

# A Reference Listening Room for 3D Audio Research

BBC Research and Development has recently invested in the refurbishment of one of its listening rooms. This room is designed to be used for listening tests conducted according to international standards, as well as research into immersive audio systems and object-based audio production.

## ACOUSTIC PROPERTIES

The acoustic treatment was designed to meet the requirements specified in ITU-R BS.1116 [1] for performing high quality listening tests. Measurements are shown with the specified tolerance curves where appropriate.

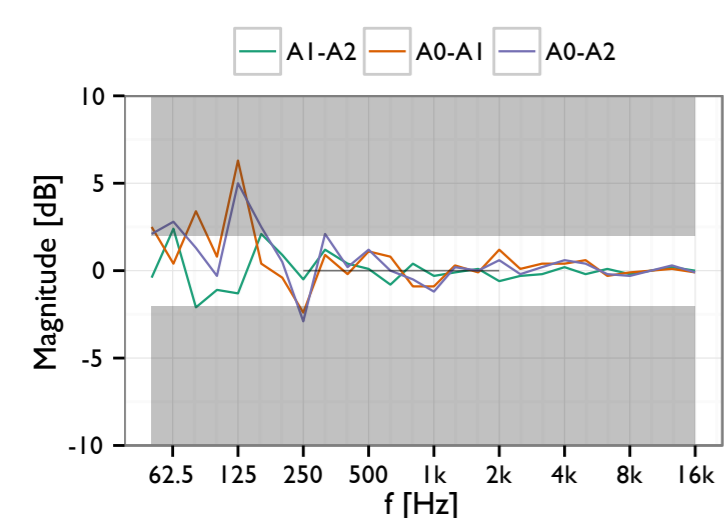
Two sets of acoustic measurements are shown:

**A** Positions from ITU-R BS.775 [2] using Geithain RL940 loudspeakers.

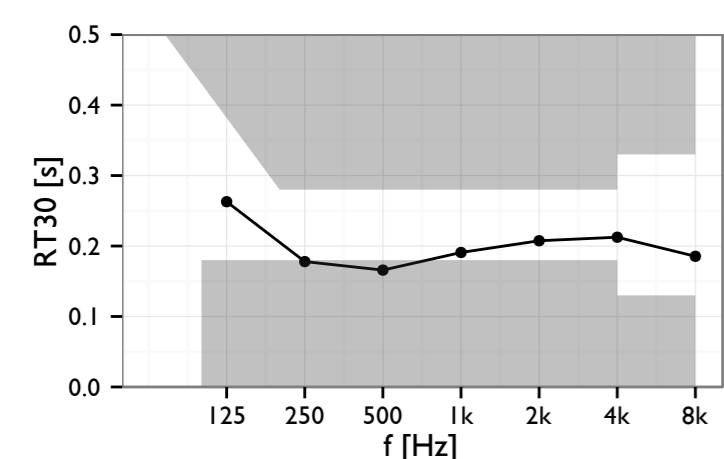
**B** Positions representative of those in an advanced sound system, using Genelec 8030B loudspeakers.

The room measures 5.05m × 5.63m × 2.88m; this meets the room proportion requirements as specified in [1].

