making communications work
for everyone

Small scale DAB trials

Annex 3: Summary of technical feasibility studies on frequency planning

Research
Document

Publication date: 26 September 2016

Contents

Section 1

Summary of frequency planning studies

Frequency availability is key to deployment of small scale DAB

1.1 A key technical enabler of the current small scale DAB trials – and for any wider roll-out of small scale DAB in the future – is that a suitable quantity, and type, of transmission spectrum needs to be available for small scale use.

1.2 Work carried out for the DCMS Digital Radio Action Plan (DRAP) during 2011 indicated that coverage of the existing local DAB layer was interference limited (i.e. the coverage of a specific multiplex tends to be limited by interference from other multiplexes using the same frequency elsewhere) rather than being noise limited (i.e. where the coverage area extends to where the signal level drops below the level of noise inherent in receivers).

An initial study indicated that additional spectrum will be required

1.3 When small scale DAB was first being considered, it quickly became apparent that additional spectrum would be required to accommodate the new services. We therefore took the opportunity to carry out an initial study to identify the potentially available spectrum for small scale DAB in the Manchester area (which is an area where there is a high level of demand from community radio, and where changes to the frequencies used by the existing local DAB multiplexes were also being planned).

1.4 The purpose of the Manchester study was to quantify what spectrum was available, and how many small local and community services in digital form this spectrum resource might support. We assumed that existing transmission sites would be used, and that these would form a number of single frequency networks (SFNs). We found that, overall, fewer sites would be required for DAB than for analogue radio, although slightly higher powers were proposed from each site (50 or 100 watts ERP for DAB rather than the 25 watts ERP typically used by analogue community radio services).

1.5 Three blocks of spectrum were identified as being of potential use in the Manchester area, and these would have accommodated the existing analogue services. However, it was also apparent that these frequencies were the only ones available over a wider area which included Liverpool, Preston and Stoke-on-Trent, and that more spectrum would therefore be required to implement small scale DAB across the wider region.

Some spectrum in Band III is very lightly used at present

1.6 In order to facilitate the small scale DAB trials, Ofcom carried out separate technical work to identify whether additional spectrum could be made available. All modern DAB receivers are able to tune to a band of spectrum between approximately 174 MHz and at least 230 MHz (also known as blocks 5A to 12D) within VHF Band III, which is internationally allocated to broadcasting. With agreement from most neighbouring countries, the UK also uses Band III spectrum for private business radio services (also known as Private Mobile Radio, or PMR). These services were introduced to the band following the closure of the UK's VHF television services in the 1980s. In addition, other counties also use the band for other secondary services

such as Programme Making and Special Events (PMSE) equipment and Assisted Listening Devices (ALDs).

1.7 Band III was completely re-planned at the International Telecommunications Union regional planning conference held in Geneva in 2006 (Ge06). As part of this re-planning, the UK agreed not to seek protection of business radio services in a part of Band III known as 'sub-band II'. Business radio services are more vulnerable to interference than the DAB and digital terrestrial television (DTT) services which are already carried in these bands in neighbouring countries. Had the UK continued the use of business radio in both sub-band I and sub-band II, this would have impeded the implementation of digital broadcasting in mainland Europe. Following the conference, sub-band II business radio users in the UK were advised of the likely increase in interference and advised to migrate to sub-band I or to alternative spectrum.

1.8 Sub-band II is now very lightly used, and in 2015 Ofcom gave the remaining users notice to vacate the band within five years. This will make six further frequency blocks available for small scale DAB. However, we carried out a technical assessment which indicated that continuing use by business radio until 2020 will mean that parts of north west England and the English midlands will have limited access until remaining business radio services have migrated out. The sub-band II blocks could be supplemented by any available frequencies within the existing local DAB spectrum.

1.9 The figure below illustrates how the usage of Band III looked before the Ge06 conference, and how it might look in 2020.

