verden har allerede varslet at de ikke vil produsere radioer for den gamle DAB-standarden lenger. DAB vil ha en kort teknisk levetid siden DAB+ nå ser helt ut til å overta som fremtidens digitale radiostandard. Velger Norge mot formodning DAB vil det kunne føre til at man først skroter 15-20 millioner FM-radioer og etter få år igjen må skrote et betydelig antall DAB-radioer. Pga oppgradering av standarden. Det vil oppleves som et grovt overgrep mot norske forbrukere. Det er derfor viktig med en avklaring på hvilken standard vi skal forholde oss til i fremtiden., og at det settes en konkret slukkedato, basert på valg av standard og utbredelse i markedet.

Situasjonen i Europa

Selv i **England** det eneste landet hvor DAB har fått et visst fotfeste er det betydelig diskusjon om standarden. Ofcom som tilsvare det norske Post- og teletilsynet har anbefalt overgang til den nye og langt bedre DAB+-standarden. Årsaken til dette er at man da båndlegger færre frekvenser og ikke minst på grunn av konkurransehensyn. Det er i dag ingen kommersielle radioer igjen på DAB-standarden i England.

Danmark har nylig sagt et klart og entydig nei til DAB. TV2 publiserte følgende melding:

"1,3 millioner radioapparater blir tause når Danmark skrur av DAB-sendingene. Omtrent alle de 1,3 millioner DAB-radioene danskene har kjøpt de siste årene kan snart ikke brukes til annet enn pyntegenstander. Danskene har nemlig bestemt å kaste vrak på det digitale radioformatet.

Ikke kompatibelt

Det danske medieforliket fører til danskene i stedet skal satse på radioformatet DAB+. Dette er imidlertid ikke bakoverkompatibelt, slik at dagens DAB-radioer ikke kan ta imot signalene. De første DAB+-sendingene er ventet å starte til neste år. Innen få år skal DAB-signalet skrus av. Fra da vil de 1,3 millioner digitalradioapparatene bare kunne ta imot tradisjonelle analoge FM-sendinger, hvis de har slik mottaker.

Mens DAB+ skal forbedre lyd kvaliteten og gi rom for flere kanaler, kan kunngjøringen føre til en ny giv for FM-radioene. For siden det ikke selges DAB+-radioer ennå, har

dansker valget mellom en DAB-radio som kan være taus om få år, eller holde seg til en analog FM-mottaker. ”

Kilde:

<http://www.tv2nyhetene.no/utenriks/vraker-dabradioen-2823498.html>

I **Sverige** har Regeringen tidligere stoppet DAB-satsingen. I løpet av kort tid kommer den svenske regjeringen med sin innstilling. Den svenske Kulturministeren uttalte nylig: ”Vi ger inga mer pengar till digitalradiosändningar utan vill att marknaden ska styra radions digitalisering. **Men det är ingen hemlighet i branschen att man på kulturdepartementet ogillar det ålderstigna digitalradiosystemet DAB även i sin nya form +.** ”

Kilde:

<http://www.sr.se/sida/artikel.aspx?programid=1012&artikel=3132830>

I **Tyskland** har DAB lenge slitt i kraftig motvind, til tross for omfattende utbygging av DAB-nettet har ikke lytterne villet kjøpe DAB. Som en følge av den sviktende markedspenetrasjonen legges nå det mest omfattende DAB-tilbudet ned i Tyskland. Tyske politikere har flagget en rask overgang til DAB+

”Den tyska public service-radion [Deutschlandradio](#) legger ned sina DAB-sändningar, rapporterar [Radioszene](#).

Avtalet med distributionsbolaget Media Broadcast har redan sagts upp och de rikstäckande digitala sändningarna kommer att tystna vid årsskiftet. Deutschlandradio började sända DAB 1999 och sedan 2004 kan 85 procent av tyskarna ta in de digitala sändningarna.

Kilde:

<http://radionytt.se/nyheter/?p=2473>

Sveits har valgt DAB +, **Polen** tester ut DAB+, **Italia** tester ut DAB+, og **Tsjekkia** har besluttet DAB+, **Frankrike** går for DMB. **Nederland** har sagt kategorisk nei til DAB. Spania har feilet med sin DAB-satsing og vil nå teste DAB+

Det må kunne slås kategorisk fast at DAB er på sterkt vikende front. I hele Europa og også i resten av verden. Skal Norge satse på en allerede utdødde standard er man nødt til å feile og hele radiomediet kan bli varig svekket. Dette vil igjen kunne sette NRKs posisjon i fare. At NRK selv ikke er bekymret for dette overrasker IKT-Norge. IKT-Norge er derfor meget overrasket over at NRK tilsynelatende ønsker å tviholde på den

utdaterte DAB-standarden , til tross for markedets dom, og utviklingen i Europa for øvrig.

DAB har i dag få om noen fordel fremfor FM at forbrukerne vil oppleve en tvangsstegning til fordel for FM som et grovt overgrep. Mange av de funksjoner som DAB har, finnes i dag allerede i FM. Problemet er bare at NRK ikke har tatt i bruk disse funksjonene som ligger RDS-teknologien. Bl.a visning av meldinger på radioens display, sangtitler og programtitler m.m. Lyden i DAB har til tross for markedsføring at DAB er digital lyd i CD-kvalitet vist seg å være langt dårligere enn hva tilfellet er på en FM-stereo mottaker. Skal man lykkes med å innføre digitalradio med begeistring må forbrukerne få noe som er bedre enn det de har i dag. Det får forbrukerne først og fremst gjennom DAB+

Den nye DAB+ standarden har en rekke fordeler fremfor den gamle DAB-standarden og Norge bør etter IKT-Norges mening så raskt som mulig ta en beslutning i favør av DAB+ og fastsette en konkret slukkedato for FM. Utviklingen vil være innen DAB+ og ikke innen den gamle DAB-standarden som stadig flere forlater. 2018 bør være en rimelig målsetting for slukking av FM-båndet. Men det må igjen være avhengig av at befolkningen har gått til anskaffelse av radioer som er kompatible med den nye radiostandarden.

IKT-Norge er svært opptatt at vi må ta en klar beslutning på fremtidens digitale radiostandard før vi fastsetter en eventuell slukkedato av FM. Uten en avklaring på standard vil forbrukerne leve i en stor grad av usikkerhet som vil gjøre digitaliseringsprosessen usikker.

