

Background

DAB is a digital radio technology that was introduced to the UK in the late 1990s, offering a wide range of radio stations for listeners with compatible radios. In fact, the UK was the first country to have such a wide array of radio stations available on DAB. However, for small stations (and in particular, community radio stations), carriage on local/regional DAB multiplexes is prohibitively expensive. Anecdotal evidence suggests costs in the tens of thousands for carriage on a large region mux (service providers do not release their rate cards to the public, so these values are not widely available).

In 2013, an Ofcom engineer, Rashid Mustapha, published a research document detailing a new mechanism for the broadcast of DAB multiplexes. The success of this trial led to a decision by Ofcom to enhance the scope of this trial scheme – as a result, Ofcom invited applications from interested parties to apply to run these small scale DAB multiplexes (minimuxes). Switch Radio, along with 50 other applicants, applied for one of ten licences. In June 2015, Switch Radio was awarded one of these trial licences, one of only three community stations to do so. In September 2015, our multiplex went to air with 10 stations, with half of those stations being community stations (Black Country Radio, Ambur Radio, Big City Radio, Gaydio, Switch Radio).

During the course of our involvement with the trial, we have installed the hardware without external assistance and developed a suite of software solutions that have both saved stations money and pushed the multiplex's capabilities to the limit.

Installation

As part of the trial, Ofcom agreed to supply stations with the necessary equipment, but provided no support with its physical installation. Stations were also required, as part of the application process to provide a proposed transmission site, coverage aspirations and technical parameters. As a community radio station with a limited budget, we were not able to afford external engineers, so we set about performing the installation ourselves. The installation broken into a number of clear steps, the first of which was installing the networking.

Networking

Our station is housed in the ground floor of a residential block of flats, while our FM transmitter is located on the roof of the same building. We aimed to place the DAB transmission kit in the



Figure 1. Topcliffe House. Current FM transmitter visible on roof.

same location, so we placed a router on the roof, and wired 60 metres of CAT5e cabling down the dry riser, through the floor and into the basement (where our studios were located). We subsequently connected the terminal end of this connection into a main router in our server room, where we have primarily located the majority of the computer hardware.



Figure 2. Cabling installation. Top left: entry from roof to lift motor room. Top right, emergence point in ground floor basement. Bottom left: dry riser

Hardware installation

We next installed the hardware associated with the DAB multiplex. Firstly, we installed the antenna – this was located approximately 10 metres away from our FM transmitter. To raise the transmitter height, we mounted the antenna on a 5 metre metal pole. As this pole was too large to be transported to the roof without the need for pulleys and/or lifting equipment (which would add further expense), we used a technique known as *stitching* to transport the mast pole to the roof. In stitching, the larger pole is cut into two smaller pieces and ‘stitched’ back together by placing both ends inside a larger pole which acts as a sheath. Bolts and Nyloc Nuts are then used to securely hold the two ends together. The antenna was then connected via co-ax to the DAB filter unit, which itself was connected to the Transmission Amplifier (TX Amp). We then subsequently connected the TX amp a software defined radio, which generated the radio signal for transmission. All of the hardware installation work, including the stitching and cabling was performed by station volunteers without any assistance from external providers.

Software installation

Both Ofcom and the OpenDigitalRadio community provide support on the operation of the multiplex software. For the basic operation of the multiplex software, we referred to the guidance provided from both of these sources. In order to receive the audio from stations at

our mux site, we required the installation of a small linux-based encoder (Odroids) at the user end. However, it quickly became apparent that the use of the Odroids was not user friendly – for instance, if services wanted to check their audio was being transmitted, the Odroids had no built in way of showing this, other than connecting the entire kit to a HDMI monitor. It became apparent that a software based solution, specifically – a solution that could run on Microsoft Windows – would be much better received by smaller stations than the encoders which have no user manipulable options. Building such a solution also allowed us to provide access to advanced features for service providers that otherwise may not have been straightforward. The software we wrote for this purpose was called the SSDAB_Encoder; we distributed this for free to stations.

SSDAB Encoder

Through no fault of their own, some community (and smaller) stations do not have significant technical capabilities. When designing the software, we tried to make it simple to use and – in particular – easy to install. The full schematics for our solution are shown below.

