



Recommended Best Practice for Programmes and Contributions from Remote Venues via Outside Sources

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1. Introduction

A significant proportion of BBC Radio output is relayed live to air from a venue external to an on-air studio. This may be an individual contributor to a discussion programme, a complete programme, such as Any Questions on Radio 4 or a concert performance on Radio 3, or two hours of 6Music programming from BBC Manchester fed directly to the transmission platforms.

There are four elements which need to be considered in order to safeguard the integrity of the output:

- Audio Quality
- Resilience
- Latency
- Cost

Audio quality will be affected by processes such as sample rate conversion and data rate compression (compounded by cascading these processes together) and latency (delay). Unnecessary conversions between analogue and digital systems should also be avoided.

Latency can have a significant effect on the sound of the end product, particularly when interaction between the outside source and the studio are a key part of the programme. **Excessive delay can render a live interview impractical.** Delay can be caused by the coding algorithm, the method of transmission or the path taken by the transmission. In order to keep round trip delay as low as possible it may be necessary to consider an encoding with a lower latency for the return circuit – this may result in a reduction in the quality of the return circuit.

To maintain **resilience** we need to consider the reliability of the equipment we deploy and the telecommunication paths we use, and whether alternatives are viable to cover in the event of failure.

It should be noted that in the vast majority of cases all ISDN lines from a particular venue are likely to be on a single cable for the majority of the route between venue and local exchange. Having a permanent main link from regularly used venues could improve resilience if the link is on a separate line from the reserve ISDN but this would incur additional costs.

For live programmes from remote venues, in addition to the main link, there should always be a reserve of MPEG L3 at 128kb (stereo) minimum available under any one of the following circumstances:

- for a billed programme from a remote venue (Any Questions, Lunchtime Concert),
- or for continuous live programme of 20 minutes or more
- or where the presenter or co-presenter is at the remote venue.

These programmes should also go through a studio or continuity with a back-up presentation option in case both main and reserve lines fail.

2. Contributions from Main BBC Centres

There is a network of high quality, linear audio links between major BBC regional centres providing resilient circuits with low latency.

Wherever possible, programmes originating in BBC studio centres in the UK should use these full bandwidth programme circuits between studios. These

can be booked through BBC booking/Schedules units: e-mail:

lcr.schedules@bbc.co.uk. If such circuits are not available, then advice should be sought on the best way of delivering the programme to the destination studio. Connectivity between the major London sites is generally provided over the London Fibre Network, giving 28 linear stereo channels over twin fibre routes for resilience.

3. Pre-recorded Presentation from a Remote Studio

Presentation links for programmes should not be recorded using data rate compressed formats such as ISDN.

If the remote studio and the recording studio are in BBC buildings linked by full bandwidth circuits these facilities should be used to provide **linear** audio for presentation links.

Where ISDN or telephone is the only option for connecting the studios, the presentation links should also be recorded as a linear simulrec at the remote studio and the audio should then be sent as a .wav file or data CD and added to the programme material in post-production.

4. Contributions from Outside Broadcast Venues within the UK

Connectivity for domestic outside broadcasts is usually via ISDN and, where Radio Outside Broadcasts are involved, the requirements are agreed between Radio OBs and the production.

The recommended minimum bit-rate for stereo speech programmes is 128kb (MPEG L3) and the recommended minimum bit-rate for music contributions is apt-X 256kb (stereo).

Resilience provision varies between networks and types of programme. Where an OB is using a single ISDN2 line it may be considered inappropriate to double the line cost for resilience, so a spare codec to cover for failure may be all that is available.

Where three ISDN2 lines are provided they may be split to use two for the main link and one for the reserve (where the reserve codec is most likely MPEG L3), or all three may be used for the main link and an MPEG L3 codec is available as a “cold” spare to be plugged to one of the lines in the event of failure. In the latter case there will be some delay in re-establishing the connection.

To ensure resilience there should always be a reserve of MPEG L3 at 128kb (stereo) minimum available in addition to the main link under any one of the following circumstances:

- for a billed programme from a remote venue (Any Questions, Lunchtime Concert etc),
- for continuous live programme of 20 minutes or more,
- where the presenter or co-presenter is at the remote venue.

These programmes should also go through a studio or continuity with a back-up presentation option in case both main and reserve lines fail.

Where return circuits are used to feed local public address systems or to take in material for later transmission, consideration should be given to the quality and latency of these return circuits.

Consideration should also be given to communications between the OB and base. Mobile phone coverage should be checked during the site survey but this may be compromised by pressure on capacity so it is advisable, where possible, to book a separate DEL for comms. Some venues have landline facilities in the local control room (Wigmore Hall, Albert Hall).

Multiple MPEG passes should be avoided wherever possible to reduce the problem of audible cascade artefacts. On a large site, such as a festival or when there are several venues in a town or city, MPEG is often used to link parts of the site together (using codecs can be cheaper and less work-intensive than other options, eg microwave links). This can mean that several code/decode cascades can occur even before the audio has left the OB site. If material, which started life being recorded on MPEG devices, is sent from one OB location to another, edited, then sent onwards, the number of conversions and cascades increases further, with resultant degradation.