IKT-Norge mener at Norge bør satse på DAB+ som fremtidens digitale radiostandard. Vi har tidligere sammenlignet DAB mot DAB + i rapport skrevet for IKT-Norge av den anerkjente radioanalytikeren Steve Green. DAB+ er DAB overlegen, og den gode nyheten er at det ikke er veldig kostandskrevende for NRK å oppgradere sitt eksisterende DAB-nett til DAB+. De digitale radioer som norske forbrukere har kjøpt vil imidlertid ikke kunne brukes, det haster derfor med en avklaring før enda flere forbrukere bokstavelig talt kjøper katta i sekken. En annen klar fordel med DAB+ er at de enkelte kanaler kan sendes med langt bedre båndbredde enn hva tilfellet er med DAB. Tilgangen på frekvenser vil også sikre oss muligheten for langt større mangfold i eteren, ved at det blir plass til langt flere radiostasjoner både i regi av NRK , andre riksdekkende aktører og lokalradioer. Samtidig er vi av den formening at ingen radiostandard på sikt vil få en like lang levetid som det FM har hatt. Internettbasert radio, satellittradio vil i hjemmene ganske raskt utfordre digitalradio. Direktør Preben Mejer ved Innovation Lab i Danmark uttaler til "Børsen" 22 september 2009 at: " DAB er et gigantisk feilskud." Preben Mejer uttaler videre: " Ligesom almindelig telefoni er blevet en av mange applikationer på internet, så vil det samme ske med radio. DAB kan bli en fejlsatsing av dimensioner. Mejer trekker frem mobilnettet som fremtidig bærer av radio til f.eks mottak i bil. 4G også omtalt som LTE vil i følge Innovative Lab ha nok båndbredde til å kunne være bærer av radiosignaler.

Konklusjon:

Det er ingen tvil om at radiomediet vil bli digitalt. Men klok av skade bør nå Norge velge en standard som flertallet av Europa vil gå for.

FM må ikke slås av før et endelig og fremtidsrettet valg er tatt.

Det foregår så mye utvikling nå, bl.a innen mobilteknologien, at det er uklart i hvor stor grad et nasjonalt sendenett for radio vil være den prefererte radiobærer.

DAB er definitivt feil valg som fremtidens radio og forbrukerne må nå få klar melding om at det ikke er fremtidsrettet å kjøpe DAB-radio nå.

Dersom Eureka 147 skal benyttes (distribusjonsstandarden for DAB/DAB+) til et nasjonalt sendenett for å erstatte FM må DAB+ velges.

Oslo, 4.10.09

Per Morten Hoff

Generalsekretær

IKT-Norge

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DAB or DAB+ - which is best for the future of digital radio in Norway?

Steven Green
20th April 2009

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Summary

DAB uses old technologies, which make it inefficient and expensive to transmit. Countries using DAB have chosen to launch new digital-only stations to drive sales, but due to DAB being an inefficient system the broadcasters had to reduce the audio quality of existing stations to below the quality provided on FM in order to allow these new stations to launch. Because of its drawbacks, the WorldDMB Forum decided to upgrade the DAB system in 2005, and in the following year it unveiled DAB+. Compared to its predecessor, DAB+ makes it affordable for broadcasters to deliver high audio quality; 2 – 3 times as many stations can be carried; it provides far more robust reception quality; and it is 3 – 5 times cheaper to transmit.

Germany, Italy and Australia are planning on launching digital radio using DAB+ over the coming year, and DAB+ services were launched in Switzerland and Malta last year. Next year, France will launch digital radio using DMB, which is very similar to DAB+, but it enables radio stations to broadcast video alongside the audio. To cater for digital radio being launched in these countries, manufacturers are installing new chipsets in existing DAB receivers to enable them to receive all of the DAB, DAB+ and DMB standards. New receiver models are also being designed.

Optimistic projections about DAB receiver sales doubling in Norway each year have failed to materialise, and annual sales actually fell by around one third in 2008. The uncertainty over how long it will take for DAB to be installed in a sufficiently high percentage of cars to allow FM to be switched off means that setting a switch-off date now would be pure guesswork, which could be inaccurate by as much as 5 – 10 years. Setting an FM switch-off date also does nothing to address the underlying problems that are holding back DAB sales.

Therefore, until this picture becomes clearer, it is recommended that the focus should be on making digital radio a more attractive proposition to consumers. One of the main issues holding back DAB sales in Norway is the lack of commercial stations broadcasting on the platform. To make it easier for commercial stations to launch on digital radio, it is recommended that commercial broadcasters should be allowed to launch their stations using the DAB+ standard, because it is up to five times cheaper to transmit using DAB+ than it is using DAB. It is also recommended that NRK migrates its stations over to using DAB+ over the next few years, as this will allow its stations to broadcast at high audio quality, and it would free-up enough capacity to allow the launch of new radio or data services, or video can be transmitted alongside the audio on NRK's most popular stations using the DMB standard. By reducing stereo DAB services to mono, it is possible to launch DAB+ versions of the same stations in the freed-up capacity. This would provide backward compatibility for non-upgradeable DAB receivers, and the DAB+ services would provide higher quality than originally.

Due to the popularity of on-demand (listen again) Internet radio services and the expectation that 80% of DAB radios will include Wi-Fi Internet connectivity in five years' time, it is also recommended that on-demand services form a key part of any plans to make digital radio more attractive to consumers.

1. DAB

The DAB system was designed in the late 1980s, and its main goals were to deliver high audio quality and unimpaired mobile reception even when travelling at high speed. The technology that lies at the heart of the DAB system is the MP2 audio codec, which delivers high audio quality at high bit rate levels (192 kbps and above). By today's audio coding standards, MP2 is a very inefficient audio codec, and this also makes DAB a very inefficient system, because it is only able to carry a low number of stations on a multiplex at high quality, as shown in Table 1.

MP2 bit rate level kbps	Audio quality ^{1,2}	Number of stations per DAB multiplex ³
224	Equivalent to or better than FM	5
192	Equivalent to or slightly worse than FM	6
160	Significantly worse than FM	7
128	Much worse than FM	9

1. Good reception quality on both DAB and FM is assumed.
2. This assumes the radio station carries audio that is complex to encode – speech stations and some music genres require slightly lower bit rate levels to deliver the audio quality levels listed above.
3. Assuming the use of error protection level PL3, as used in Norway

Table 1. MP2 audio quality levels relative to FM

When DAB was being designed the efficiency of the system wasn't a problem, because there were few FM radio stations broadcasting at the time. Since then, however, a large number of new FM stations have launched across Europe, and countries that have adopted DAB have chosen a strategy of launching new radio stations that are exclusively available on digital radio in order to drive DAB take-up. This has resulted in the DAB system being expected to carry a much larger number of radio stations than it was originally designed to accommodate.