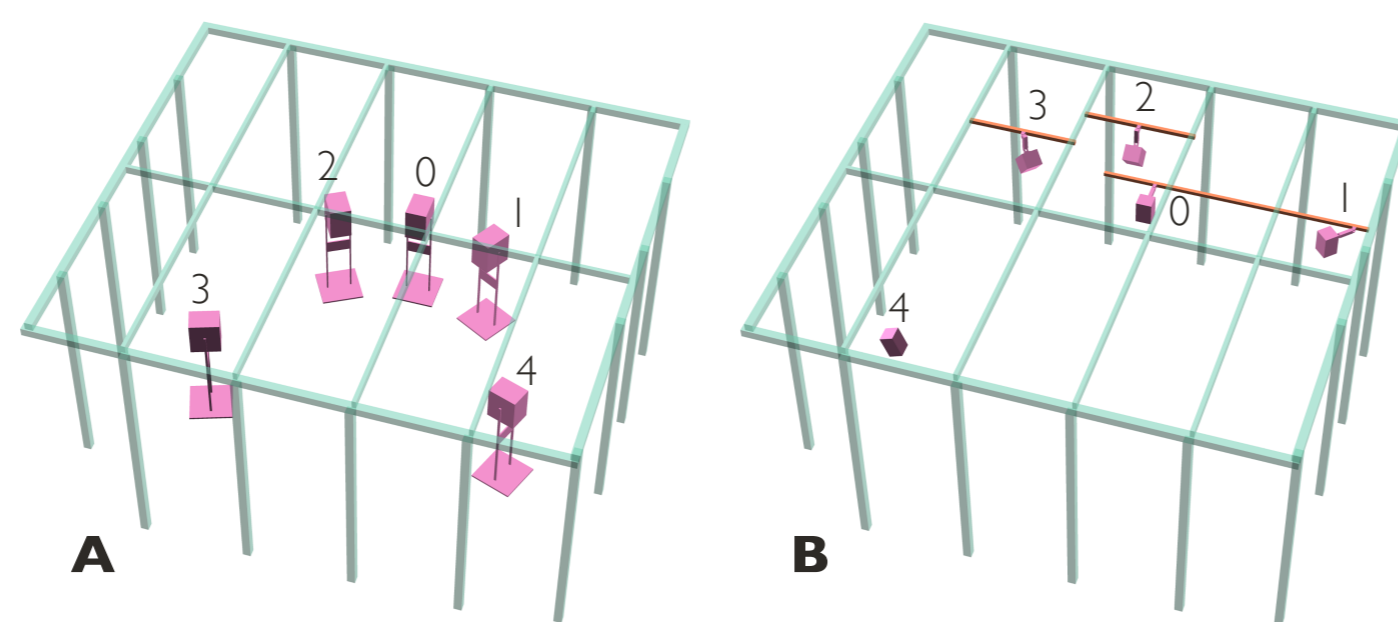
The background noise was measured between 31.5 Hz and 8 kHz to be below NRI5. Changes to meet NRI10 are under investigation.



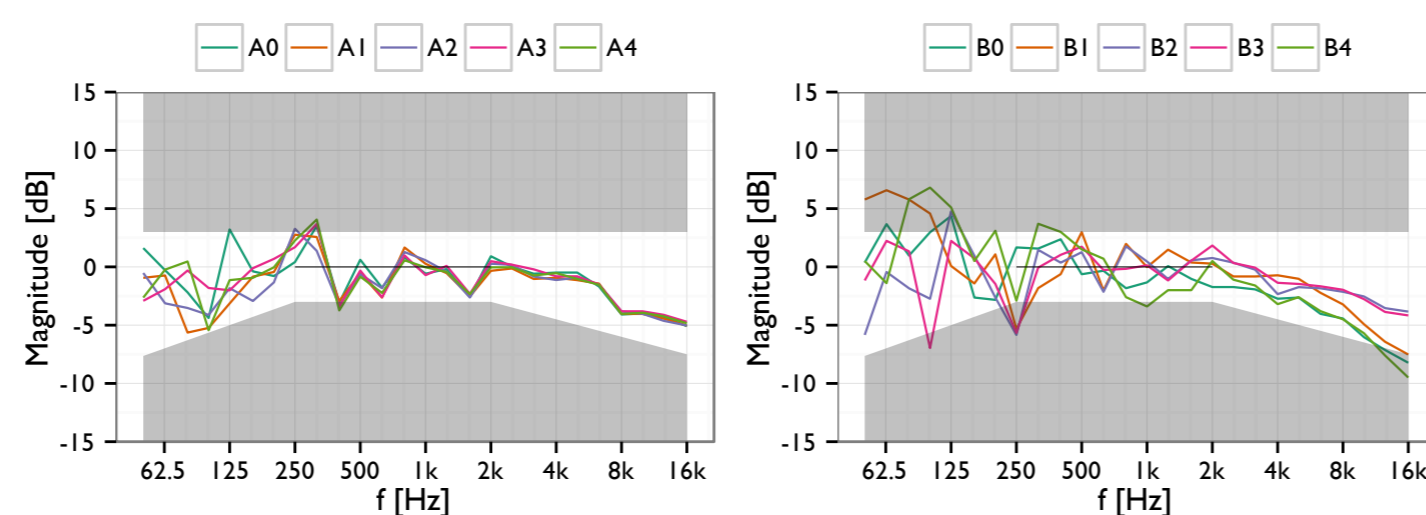
Differences between the unequalised room response measurements for the front 3 loudspeaker positions.



