

The use of BWF files in Swedish Radio

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An article by Richard Chalmers [1] offers a brief introduction to the new audio file format known as the Broadcast Wave Format (BWF).

In this article, the author gives some background information on why the development of a common audio file format was essential for a radio broadcasting organization such as Swedish Radio (SR). BWF files will now be used in SR whenever audio workstations are interconnected via LANs and WANs.

1. Introduction

Swedish Radio (SR) uses audio software systems from a number of different manufacturers. More than 500 PCs are used in 30 local area networks (LANs) for the editing of various kinds of programmes and, in our continuity suites, audio playout systems are used .

In the future, we expect to see on our PCs the integration of applications for audio, newsroom text systems, Internet production, and tools for the handling of DAB and RDS programme-associated data (PAD). The new *Broadcast Wave Format* (BWF) file is a first important step towards this coming development.

The audio files produced by different software systems have often been incompatible: too many different file formats have been in use. The introduction of the BWF [2] – an EBU initiative, in close collaboration with the audio industry – provides a good solution to this unsatisfactory situation. Most audio software manufacturers have now committed themselves to use the BWF.



Swedish Radio International reporter, Gaby Katz, using a PC for audio editing and playout.



2. Structure of the Swedish Radio computer network

The PCs used for audio editing and playout are interconnected in Novell-based LANs. All the LANs are connected via routers in a corporate wide area network (WAN). This network is shown in Fig. 1. It links 25 regional offices to SR's broadcasting centre in Stockholm.

The network is used not only to transfer audio files via TCP/IP, but also for the transfer of digital audio in real time. The bandwidth for data communication is 2 Mbit/s. File transfers are becoming more and more common, and are replacing real-time transfers.

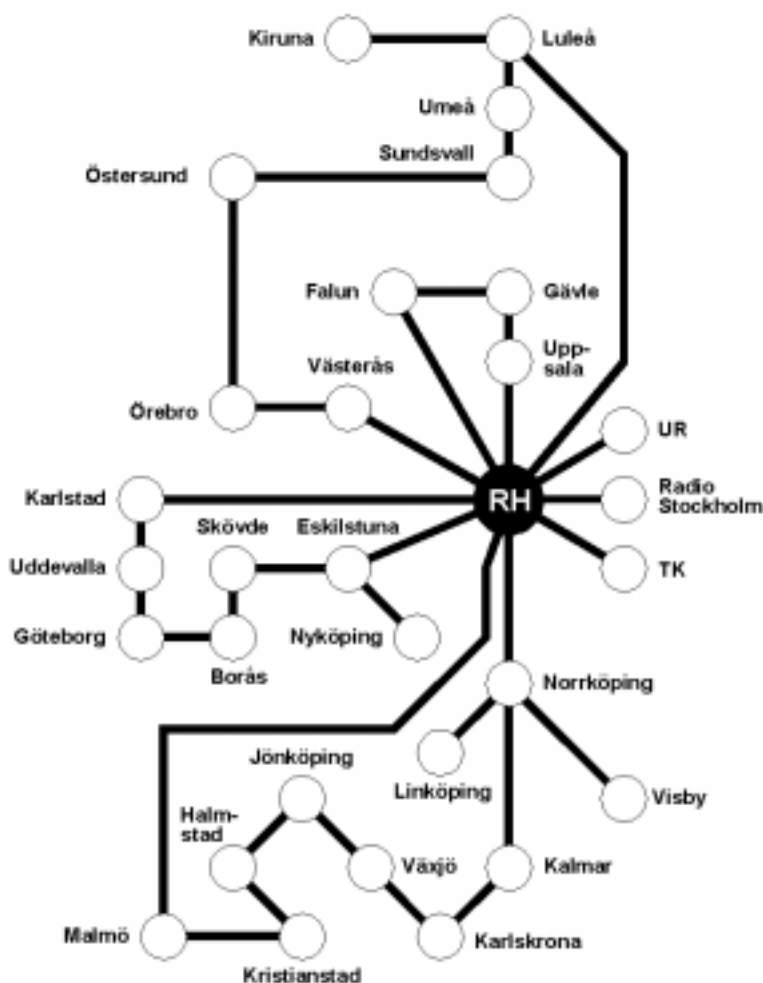


Figure 1
A corporate network connects 25 regional offices to Swedish Radio's broadcasting centre in Stockholm.