1.1 Audio quality

Broadcasters in countries such as the UK, Denmark and Norway have chosen to address the problem of DAB having to carry a higher number of stations by reducing the bit rate levels used so that more stations can be carried on each DAB multiplex. For example, the standard bit rate for stereo radio stations on DAB used to be 192 kbps, but most stereo stations on DAB in the countries mentioned above are now using 128 kbps, and the audio quality of these stations is considerably worse than on FM as a result – cf. Table 1.

DAB broadcasters often say that the audio quality on low bit rate DAB stations is adequate. However, if listened to on even modestly priced hi-fi systems, FM clearly provides much higher audio quality than low bit rate DAB stations do. For example, when the audio signal is difficult to encode – such as when there are multiple instruments playing simultaneously – the sound of a low bit rate DAB station becomes very dull and muffled. These problems are most evident on music containing electric guitars and classical music, and these effects are purely the result of using the MP2 audio codec at too low a bit rate level.

The MP2 audio codec is also used to encode the audio for digital TV channels and radio stations broadcasting on the DVB digital TV systems. However, the vast majority of TV channels do use MP2 at high bit rate levels – for instance, the BBC uses a bit rate of 256 kbps for the MP2 audio on its BBC1, BBC2, BBC3 and BBC4 TV channels, and a bit rate of 192 kbps for the BBC News channel. And the German radio broadcaster ARD uses a bit rate of 320 kbps MP2 for the 54 radio stations it broadcasts on digital satellite. Broadcasters simply would not waste transmission costs or capacity by transmitting audio streams at these higher bit rate levels unless they considered there was a benefit in doing so.

1.2 Transmission costs

The efficiency of a digital radio system directly affects the transmission costs each station has to pay, because the higher the number of stations that can be carried on a multiplex the lower the costs will be for each station, and vice versa. DAB being an inefficient system therefore also means that it is very expensive to transmit. Figure 1 shows the cost of transmitting a radio station on a typical UK local DAB multiplex at different bit rate levels, along with how much it costs to transmit the same station on FM. DAB's very high transmission costs are another factor that has contributed to stations choosing to reduce the audio quality level, because some stations have chosen to use lower bit rate levels in order to save money.

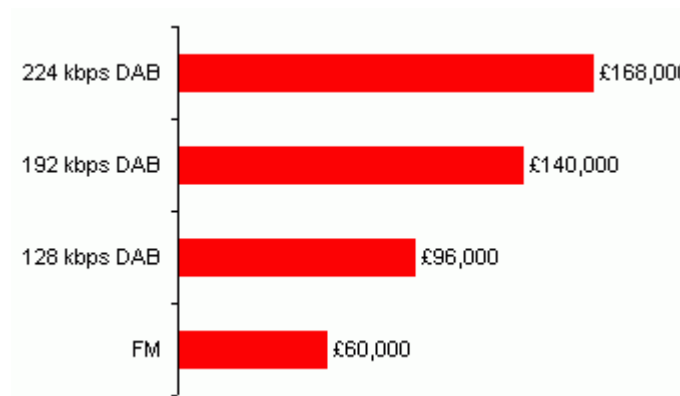


Figure 1. Annual transmission costs per station for local radio stations on DAB and FM in the UK [1] (£1 = 9.9 Norwegian Kroner)

1.3 Reliability

The error correction coding that DAB employs to provide reliable reception quality is poor, and in practice this means that listeners hear an annoying sound that is often referred to as 'bubbling mud' when the signal being received isn't strong. Poor reception quality is a common complaint amongst DAB owners. Such reliability problems can be overcome by increasing the transmission powers, but this comes at the expense of increasing the transmission costs.

2. DAB+

Due to complaints about the DAB standard using outdated technologies from broadcasters, regulators and governments in a number of countries, and the threat that these countries would choose to use one of the new and much more efficient mobile TV systems instead, the WorldDMB Forum chose to upgrade the DAB system in 2005, and the new DAB+ standard was unveiled the following year. The main goals when designing DAB+ were that it should solve DAB's efficiency problems, and it should allow DAB+ stations to broadcast alongside DAB stations on existing multiplexes, as this would allow broadcasters to continue using existing DAB transmission networks.

DAB+ provides the following advantages compared to DAB:

- High audio quality can be delivered affordably
- 2 – 3 times as many radio stations can be carried on a multiplex, thus providing greater choice for listeners
- Transmission costs per station are 3 – 5 times lower
- Reception quality is far more robust
- Less spectrum is required
- Stations can deliver surround sound at low additional cost

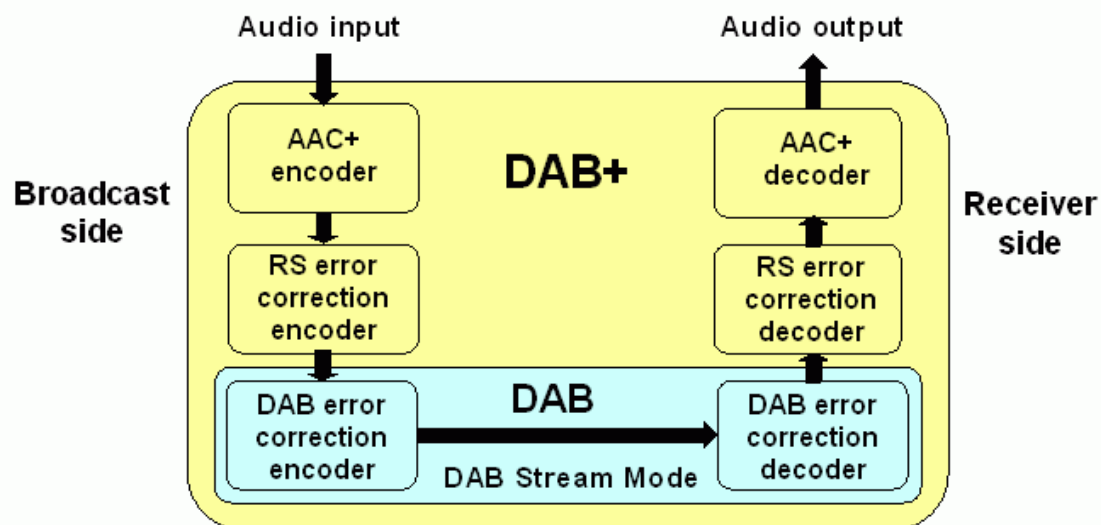


Figure 2. DAB+ system block diagram

DAB+ solves DAB's efficiency problems by employing the HE-AACv2 (High-Efficiency Advanced Audio Coding version 2) audio codec, which is better known by its brand name 'AAC+'. AAC+ is the most efficient audio codec available today. DAB+ also uses 'Reed-Solomon' error correction coding to make reception quality far more robust than on DAB. As shown in Figure 2, DAB+ services are broadcast on the original DAB system, and this enables DAB and DAB+ stations to transmit side-by-side on the same multiplex. The WorldDMB Forum has also ensured that existing data services that are available for DAB services, such as traffic announcements and