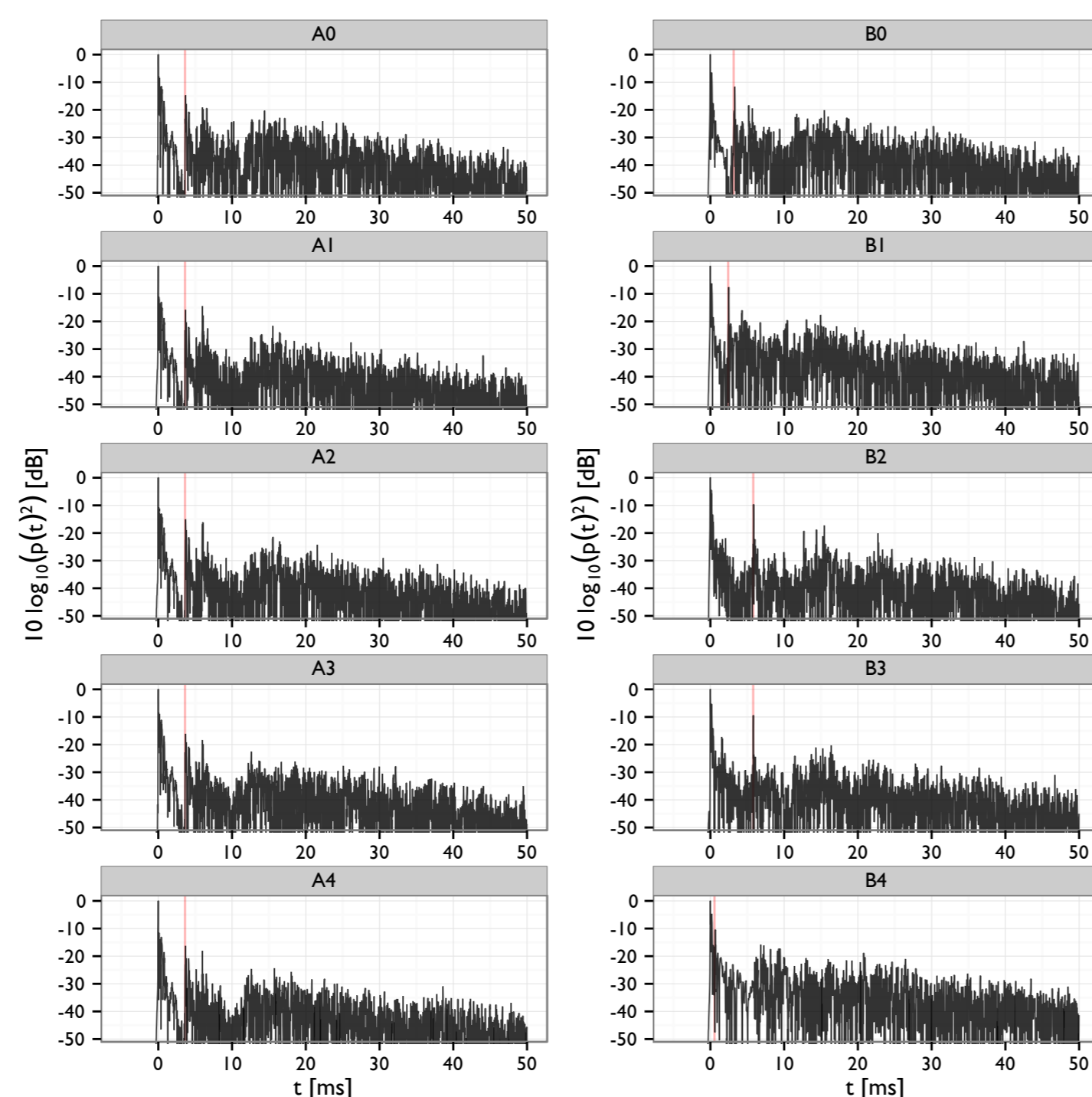
Preliminary mean reverberation times from 25 measurements.