3. Using BWF as the native file format

SR's policy is to use only a few audio software systems. In our view, they should all use BWF as the native file format stored on disk. The final stereo file for playout from a multi-channel workstation should be stored in *linear PCM BWF*.

If BWF is used as the native file format, the operating system – or an automatic middleware – can be used to retrieve a file from a remote location or from an in-house mass-storage archive with no need for conversions. However, if there is a proprietary native file format stored on disk, a broadcaster who has different audio software systems and many interconnected audio servers will encounter problems – even if BWF is used as an interchange format for the exporting and importing of files.

4. Audio coding

The audio coding used in the BWF files is either *linear PCM* or *MPEG Layer 2*.

DAB transmissions will make it necessary for radio broadcasters to use 20-bit linear coding whenever possible. In the case of certain highly-dynamic programme material, the extremely low perceived noise level in DAB (relative to FM) – especially for a DAB listener using ear-phones – will make the noise level from a 16-bit original recording audible. Inputs to MPEG



PC cards should therefore, if possible, be equipped with 20-bit analogue-to-digital converters (ADCs).

After many hours of radio programming using MPEG Layer 2, no audible degradation effects have been noticed at Swedish Radio. SR has decided to standardize on a bit-rate of 192 kbit/s for mono and 384 kbit/s for stereo, at a sampling frequency of 48 kHz. In the early 90s, the ITU-R conducted listening tests on MPEG Layer 2 in several countries. The results showed that lower bit-rates than 192 kbit/s per audio channel should be avoided for production purposes, mainly because of the audible artefacts which result from the concatenation of Layer 2 audio equipment (*Fig. 2*).

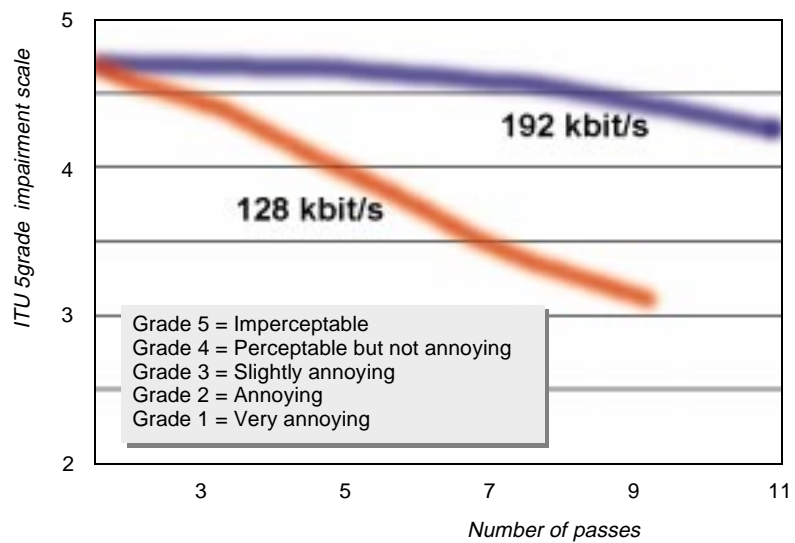


Figure 2
Loss of quality with successive concatenations.

Editing at a minimum resolution of 24 ms, which is the block length of Layer 2, has not been a problem in news and other speech-based programmes. For the more sophisticated editing required in music production, workstations with linearly-coded files (sampled at 48 kHz) are used. This results in a minimum editing resolution of around 0.02 ms.

5. File conversions

When BWF is eventually used by all the systems at our broadcasting centre, conversions will still have to be made between linear-PCM BWF and MPEG BWF files. Conversion of the sampling frequency from 44.1 to 48 kHz and conversions between 16-bit and 20-bit files will also be required on occasions. It will be possible to perform all these steps automatically via fast processors in the computer infrastructure of each radio channel. The chunks of the incoming BWF file contain all the necessary information.