scrolling text, are also available for DAB+ services, and it has set up a taskforce to add the MPEG-4 BIFS standard to allow interactive graphics to be transmitted alongside the audio.

2.1 MPEG Surround

DAB+ makes the new MPEG Surround multi-channel audio format available. This technology enables surround sound to be delivered using bit rate levels as low as 5 kbps, which allows broadcasters to deliver an enhanced service at low additional cost. MPEG Surround is expected to be of most benefit to in-car listeners, as many cars contain speakers positioned both at the front and to the rear of the driver.

2.2 DAB versus DAB+

2.2.1 Efficiency

Table 2 summarises the efficiency of DAB+ relative to DAB by comparing, in a like-for-like manner (appropriate AAC/AAC+ bit rate levels are chosen so that DAB and DAB+ stations provide the same level of audio quality), the number of stations that can be carried on a multiplex using the two standards.

DAB bit rate kbps	DAB+ bit rate ¹ kbps	Number of DAB stations per multiplex	Number of DAB+ stations per multiplex	Efficiency of DAB+ relative to DAB
224	120	5	9	1.8
192	96	6	12	2
160	64	7	18	2.6
128	40	9	28	3.2

1. The DAB+ bit rate is approximately 10% higher than the AAC/AAC+ bit rate due to the overhead of the Reed-Solomon error correction coding.

Table 2. Efficiency of DAB+ relative to DAB [2]

2.2.2 Transmission costs per station

Results from field trials have shown that the Reed-Solomon error correction coding used for DAB+ allows multiplexes carrying DAB+ services to be broadcast with power levels that are 37 – 50% (2 – 3 dB) lower than that required to transmit DAB multiplexes. Using the approximation in [4] that multiplex transmission costs are proportional to the transmission powers, this means that the total transmission costs for a DAB+ multiplex would be reduced by 37 – 50% relative to the cost of transmitting a multiplex carrying DAB services.

Using the lower figure of 37%, and combining this with the efficiency of DAB+ relative to DAB, Table 3 estimates the reduction in transmission costs per station by switching from using DAB to DAB+.

DAB bit rate	DAB+ bit rate	Efficiency of DAB+ relative to DAB	Reduction in multiplex transmission costs by using DAB+	Ratio of DAB to DAB+ transmission costs per station	Reduction in transmission costs per station by switching to DAB+
kbps	kbps				
224	120	1.8	37%	2.9	66%
192	96	2	37%	3.2	69%
160	64	2.6	37%	4.1	76%
128	40	3.2	37%	5.1	80%

Table 3. Estimate of reduction in transmission costs per station by switching from DAB to DAB+

Table 4 shows how the above reduction in transmission costs affect the cost of transmitting UK local stations on DAB that were given in Figure 1 above.

DAB bit rate	DAB+ bit rate	Annual transmission cost per station using DAB	Reduction in transmission costs by switching to DAB+	Annual transmission cost per station using DAB+
kbps	kbps			
192	96	£140,000	69%	£43,400
128	40	£96,000	80%	£19,200

Table 4. Estimate of DAB versus DAB+ transmission costs per station (£1 = 9.9 Norwegian Kroner)

3. DMB

The DMB (Digital Multimedia Broadcasting) standard allows broadcasters to transmit radio stations that consist of audio-only, audio with synchronised video, or audio with synchronised interactive graphics (graphics streams use the MPEG-4 BIFS standard), and France has chosen to adopt DMB as its digital radio system due to its superior multimedia capabilities.

DMB is very similar to DAB+, because it is also an upgrade of the original DAB system that has employed the AAC+ audio codec to provide higher efficiency, and Reed-Solomon error correction coding has been adopted to make the reception quality more robust. DMB also supports the MPEG-4 H.264 codec for video.

Although DMB is more flexible regarding the combinations of media streams it can carry, DMB is less efficient than DAB+ at carrying audio-only streams. The reason for this is that DMB uses more data for ‘overhead’ than DAB+ does, as shown in Figure 3 below, and this reduces the bit rate available to carry the audio stream, as

shown in Table 5 below. This is equivalent to saying that DMB provides lower audio quality than DAB+, or that it is more expensive to transmit a radio station on DMB.

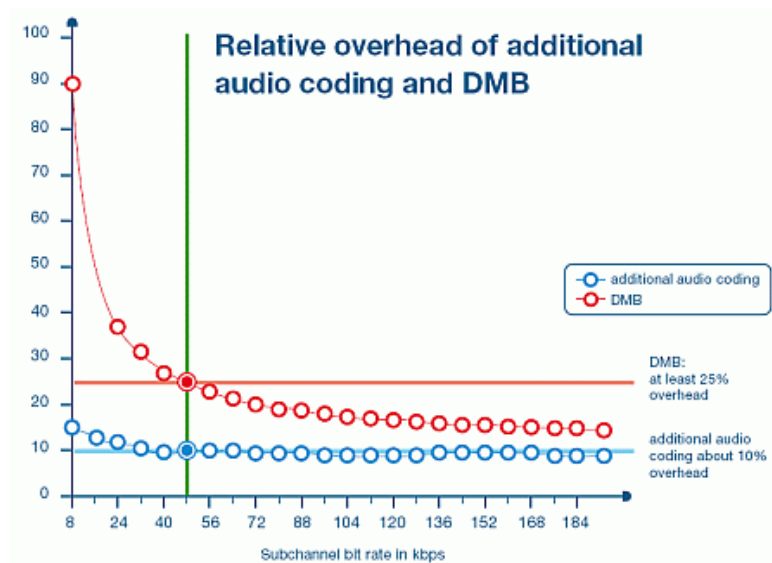


Figure 3. DMB versus DAB+ percentage overhead (DAB+ is referred to as “additional audio coding” in the figure) [3]

	DMB	DAB+	DMB	DAB+
Sub-channel bit rate	48 kbps	48 kbps	136 kbps	136 kbps
Overhead	25%	10%	16%	10%
Overhead bit rate	12 kbps	4.8 kbps	21.8 kbps	13.6 kbps
Bit rate available for audio	36 kbps	43.2 kbps	114.2 kbps	122.4 kbps

Table 5. The effect of overhead on audio stream bit rate

Because of DMB’s higher overhead, it is recommended that audio-only services should use DAB+. Also, the WorldDMB Forum is currently working on allowing MPEG-4 BIFS interactive graphics streams to be delivered alongside DAB+ services. Once that has been implemented, DMB should only be used for services that carry video alongside the audio.