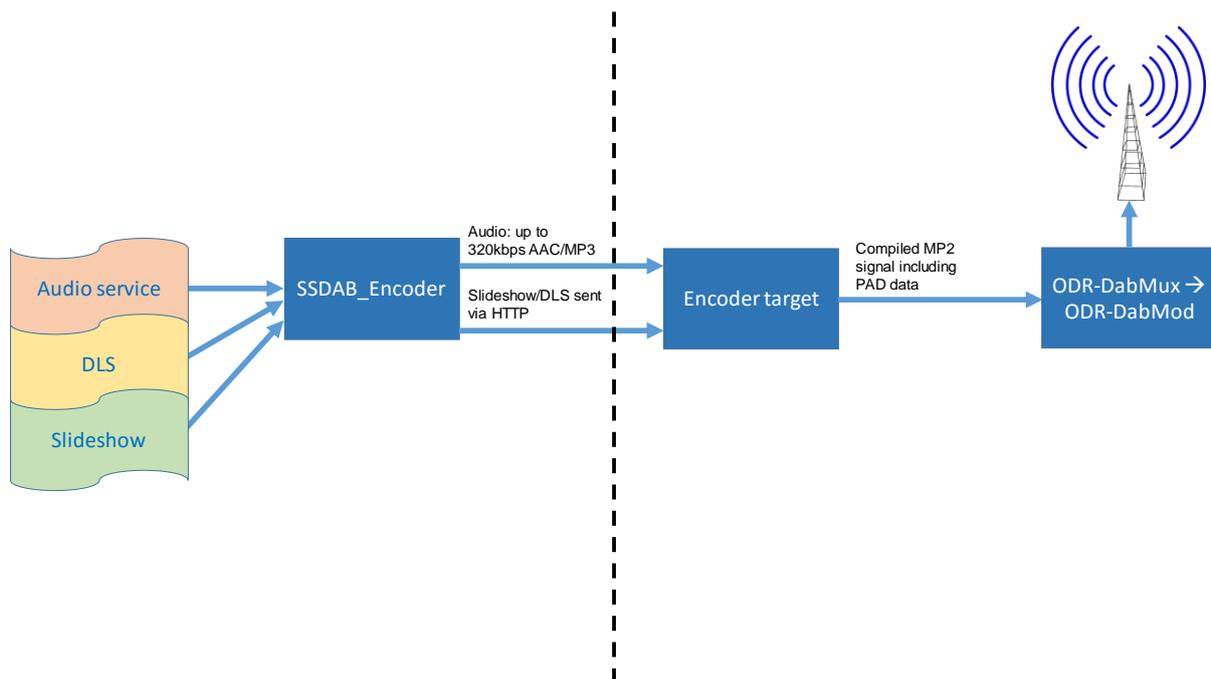


Figure 3. Schematic of the role of SSDAB_Encoder in the transmission chain for the Trial Birmingham DAB multiplex.

When developing the software, we spoke with the smaller stations to identify things that would be beneficial to help save them money, time and administrative burden. A number of things became apparent and we wrote these features into the software based on their feedback:

Audio processing

Audio processing is important for stations; poor audio processing can be quickly identified by listeners and is not something that should be left unconsidered for broadcast stations. However, it is well known that the audio processing parameters for FM and DAB are not the same. Worse still, some smaller stations (such as those making the transition from online to DAB) have no audio processing in place whatsoever. As a result, stations (including those involved in other SSDAB trials that *don't* use our encoder) have three choices: purchase a new audio processor for their DAB stream, use identical settings to their FM stream, or use unprocessed sound.

To provide a solution to this problem, we used a digital sound processing plugin, namely StereoTool and included this in the mixer chain to allow stations access to a high-end processing solution for their audio with the need to purchase additional expensive hardware. StereoTool takes the raw audio from the source, processes it, returns it to the encoder which subsequently transmits it to our multiplex. Stations with DAB audio processing facilities in place are able to turn off StereoTool processing.

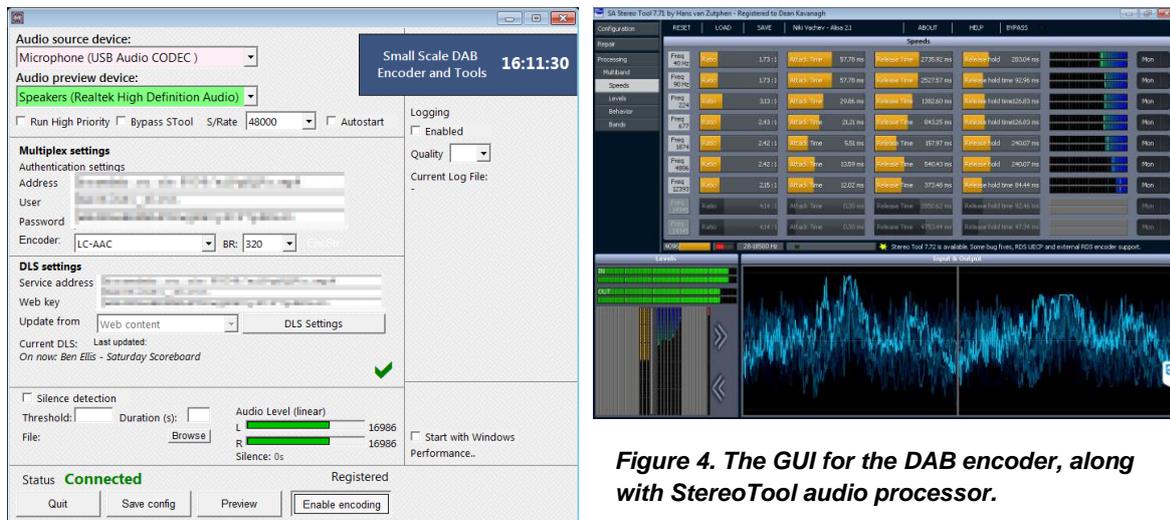


Figure 4. The GUI for the DAB encoder, along with StereoTool audio processor.