Loudspeaker positions for the measurements shown below.



Unequalised operational room response in 1/3 octave bands.

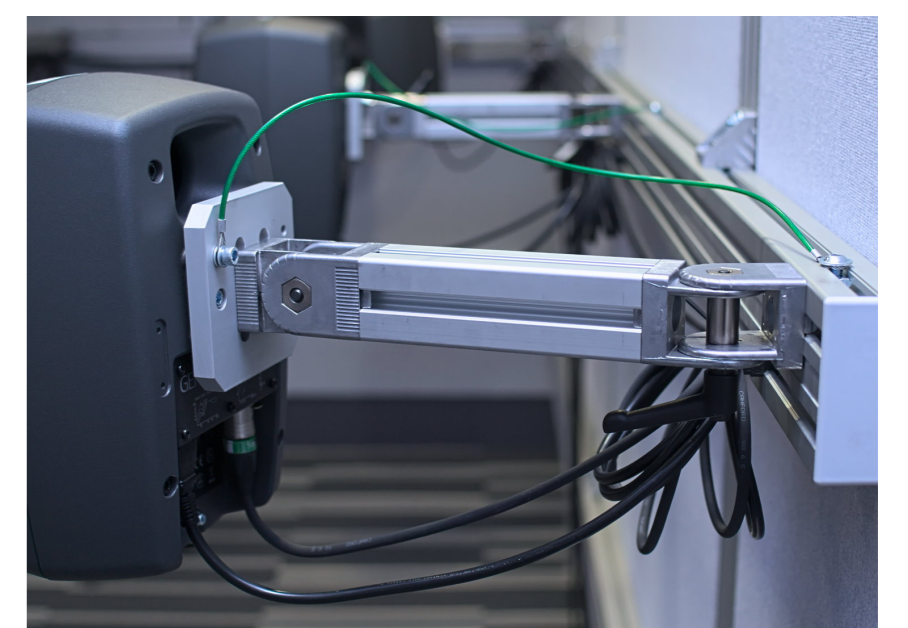


Full-range energy time curves. Red lines show the expected position of floor reflections.