To give an indication of the total bit rate levels required for DMB radio stations that include video streams: If a bit rate of 87 kbps were used for a radio station’s audio stream and 35 kbps for the video stream (35 kbps was a typical bit rate level used for video on a DMB trial in France), the total bit rate for the DMB radio station would be in the region of 165 kbps after taking into consideration the average overhead of 36% (the overhead is higher for audio-video streams than it is for audio-only services).

4. Digital radio receivers

4.1 WorldDMB Receiver Profiles

The WorldDMB Forum published a set of Receiver Profiles [9] in September last year, which consist of a list of required and recommended features for different classes of receivers. One of the main aims of the Receiver Profiles was to ensure that all new digital radio receivers would be able to receive the DAB, DAB+ and DMB standards, so that devices would work in any country that had adopted one of these standards. The ability to sell the same receiver models in any country using one of these standards will also deliver economies of scale for manufacturers, which should drive down receiver prices over time.

The Receiver Profiles use a hierarchical approach where higher profile receivers include all of the features supported by lower profile receivers, plus additional features are added. A brief overview of the three Receiver Profiles is given in Table 6:

Profile	Receiver type	Description
Profile 1	Standard	Mass-market audio receiver with a basic alphanumeric display.
Profile 2	Rich Media	Audio receiver with a colour display; ability to receive and display multimedia services ranging from still pictures to interactive graphics and text – e.g. picture slideshow, MPEG-4 BIFS, electronic programme guide etc.
Profile 3	Multimedia	A multipurpose receiver with a colour screen display, also capable of rendering video using the MPEG-4 H.264 video format.

Table 6. Overview of WorldDMB Receiver Profiles

4.2 DAB+ receiver availability

There are a wide range of DAB models available, but most of these models don't support DAB+ or DMB. However, manufacturers are currently in the process of installing new chipsets into existing DAB models so that they support all three standards as well as designing new models in time for the launch of digital radio using DAB+ and DMB in a number of countries – such as Australia, France, Italy and Germany – over the next twelve months.

In order to allow receiver manufacturers to switch existing DAB-only models over to supporting all three standards, Frontier-Silicon, which has a 70% share of the DAB chipset market, has produced new DAB/DAB+/DMB receiver modules that can simply be slotted-into existing models without requiring the manufacturers to carry out any redesign work – Figure 4 below shows Frontier-Silicon's DAB module roadmap. One of these new modules, the Venice 7, has been cost-optimised to allow manufacturers to produce DAB/DAB+/DMB receivers at the same cost as producing

DAB-only models. As the higher manufacturing cost of producing models that support DAB+ was holding the manufacturers back from launching models that supported the new standard, this development is expected to lead to a rapid increase in the number of models that support DAB+, and all digital radios on sale are expected to support all three standards within the next couple of years.

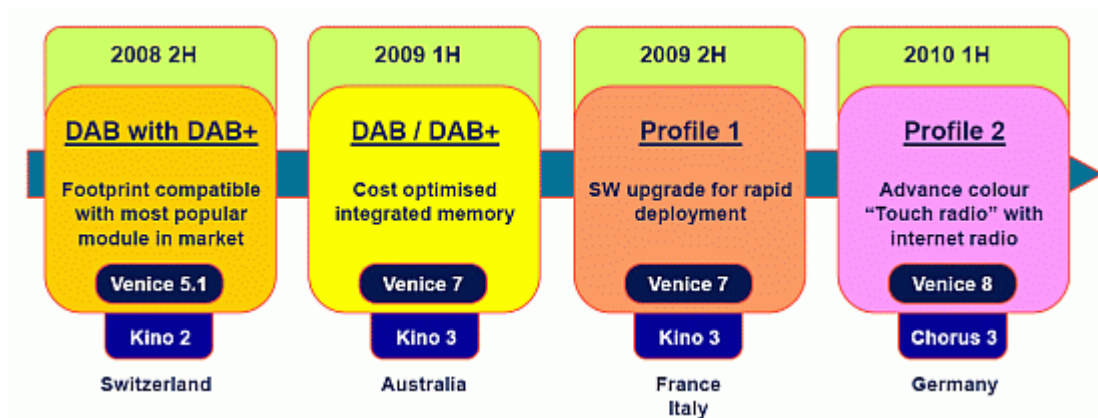


Figure 4. Frontier-Silicon DAB/DAB+/DMB module roadmap

4.3 In-car DAB/DAB+

The most difficult challenge that needs to be overcome before FM could be switched off will be to get DAB/DAB+ receivers installed in a sufficiently high percentage of cars. The reasons why this process will be so difficult are as follows:

- It takes twelve years to replace all of the cars that are on the road at any given time [8]
- It takes an average of four years for a new model of car to go from the beginning of the design stage to it actually rolling off the production line [8]
- It is expensive to fit after-market car stereos in modern cars because the stereo is typically built-into the dashboard of cars as an anti-theft measure – this high deters people from installing new car stereos
- The only alternative way of getting DAB/DAB+ inside cars is to use a DAB/DAB+ in-car adaptor, such as the Pure Highway, but this involves trailing wires around the car to supply power to the unit and to act as an aerial – a high proportion of people will not find this solution acceptable

Because of the last two points above, and assuming that the broadcasters and Government would only want to switch off FM once a high percentage of cars are able to receive DAB/DAB+ broadcasts, the date when FM could be switched off will effectively be determined by the speed at which new cars are sold in Norway, as well as by the time it takes the car manufacturers to begin fitting DAB/DAB+ car stereos as standard. The length of time this process takes is very likely to be the limiting factor for when FM could be switched off.