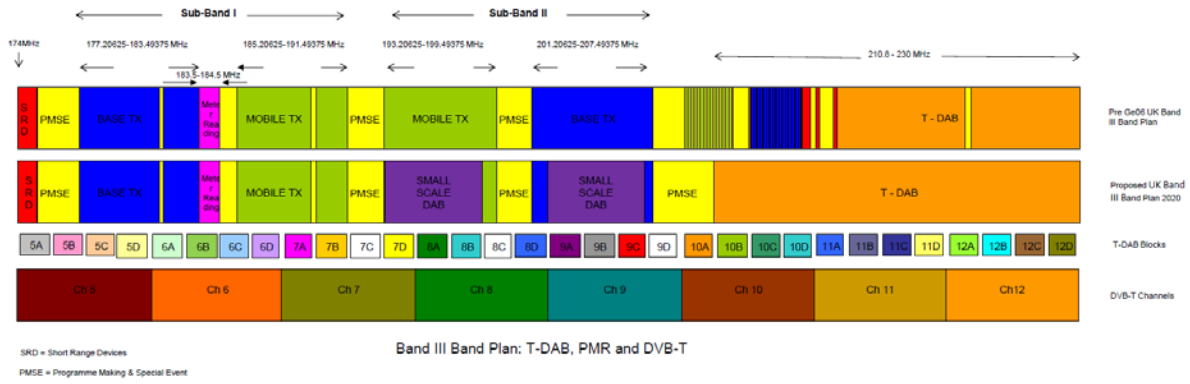

Figure A1: Plan of UK Band III usage

The additional spectrum could be suitable for small scale DAB, but would be subject to some constraints

1.10 As mentioned above, the UK has already partially vacated business radio from sub-band II in order to enable the roll-out of DAB and DTT in mainland Europe. Neighbouring countries therefore now have broadcasting allocations on these frequencies which have protected rights recorded in the Ge06 Plan. Consequently, any UK roll-out of small scale DAB will not be able to impede the implementation of these services in neighbouring countries.

1.11 The UK rolled out most of its existing DAB some years before neighbouring countries. The final requirements for DAB spectrum by Belgium, France, Ireland and the Netherlands are not yet fully known and may not be for several years. Where DTT in the VHF band was planned at Ge06, we now expect that these allocations will instead be used for DAB. It is within this changeable landscape that small scale DAB in the UK will need to be planned.

1.12 However, there is an increasing interest in small scale DAB in Europe, and this may provide opportunities to standardise usage in a particular part of the spectrum.

1.13 Based on neighbouring countries' existing Ge06 implementation rights and subsequent developments, we expect that the following areas could be subject to significant levels of interference (particularly to mobile DAB reception), on some or all frequency blocks in sub-band II:

- SW Scotland (Dumfries & Galloway, Ayrshire, Isle of Arran, Mull of Kintyre);
- Northern Ireland;
- West and north Wales;
- Southern & Eastern parts of England (including some or all of Cornwall, Devon, Dorset, Hampshire, the Isle of Wight, Sussex, Surrey, Kent, Essex, Suffolk, Norfolk & London).

1.14 While outside the scope of our technical studies, we expect similar issues on the Isle of Man and the Channel Islands.

1.15 Small scale DAB would need to be implemented on the frequency blocks which are available in each area on a case by case basis. However, as neighbouring countries' frequency plans evolve it is likely that some small scale DAB services could need to change frequency to accommodate this. They should be implemented in a technical manner that allows this.

1.16 When planning frequencies for analogue community radio, less restrictive planning parameters have been used than for local and national radio in order to maximise the number of services which can be provided. Ofcom believes that the same planning parameters already used for local and national DAB will also probably need to be applied to small scale DAB. However, for DAB there are two licensed coverage levels, classed as 'mobile' and 'indoor'. Within the indoor coverage zone, mobile coverage will also be available. Therefore, one option may be for us to plan and protect only indoor coverage. This would also allow more frequencies to be usable, particularly where interference from neighbouring countries is an issue.