Silence Detection

Silence detection is a critical tool in any radio station's arsenal. While established stations may have hardware solutions (e.g. Sonifex RB-SD1), smaller stations may not have silence detection in place. We wrote this into the encoder such that if the source stream falls silent for a defined amount of time a backup audio file is played. Upon return of the source stream, the backup ceases to play and the encoder returns to sending the processed source audio to the multiplex. The silence detection built into the encoder gives station a solution that does not require expensive hardware solutions.

Logging

Logging is – at its most serious level – an important regulatory requirement for any Ofcom licenced station. The ability to log audio from the encoder is not a major concern for existing stations, who generally all have the ability to audio already due to their responsibilities to Ofcom. However, a number of the stations we took on board were making the transition from Internet only to a licenced Ofcom radio station. These services did not previously have any logging solution in place. The inclusion of this feature in the encoder saved these services the expense of purchasing a logging solution.

DLS and Slideshow

One of the advantages of our encoder is that we can update the encoder as required. With this in mind, we added the following features incrementally to the encoder:

- **DLS:** Dynamic Label Segment is the DAB equivalent of RDS in FM. In a subsequent release of the encoder we gave stations the capability to change their DLS string (the text shown on radios) themselves either manually, from their playout systems or from the web.
- **Slideshow:** In the most recent version of the encoder, we have given stations the ability to upload Slideshow images, utilising the ability of the platform to display graphics alongside text. An example of what this looks like is below.



Remote monitoring

Monitoring solutions for technology as niche as that involved in the small scale DAB trial are scarce, and it is critical that both us (as the operator) and the stations involved (as service providers), know about problems that may arise during the transmission of their streams. In order to provide this facility, we built a suite of monitoring tools that are specific to the small scale DAB trial. The solutions are written in PHP and are fully automated. Our solutions monitor both: 1) the state of the multiplex in general and 2) the status for each individual station on the multiplex. This information is available to all service providers 24 hours a day, so that they can

see in real-time the status of their contribution to the multiplex. We also offer full logging so that services can see the performance of their service over time. In order to ensure that stations are always aware of the state of play for their services, we also provide the facility for stations to receive emails an event occurs related to their service. Examples of the overview screen is below:

The screenshot shows the website interface for 107.5 Switch Radio. At the top, it displays the station's name and logo, along with the current program 'Ultimate Love Songs' and the time '10pm-1am'. There are navigation links for 'Listen Live' and 'Contact'. Below this is a menu with options like 'Schedule', 'Traffic', 'Listen Back', 'Photos', 'Scoreboard', 'Win!', 'Volunteer', 'Advertise', and 'About'. A weather widget shows 'Sunday - 21:00 BST: Sunny Intervals, 18°C (64°F)'. The main content area is titled 'Multiplex status:' and contains a table with the following data:

Service name	Status	Last Updated	Options
[1] Switch Radio		5/6/2016 18:26:18	View log Mark Manual on Mark Manual off
[2] Unity FM		5/6/2016 22:15:39	View log Mark Manual on Mark Manual off
[3] Touch		5/6/2016 10:19:16	View log Mark Manual on Mark Manual off
[4] Gaydio		3/6/2016 13:33:45	View log Mark Manual on Mark Manual off
[5] Scratch Radio		5/6/2016 10:14:16	View log Mark Manual on Mark Manual off
[6] L Greek Radio		28/5/2016 23:43:15	View log Mark Manual on Mark Manual off
[7] Black Country		5/6/2016 5:22:14	View log Mark Manual on Mark Manual off
[8] Ambur Radio		28/5/2016 23:43:17	View log Mark Manual on Mark Manual off
[9] Starpoint Radio		4/6/2016 21:54:56	View log Mark Manual on Mark Manual off
[10] Big City Radio		3/6/2016 6:57:44	View log Mark Manual on Mark Manual off

At the bottom of the page, there is contact information for the station, including the address: Lower Ground Floor, Topcliffe House, Hawkinge Drive, Castle Vale, Birmingham, B35 6BT. T: (0121) 749 1339. It also includes a disclaimer: 'Switch Radio is a non-profit company limited by guarantee, registered in England and Wales number 08438993. Registered address: as contact address.' and links for 'Competition terms and conditions', 'Presenter access', and 'Login'.

Overview

We believe that the way we have developed the additional tech behind the small scale DAB trial has both significantly improved the capabilities of the platform, and also given participating stations added value during their time in the trial. We continue to push the technology forward and push the boundaries of what we can offer stations.