5. DAB, DAB+ & DMB adoption in Europe

DAB is being transmitted in a large number of countries, but with the exception of the countries listed in Table 7, DAB sales elsewhere have been very low or non-existent.

Country	DAB receiver sales '000s	Population million	Date updated
UK	8,530	60.6	29/1/2009
Denmark	750	5.5	23/6/2008
Germany	546	83	16/1/2009
Norway	230	4.8	9/7/2008
Switzerland	120	7.5	14/10/2008

Table 7. Total DAB receiver sales [Source: WorldDMB Forum]

Table 8 below provides a summary of European countries where there has been recent activity and/or interest in using the DAB, DAB+ or DMB standards for digital radio.

Country	Status
Czech Republic	DAB+ is currently being trialled.
Denmark	Although Denmark has the second-highest DAB receiver sales after the UK, it is reportedly interested in using DAB+ and DMB as well [5].
France	<p>France is planning on launching digital radio using the DMB standard in 2010. France already has a large number of FM radio stations broadcasting, so rather than launching new digital-only radio stations to drive take-up, the French radio broadcasters have chosen to use DMB because of its ability to carry video and/or interactive graphics alongside the audio in order to enhance the listening experience.</p> <p>The French government has recently announced that all new radio receivers with the exception of car stereos must be able to receive digital radio by 1st September 2012, and this will be extended to all car stereo units in September 2013.</p>
Germany	<p>The sixteen German regional Governments (Länder) and the country's radio broadcasters have agreed to launch a nationwide DAB+ multiplex early next year, and a "Big Bang" promotional re-launch of digital radio is planned for Spring/Summer 2010. Capacity on the new national DAB+ multiplex will be shared between the public service broadcaster Deutschlandfunk and commercial broadcasters.</p> <p>DMB is also used in Germany for the 'watcha' DMB mobile TV service.</p>

Hungary	Hungary is trialling DAB+.
Italy	Italy has chosen to re-launch digital radio using DAB+ in the second half of 2009. There are currently 47 DAB+ services broadcasting in Italy, along with 6 ‘DMB VR’ (DMB Visual Radio) services.
Ireland	Ireland is the only country to have recently chosen to use the original DAB standard for digital radio. There are 10 DAB services broadcasting on one multiplex.
Malta	Malta was the first country to exclusively broadcast digital radio using the DAB+ standard when it launched commercially in 2008.
Sweden	In July 2008, the Swedish Radio and TV Authority (RTVV) submitted a report on the future of radio to the Minister of Culture recommending that DAB+ should be adopted in the country. Both commercial radio companies and Swedish Radio welcomed the conclusions made in the RTVV report [6], and the Swedish government is expected to consider whether to roll out digital radio using DAB+ next year.
Switzerland	<p>Despite being one of the few countries with significant DAB receiver sales, Switzerland has chosen to switch to using DAB+.</p> <p>The country’s first DAB+ multiplex launched in October 2008, and the Swiss public service broadcaster SRG-SSR has recently published a timetable (which is included in this report as Figure 8 below) to migrate its stations over to using DAB+ by the end of 2012.</p>
UK	The UK is the country with the highest DAB receiver sales, and because of that it remains committed to DAB. However, it is widely accepted amongst the UK radio broadcasters and the regulator Ofcom that the UK will migrate to using DAB+, and it is only a matter of when DAB+ services will launch rather than if. The commercial radio broadcasters are especially keen on using DAB+ because of its far lower transmission costs.

Table 8. Activity or interest in DAB, DAB+ or DMB in European countries

One of the benefits of all digital radio receivers supporting the DAB, DAB+ and DMB standards is that countries that haven’t yet expressed a preference towards one standard won’t have to make that decision, because the broadcasters in those countries will be able to choose which of the three standards best meets their needs. However, if recent interest is anything to go by then it is looking likely that DAB+ will go on to become the dominant digital radio standard across Europe.

6. Take-up of DAB in Norway & the UK

NRK's original projections were that DAB sales would double each year, and that total DAB sales in Norway would reach 1 million by the end of 2010. However, Figures 5 and 6 below shows that these growth projections were overly optimistic.

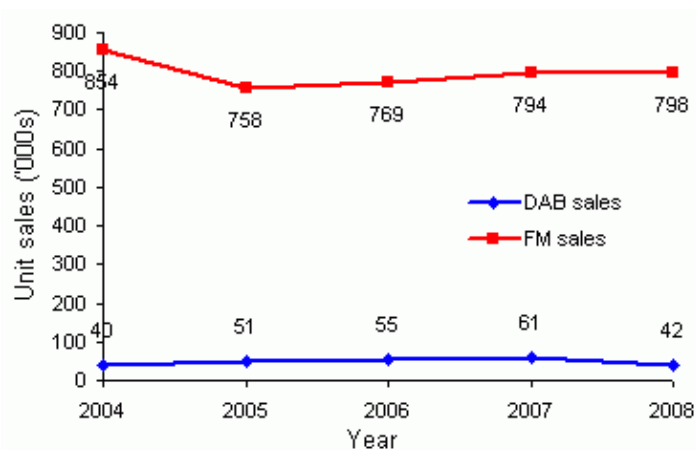


Figure 5. DAB versus FM annual device sales in Norway [Source: Elektronikkforbundet]

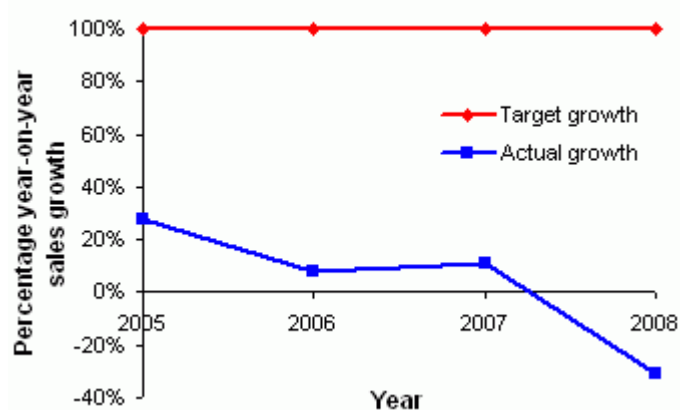


Figure 6. DAB year-on-year sales growth in Norway – target versus actual growth

The pattern of DAB sales growth in Norway bears a striking resemblance to the DAB sales growth in the UK, shown in Figure 7 below, albeit that the levels of growth are different in the two countries. There is certainly a clear downward trend in the sales growth in both countries, and as both countries have adopted the same strategy to drive DAB take-up of reducing the audio quality of existing stations so that new digital-only stations can be launched, it is worth stopping to consider whether this is the most effective strategy to take.