Our second study concluded there would be sufficient spectrum to enable existing analogue services to move to DAB in most areas, although some areas of congestion remain

1.17 Ofcom carried out a second technical study (available as Annex 4[1]) to identify whether the six additional blocks of sub-band II spectrum might be sufficient to potentially provide a technical opportunity for existing analogue-only community and

[1] Annex 4, http://stakeholders.ofcom.org.uk/market-data-research/other/radio-research/ssdab-final-report

local radio services to be carried on DAB. Where this was not possible the study considered whether any available blocks within the existing local DAB spectrum could be used instead.

1.18 The study assumed that the analogue broadcasters' existing transmission sites would be used for small scale DAB, and found that:

- In all but a few locations six blocks of spectrum would be sufficient to create notional multiplexes which could accommodate all of the existing non-DAB services. The areas of congestion identified were:
  - North Somerset and south east Wales;
  - The east midlands of England (where no local DAB frequencies are available either);
  - Areas to the south of Manchester.
- Some additional benefit could also be gained by using the more efficient DAB+ coding, as more services could be carried on a single multiplex;
- Indoor coverage would generally be protected from interference; however mobile coverage would often be reduced during periods of enhanced propagation (such as high pressure weather conditions);
- Incoming international interference would be a significant issue in numerous locations;
- Using powers of up to 100 watts and directional transmitting antennas, robust indoor coverage could be achieved while keeping levels of outgoing interference to neighbouring administrations to generally acceptable levels;
- Overall fewer transmitters would be required for the notional digital multiplexes than for the individual analogue services they might carry.
- While potential nominal coverage areas were found for all of the existing analogue services, the study did not investigate the potential for small-scale DAB in areas where there are no existing community or analogue-only radio stations. Further research would be required in order to produce a plan which will allow small scale DAB to be implemented in all areas.

There are other issues that require further consideration when developing a plan for small scale DAB deployment

Interference to local and national multiplexes

1.19 New DAB transmitters have the potential to cause an effect known as 'adjacent channel interference' (ACI) or 'blocking' to reception of multiplexes which provide a service in the vicinity. In order to minimise this effect, the UK has endeavoured to co-site DAB services as far as possible. However, the different network topologies required for local and national services means this cannot always be achieved and in some cases mitigation measures are required. This mitigation is based on the premise that operator of the new multiplex resolves any issues, and mitigation is not applied retrospectively. Mitigation can be achieved in a number of ways, including:

- Site sharing, or the use of a site close to the ‘victim’ service(s);
- Moving the site to a location away from population and major roads;
- Moving the site to an area where the ‘victim’ service signal level is high;
- Adjusting transmission parameters (e.g. using lower powers or directional antennas)
- Providing a co-sited low power transmitter carrying the ‘victim’ service(s)

1.20 As any future small scale multiplexes are expected to have smaller coverage areas than existing multiplexes, the small scale transmitter network topologies would be different to their local and national counterparts, and this may lead to blocking issues. During the trials, low transmission powers were used, which helped to minimise these effects, and we didn’t find significant ACI issues at the 10 trial locations. This may have been due to the small scale trials all being located in areas where existing DAB signal levels are fairly high. However, it was noted that the trial services were sometimes impacted by the higher power transmitters used by existing national and local transmitters already operating within their service areas – this is an effect known as ‘reverse ACI’.

Further work

1.21 One complexity of the frequency planning process is how to define the area served by a multiplex and to identify those services which will be carried on it. Each analogue local or community service has a distinct service area derived from the transmission parameters it uses. In contrast, a DAB multiplex delivers the same coverage area to every service carried by it. To avoid disenfranchisement of analogue listeners, the digital coverage would need to extend to serve all of the analogue services carried by it. This may lead to an alteration of the original localness of the individual programmes carried. Significantly larger service areas could be achieved by carrying a service on geographically adjacent multiplexes. The study found that, in the majority of areas, frequency availability means that only one small scale DAB multiplex could be planned.

1.22 Due to the very limited number of frequencies available it would be very easy to allocate them all in the first sequence of licensing. This could mean that frequencies would not be available in adjacent areas for future small scale DAB services.

1.23 One way to avoid this would be to define a whole UK coverage plan identifying a frequency for all areas which could be pre-coordinated with neighbouring countries. The downside is that frequencies would be allocated to areas where no service operates.