For this reason it is advisable to keep the starting quality as high as possible and try to use non-MPEG coding in long chains of transmission.

5. Contributions from non-BBC Studio Centres

ISDN is the normal method of connecting to professional programme making centres outside the BBC. We are usually constrained by the ISDN facilities already available to the outside body and we endeavour to establish the best quality achievable with the equipment available.

Some independent productions produce live programmes entirely from non-BBC studios on a weekly basis. In the past ISDN has been relied upon for main links and reserves where applicable. There seems no good reason why the requirements for an independent production should be lower than for a BBC production.

Where a regular live programme is produced entirely from a non-BBC studio we recommend that the main circuit is a full bandwidth link, with an ISDN reserve. The costs need to be agreed at the commissioning stage.

6. News, Sport and Radio 5 Live

Programme contributions into News and Sport programmes will most often be acquired through the use of ISDN circuits, although an increasing use is being made of VOIP due to the increasing non-availability of ISDN, particularly at non-UK venues.

Standard coding for ISDN material is MPEG Layer 2, 24Khz sampling, although G.722 is acceptable for short speech-based inserts. For higher quality and low delay AAC LD 64Kb with G722 cue is preferred, especially where the contribution represents a high proportion of a programme.

A standard protocol for **VOIP** (properly called ACIP – Audio Contribution over IP) has yet to be formalised although preliminary agreement has been reached between the EBU and suppliers. **Wherever possible ACIP equipment should conform to the technical specification published at http://www.ebu.ch/CMSimages/en/tec_doc_t3326-2008_tcm6-54427.pdf**

The preferred receiving equipment at time of writing (2008) for News, Sport and 5 Live contributions is the Comrex Access with either a Comrex access unit or Luci Live software at the far end. The coding and protocol used should aim to keep quality high and delay low, the best combination for this is AACLD or HE using the UDP rather than TCP protocol.

Other ISDN standards and ACIP contributions should be discussed with the programme and tests should be done well in advance of any live broadcast.

Wherever possible, programmes originating in BBC studio centres in the UK should use the full bandwidth programme circuits between studios. These can be booked through BBC booking/Schedules units. If such circuits are not available, then advice should be sought on the best way of delivering the programme to the destination studio.

7. Contributions from Smaller BBC Centres

Each local radio station has a small NCA studio to allow other BBC sites to do remote interviews with contributors from the area. Connectivity is usually via ISDN using G.722 only or G.722/MPEG L2 at 64kb (mono). Contributors from these studios usually dial up their own connection with no technical assistance available. There is rarely a back-up facility and the requirements of News programmes have priority over other bookings.

8. Contributions from BBC Studios and Music Venues with Permanent Circuits into BH

There are some sites local to W1 that are too far away to connect directly to the W1 infrastructure (e.g. **Maida Vale, Yalding House, 35MHS**), and a number of venues that the BBC uses which are permanently equipped with facilities that allow them to be considered as an external studio (e.g. **Wigmore Hall, Royal Albert Hall**). For most of these sites we use a 2Mb E1 circuit, as it provides the best value, combined with a multiplexing codec (e.g. Intraplex, APT Oslo). This combination provides the flexibility to have a number of audio channels of different quality dependent on use. The normal coding standard for channels used for programme audio is J.41 (one step up from NICAM in terms of audio quality). For programme speech (i.e. news material) we use apt-X coding at 128kb (mono) in some cases. For most sites where we are using 2Mb E1 circuits a permanent reserve cannot be justified on cost grounds. Sites that are used for live transmission are therefore equipped with an ISDN line and codec for use as a reserve. **These lines should always be tested before transmission and be routed to the desk as “hot” reserves, for instant back-up.**

9. Contribution from International Outside Broadcast Venues

There may be limits to what options are available in the country or we may be using the facilities of a local broadcaster. Some international OBs are multilateral events (i.e. EBU) so we don't have sole responsibility.

We should seek the same minimum requirements as for domestic OBs but accept that exceptions are going to be more common on foreign soil.

VOIP is often used where ISDN is not available. A standard protocol for **VOIP** (properly called ACIP – Audio Contribution over IP) has yet to be formalised although preliminary agreement has been reached between the EBU and suppliers.

Wherever possible ACIP equipment should conform to the technical specification published at http://www.ebu.ch/CMSimages/en/tec_doc_t3326-2008_tcm6-54427.pdf

10. Use of Satellite Equipment

Satellite uplinking may be the only method of transmission available on occasion but it relies on a clear view of the southern sky. High audio bandwidths are achievable but this costly as it requires complex equipment and specialist operator skills. Connection costs are also high and there may be no return circuit - the coding standard may be proprietary requiring specific decoding plant at the receiving end. All satellite circuits are subject to significant transmission delay. Public access systems, such as Inmarsat, can be operated by most users but they generally offer low bandwidth data calls (say, 64KB) where an ISDN codec can be used to make a two-way connection to the studio. Currently, only a few MPEG codecs offer the 64KB option for stereo with obvious severe quality constraints arising from lossy data compression.

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Outside Sources

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