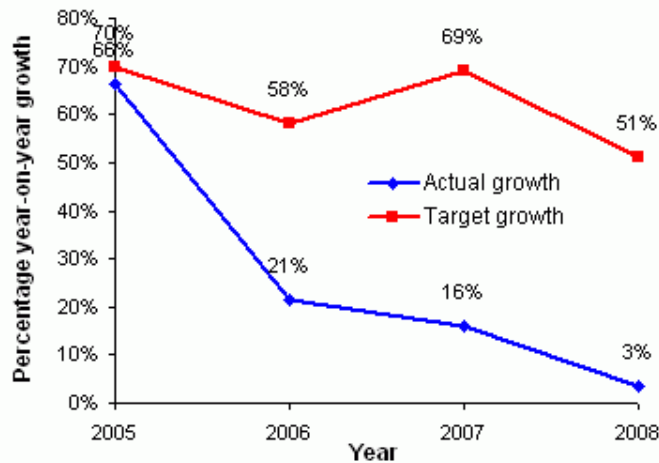


Figure 7. UK year-on-year DAB sales growth – target versus actual growth [10]

Using evidence from the UK, FM listeners listen to an average of approximately 2.5 stations each, whereas DAB owners listen to an average of 3.0 stations each. And despite there being a much larger number of radio stations available on DAB than on FM, DAB listeners in the UK spend approximately 75% of their time listening to stations that are also available on FM [7]. As listeners tend to carry on listening to their favourite FM stations once they've bought a DAB radio, this raises doubt over whether it was the right decision to reduce the audio quality of existing stations by as much as they have been, and that it would be appropriate to improve the audio quality of the most popular stations as this would provide the greatest benefit for the largest number of listeners.

The lower DAB sales growth in Norway compared to that in the UK is likely to be mainly attributable to the small number of commercial radio stations broadcasting on DAB in Norway, whereas commercial FM stations in the UK are available on DAB, and there are a few digital-only commercial stations as well. Another reason for the higher growth in the UK is likely to be due to the very high level of promotion that DAB has received in the UK, as the BBC has shown 21 high-impact TV advertising campaigns for DAB since 2002, and there have been a similar number of advertising campaigns for it on commercial radio as well.

Reasons given for the lower-than-expected DAB sales growth in the UK are that the audio quality isn't good enough, the reception quality is unreliable for many, and despite there being far more stations available on DAB than on FM, many consider that the breadth of choice available isn't actually very good, due to there being a lot of overlap between stations – for example, there are a number of stations that play rock music, and a number of stations that play classic rock, whereas less popular genres of music aren't catered for. Another school of thought regarding the issue of the additional choice required to drive sales is that more should be invested in programming so that the quality of the content that's exclusively available on digital radio should be higher than it has been up to now.

7. Internet radio

Due to the dramatic reduction in the price of Internet bandwidth over the last few years, it has become economically feasible for large broadcasters to deliver TV and radio content at high quality over the Internet. One such example of this is the BBC iPlayer service, which allows users to access TV and radio on-demand via their computers that's been broadcast over the past seven days, as well as offering live streams for all of the BBC's TV and radio channels. The BBC iPlayer has been a huge success with the public since its launch on Christmas Day 2007, and its success has led some people in the TV industry to predict that 40% of all TV viewing will be watched on-demand by 2013. Although radio is more likely to be consumed live than TV is, the next few years could see a dramatic shift towards on-demand consumption for radio as well.

Internet radio has a number of advantages over traditional broadcasting systems such as DAB/DAB+ when delivering content to home listeners:

- On-demand content can be delivered – broadcast systems are incapable of delivering on-demand content
- Higher quality than on DAB can be provided now due to streams being able to use modern audio codecs such as AAC/AAC+
- Higher quality than on DAB+ – or even the possibility of 'HD' radio – is possible in the future due to the exponentially falling price of bandwidth
- Unlimited choice – no restrictions due to spectrum availability
- Users can interact and provide feedback
- It is easy to deliver video or pictures alongside audio streams
- Radio can be personalised
- IP Multicast is likely to be supported in future, which would make the distribution of live Internet streams essentially free for broadcasters

Internet radio cannot fully replace broadcast radio systems at the present time, though, for the following reasons:

- DAB/DAB+ is freely available, whereas Internet radio requires people to subscribe to fixed or mobile broadband
- Broadcast systems are inherently more efficient and less expensive to distribute than mobile phone networks

7.1 Wi-Fi Internet radios

To cater for people who would like to listen to Internet radio on portable radio devices, a range of new 'Wi-Fi Internet radio' products have been released over the last couple of years, and the last year has seen the launch of new combined Wi-Fi / DAB radios. Wi-Fi Internet connectivity is also increasingly being added to other types of audio equipment, and this trend is set to accelerate due to the chief executive of Sony, Howard Stringer, announcing at the Consumer Electronics Show (CES) in Las Vegas earlier this year that 90% of all Sony products would be able to connect to the Internet by 2011, and Colin Crawford, the Director of Marketing at DAB radio

manufacturer Pure Digital, and Anthony Sethill, the chief executive of the DAB chipset manufacturer Frontier-Silicon, jointly predicted that 80% of all DAB products would have Wi-Fi Internet connectivity in 5 years' time.

8. Conclusions & Recommendations for DAB in Norway

The main recommendation is that Norway should plan to migrate existing DAB stations over to using DAB+ as soon as possible (see the 'DAB to DAB+ migration scenario' section below for a backward-compatible way to achieve this), and that commercial radio stations should be allowed to launch using DAB+ immediately.

Annual DAB sales in Norway have fallen well short of the 100% annual growth levels originally projected, and with sales actually falling by approximately one third last year, it is clear that important changes need to be made. However, NRK requesting that the Government should set a switch-off date for FM wouldn't have the desired effect of substantially increasing DAB sales today, because consumers ignore switch-off dates that are many years into the future. It would also be impossible to set a switch-off date today with any degree of accuracy, because it is impossible to predict when a sufficiently high percentage of cars would be able to receive DAB/DAB+ broadcasts, and this is very likely to be the limiting factor on when FM could be switched off. Attempting to set a switch-off date for FM would also divert work away from addressing the underlying problems that have led to DAB sales being so far below target.