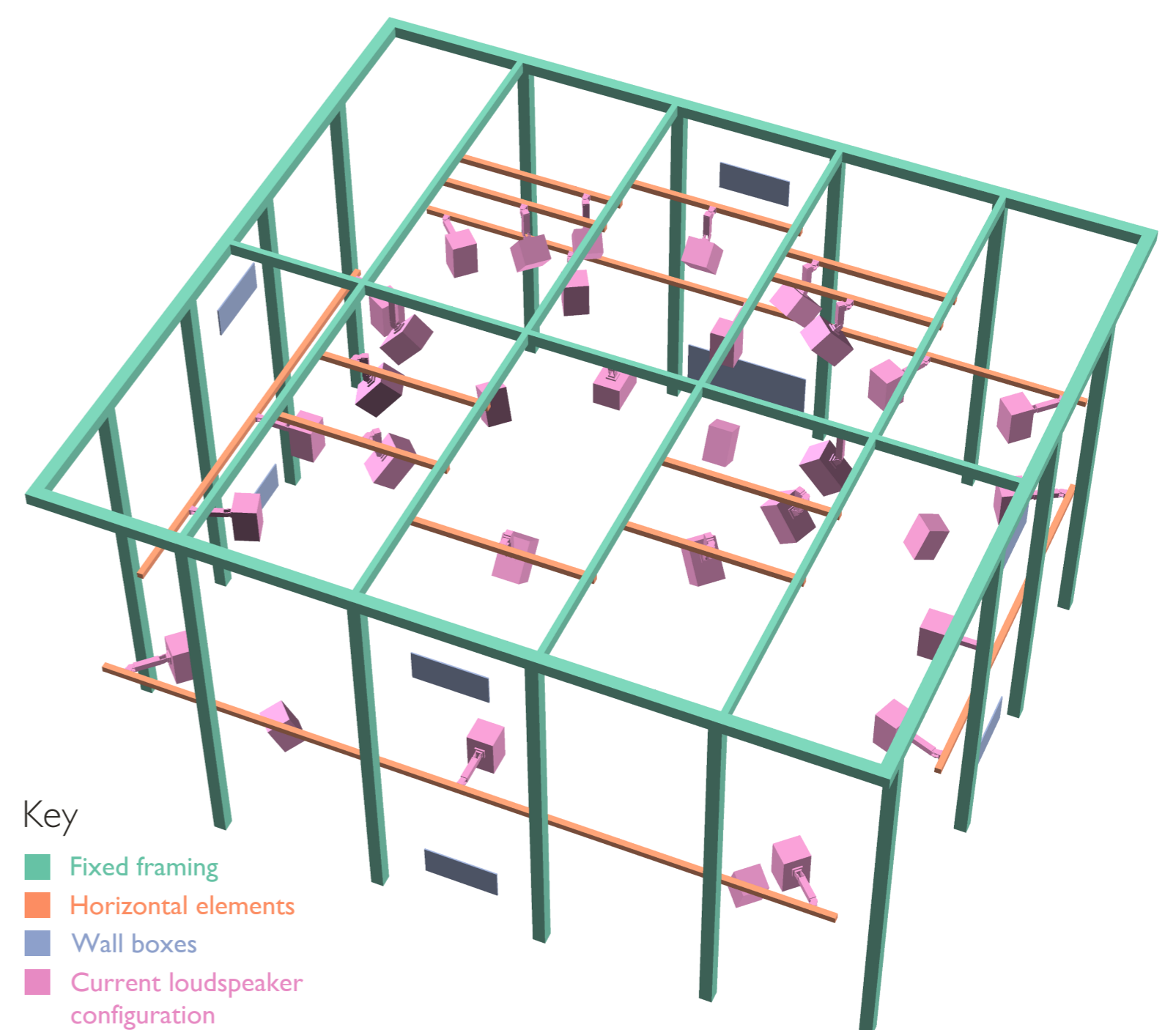
## LOUDSPEAKER MOUNTING

A flexible loudspeaker mounting system is installed to allow loudspeakers to be placed at almost any position on the walls and overhead.

The currently installed configuration contains 34 loudspeakers, covering layouts A to F and H specified in ITU-R BS.2051 [3].



Loudspeaker mounting bracket.



## CONCLUSIONS

The facility meets all critical acoustic and electro acoustic design goals according to existing ITU standards. The design process has highlighted the need for standardised listening environments for immersive audio, as well as the challenges of building a flexible environment to very high acoustic standards.

## REFERENCES

- [1] ITU-R BS.1116-3, Methods for the subjective assessment of small impairments in audio systems. ITU Radiocommunication Assembly, 2015.
- [2] ITU-R BS.775-3, Multichannel stereophonic sound system with and without accompanying picture. ITU Radiocommunication Assembly, 2012.
- [3] ITU-R BS.2051-0, Advanced sound system for programme production. ITU Radiocommunication Assembly, 2014.

Find out more:

[bbc.co.uk/rd/sound](http://bbc.co.uk/rd/sound)

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