EBU Technical Recommendation R97-1999
Exchange sound programmes as BWF files on recordable data discs (CD-R(recordable), CD-RW(rewritable) and DVD-R)

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The EBU has standardised the BWF file format for sound programme material [1]. Recordable optical data discs such as CD-R and DVD-R have many attractive features for the exchange of such sound programme files. However, several different recording formats already exist for these media, and not all are readable on all computer platforms. Therefore, for the time being, the prior agreement of the recipient organisation should be obtained before sound programme material is exchanged in this form.

Recently a Universal Disc Format (UDF)[1] [2, 3] has been specified by the Optical Storage Technology Association (OSTA), and is now the standard format used for DVD-R and other types of Optical Disc Storage. It can also be used for CD-R.

However, in the past, the older ISO 9660 disc format has been used for CD-ROMs and many older players are not able to read the UDF format. For this reason, although the EBU would like to encourage the use of the UDF, it recognises that it as yet too early to recommend its universal use for programme exchange.

The EBU *recommends*,

that if CD-R and DVD-R data discs[2] are used as a support for exchange of programme material as audio files, with the prior agreement of the recipient organisation, they should conform to the following requirements.

1. Disc Characteristics

1.1. Specification

A data CD-R must be recorded according to the CD-R "yellow book" [4].

A data DVD-R must be recorded according to the DVD-R "red book" [5].

1.2. Disc format

1.2.1. CD-R

The disk format used on CD-R data discs should be:

- ISO9660, if it is uncertain that the receiving organisation can accept UDF,
- UDF 2.0 (for future applications but by prior agreement at the moment)

1.2.2. DVD-R

The disk format used on data DVD-R discs should be UDF 1.02

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1 Explanatory information on the use of UDF is given in the Appendix 1.

2 The exchange of programmes as recordable audio CDs is covered in EBU Recommendation R 89 [11]

1.3. Quality of the support

Blank discs should be of good quality and there must be no obvious surface defects on the blank disc or after recording. After recording, a sample disc[3] should, at least, meet Grade B according to the Compact Disc Red-book.

1.4. Protection

The disc must be supplied in an undamaged "Jewel Case".

2. Recorded Files

2.1. Specification

Recorded files should conform to the specification of the Broadcast Wave Format (BWF), EBU Tech 3285 [1]

The files may be of any form and contain any number of channels conforming to the BWF specification, for instance:

- Linear, two channel PCM audio to EBU Recommendation R85 [6]
- MPEG coded files to the specification in Supplement 1 to EBU Tech 3285 [7]
- Linear, multichannel PCM audio files to Supplement 2 to EBU Tech 3285 [8]

2.2. Audio Sampling frequency

Recorded Files should contain audio signals sampled at a frequency of 48kHz. Other sample frequencies should be used with prior agreement only. (See EBU Recommendation R85 [6])

3. Audio signals in BWF files

3.1. Recording Level

Audio signals should be recorded according to EBU Recommendation R68 [8].

Other recording levels should be used by prior agreement only.

3.2. Line-up tone

If a line up tone is incorporated in any files on the disc, it should conform to EBU Recommendation R68. This should be 30 s of 1 kHz tone recorded on both channels at Alignment Level, as shown in *Table 1*.

Alignment Level should be 9 dB below PML, at -18dBFS (actually 18.06 dBFS, corresponding to a ratio of 1:8).

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[3] *For obvious reasons it is not possible to test individually a write-once medium such as a recordable optical disc.*

Studies by EBU Members have found that batches of optical discs have consistent properties and that the quality of one sample can give a realistic prediction of the performance of other discs in the same batch.

Table 1 - Digital codes for maximum levels and alignment levels for 16 and 20 bit coding

Maximum coding level (0 dBFS)		Audio alignment level	
negative peaks	**positive peaks**	**negative peaks**	**positive peaks**
8000	7FFF	F000	0FFF
80000	7FFFF	F0000	0FFFF

The left and right channels of a stereo programme may be differentiated by using an interrupted tone on the left channel, as specified in EBU Recommendation R49 [9].

3.3. Emphasis

No pre-emphasis shall be used.

4. Accompanying Information

4.1. Labels

All disks and cases should be clearly labelled, indicating programme details, and the recorded format. To avoid possible damage, discs must only be labelled using methods in accordance with the manufacturer's instructions.

4.2. Metadata files

All metadata recorded as files in the disc and not included in the BWF audio files should be clearly linked to the appropriate file.

Bibliography

[1] EBU Tech 3285. **Specification of the Broadcast Wave Format: A format for audio data files in broadcasting**

[2] OSTA: **Universal Disk Format Specification version 1.02** See www.osta.org/

[3] OSTA: **Universal Disk Format Specification version 2.00** See www.osta.org/

[4] ISO/IEC 10149:1993 **Information technology - Data Interchange on read-only 120mm optical data discs** (CD-ROM: based on the Philips/Sony “Yellow Book”)

[5] DVD consortium "**Red Book**"

[6] EBU Recommendation R85-1997: **Use of BWF for exchange of audio data files**

[7] Supplement 1 to EBU Tech 3285. **MPEG Audio**

[8] Supplement 2 to EBU Tech 3285: **Linear PCM Multichannel audio** (to be published)

[9] EBU Recommendation R68-1995: **Alignment level in Digital audio production equipment and in digital audio recorders.**

[10] EBU Recommendation R49-1993: **Tape alignment leader for the exchange of television programmes**

[11] R Recommendation 89-1997: **Exchange of sound programmes on Recordable Compact Discs, CD-R**

Appendix 1

File formats used on optical disc media

1. ISO9660: The CD-ROM format

Standard CD-ROMs are usually formatted using the file system specified in ISO 9660. (The Macintosh operating system also supports HFS formatted discs.) Windows and Mac computer systems have built-in ISO 9660 readers and so can read ISO 9660, CD-ROM and CD-R data discs.

However, ISO 9660 has certain limitations, especially in the areas of allowable filenames and size of files. These have made it an inappropriate choice for use on DVD, CD-RW and other new disc media.

2. The Universal Disc Format, UDF

UDF is designed to address the limitations of ISO 9660. It defines the storage of a large amount of data on optical media in a way that can be understood by all of the major computer platforms (DOS/Windows, Mac, Unix). Specifically, UDF supports "packet writing" a technique that allows files to be added to a CD-R (and CD-RW) disc incrementally. (In addition, UDF allows for the random erase of individual files on CD-RW media, freeing up space in the process).

There are currently two versions of UDF.

2.1. UDF 1.02

UDF 1.02 is the version used on DVD-ROM and DVD-Video discs.

UDF Volume Access for Macintosh reads both versions of UDF.

Windows 98 and Mac OS 8.1 operating systems support UDF 1.02.

2.2. UDF 2.0

UDF 2.0 is a superset that adds support for CD-R and CD-RW. Free Readers for UDF 2.0 are available for both of Windows 98 and Mac OS 8.1 platforms.

Future versions of UDF are also planned