Therefore, it would currently be better to focus on how to make digital radio a more attractive proposition to consumers, and the best way to achieve that would be by planning for a quick migration from using DAB to DAB+. One of the main problems holding back the take-up of DAB up to now will have been the lack of commercial radio stations broadcasting on DAB. Commercial broadcasters will inevitably be deterred from launching by the high cost of transmitting on DAB, especially at a time when there are downturns in the global economy and in the radio advertising market in particular. Therefore, as the transmission costs are up to five times lower when using DAB+ than they are on DAB, it is recommended that commercial radio broadcasters should be allowed to launch on digital radio using the DAB+ standard, as this would make it much more likely that they would choose to launch their stations on the platform.

Furthermore, NRK's five regional DAB multiplexes are full, and the bit rate levels being used for the stations are too low to deliver audio quality that's as good as on FM. Migrating NRK's DAB services over to using DAB+ would eventually allow all of NRK's radio services to broadcast with near CD-quality sound, and it would free-up enough capacity to allow the launch of new radio stations or data services, or the most popular stations could broadcast video alongside the audio using the DMB standard.

DAB sales are only in the region of 250,000 today, whereas there are estimated to be around 15 – 18 million FM devices in Norway. Therefore, considering that all digital radios on sale will support DAB, DAB+ and DMB in the near future, it is inevitable that the number of receivers that support DAB+ will outnumber those that don't

within a relatively short period of time (assuming that receiver sales will grow in future, of course), and eventually the number of DAB+ receivers will vastly outnumber DAB-only devices. It therefore makes sense to plan for a quick migration of services over to DAB+ so that broadcasters can take full advantage of the benefits that DAB+ offers as quickly as possible.

Due to the popularity of on-demand services amongst consumers and the increasing availability of audio devices that include Wi-Fi Internet connectivity, it is also recommended that on-demand services should play a key part in any strategy seeking to make digital radio more attractive to consumers.

9. DAB to DAB+ migration scenario

One possible way to migrate existing DAB services to DAB+ whilst maintaining backward compatibility with DAB receivers until NRK considers that it would be acceptable to switch the DAB services off completely would be to do the following:

1. Switch DAB stereo stations to mono and halve the bit rate level used
2. Launch a DAB+ stereo version of the same station in the freed-up capacity

As an example, the NRK P3 DAB service, which uses 128 kbps, could be reduced to 64 kbps mono, and a 57.9 kbps DAB+ stereo version of NRK P3 could be launched in the freed-up capacity.

This migration scenario provides a number of benefits:

- The new DAB+ stereo services would provide significantly higher audio quality than the original DAB stereo services due to the high efficiency of the AAC+ audio codec
- Owners of non-upgradeable DAB receivers would not lose any existing stations during the transition period
- The availability of higher quality DAB+ services should lead to higher receiver sales
- The large majority of DAB receivers sold to date are small portable radios, so this scheme would have no effect on the audio quality of single-speaker portable radios, and it would only have a minimal impact on the audio quality of portable radios with two speakers, because such receivers are incapable of reproducing a true stereo image

Figure 8 below shows the Swiss public service broadcaster SRG-SSR's timetable for migrating its services from DAB to DAB+, and NRK could follow a similar migration process for its stations, consisting of, for example the following two-stage plan:

1. Launch DAB+ versions of all NRK stations by the end of 2011 or 2012 using capacity freed-up by switching existing DAB stereo stations to mono (no DAB services would need to be withdrawn)

2. Start phasing out DAB services from 2013 or 2014 onwards to allow the bit rates of DAB+ services to be increased and/or to allow new audio/data/video services to be launched.

Jahr	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1. Layer										
DRS 1	Green	Green	Green	Green	Green	Green	Green	Green		
DRS 1						Orange	Orange	Orange	Orange	Orange
DRS 2	Green	Green	Green	Green	Green					
DRS 2						Orange	Orange	Orange	Orange	Orange
DRS 3	Green	Green	Green	Green	Green					
DRS 3						Orange	Orange	Orange	Orange	Orange
DRS Musikkwelle	Green	Green	Green	Green	Green	Green	Green	Green		
DRS Musikkwelle						Orange	Orange	Orange	Orange	Orange
DRS 4 News	Green	Green	Green	Green	Green	Green	Green	Green		
DRS 4 News						Orange	Orange	Orange	Orange	Orange
DRS Virus	Green	Green	Green	Green	Green					
DRS Virus						Orange	Orange	Orange	Orange	Orange
Radio Rumantsch	Green	Green	Green	Green	Green					
Radio Rumantsch						Orange	Orange	Orange	Orange	Orange
Schweiz Classic	Green	Green	Green	Green	Green					
Schweiz Classic						Orange	Orange	Orange	Orange	Orange
Schweiz Jazz	Green	Green	Green	Green	Green					
Schweiz Jazz						Orange	Orange	Orange	Orange	Orange
Schweiz Pop	Green	Green	Green	Green	Green					
Schweiz Pop						Orange	Orange	Orange	Orange	Orange
La Première	Green	Green	Orange	Orange	Orange					
Rele Uno	Green	Green	Orange	Orange	Orange					
WRD			Orange	Orange	Orange					
						SRG SSR 5.2.2009 (Änderungen vorbehalten)				

DAB stereo	Green
DAB mono	Light Green
DAB+ stereo	Orange
DAB+ mono	Dark Orange

Figure 8. SRG-SSR DAB to DAB+ migration timetable [10]

References

1. Email correspondence.
2. ETSI TS 102 563, Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio, v1.1.1, 2007, (the 'DAB+ standard')
3. 'DAB+, The additional audio codec in DAB', WorldDMB Forum
4. 'Broadcasting to Handhelds – an overview of systems and services', C. Weck & E. Wilson, EBU Technical Review, January 2006
5. 'Update on Denmark, Norway & Sweden', presentation slides by Jorn Jensen, NRK, April 2009
6. 'Radioföretagen positiva till digital radio: "Radion behöver fler kanaler"', <http://tinyurl.com/c7hc85>
7. 'UK Commercial Radio in numbers: Q4 2008', <http://tinyurl.com/csvqcg>
8. Phone conversation with representative from the Society of Motor Manufacturers & Traders (SMMT), UK, 2008
9. Digital Radio Receiver Profiles, WorldDMB Forum, 2008
10. 'Receiver Profiles and Broadcast Services', presentation slides by Thomas Saner, SRG-SSR, April 2009