6. The Tage system

Tage, which means “give and take” in Swedish, is an automatic file transfer system that is used by Swedish Radio. It is reached via a Web browser interface, installed on all the PCs connected to the SR intranet (*Fig. 3*). The *Tage* server on each radio channel is a middleware which collects information from different databases and legacy systems. The BASYS news-room system is one of them.

Each radio channel or department maintains an output directory of current material (audio items and text) on *Tage*: this material is on offer to all other channels in SR. The “kill dates”



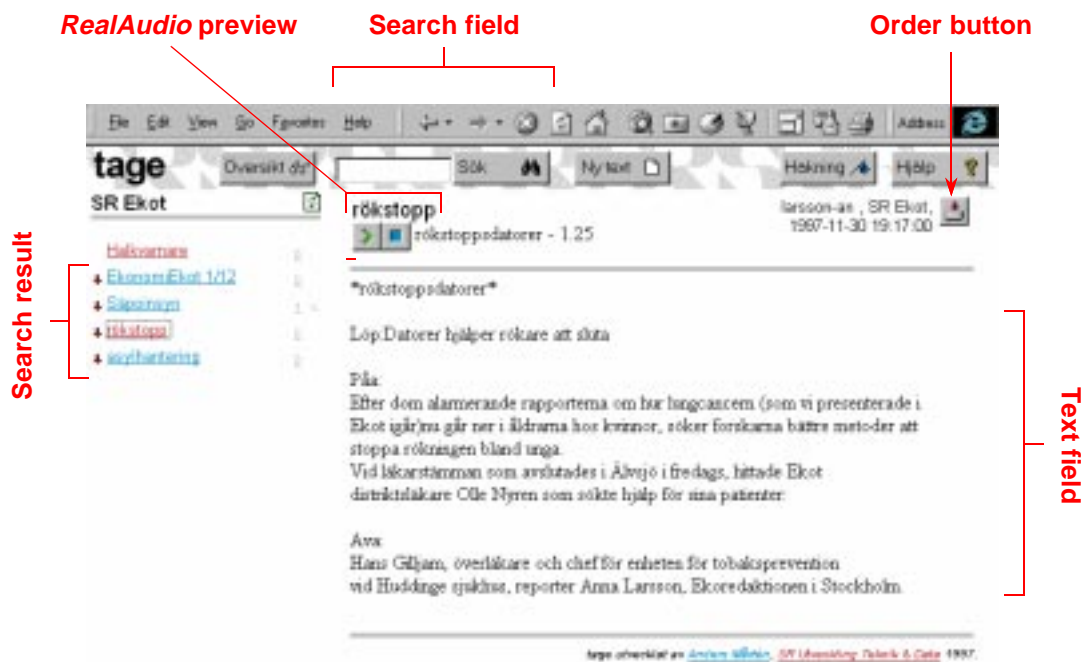


Figure 3
The automatic file transfer system, *TAGE*, uses any PC with a web browser to retrieve audio files and text from a remote location within SR.

are adjustable, either manually or automatically. Searches can be carried out for a specific subject, and instantaneous browsing with *RealAudio*¹ quality is possible on any desktop PC. When demanded, the high-quality audio file is transferred to the nearest sound server within a few minutes, depending on the instantaneous level of traffic using the WAN. Higher priorities can be set for news items.

7. The SESAM system

SESAM is an SR system under development (Fig. 4). The goal is to create an integrated PC tool for all categories of staff. Text-handling systems with search facilities, and audio software for editing and playout, are included. *SESAM* will also be used for the production of Internet Web pages and DAB ancillary data.

All items of text, audio and other files in *SESAM* will be located by a corporate database system. Via this common database, all the production systems will be able to interact with distributed servers and mass-storage archiving systems. Various pilot systems will come into operation during 1998.

8. What happens to audio quality in a PC environment?

Audio cards are available at different levels of cost and quality, but the audio quality can be maintained by using the following method.

1. RealAudio is an Internet audio software from a company called RealNetworks (formerly known as Progressive Networks).



The workstations in control rooms, and portable systems for recording in the field, should be equipped with high-end audio cards. If possible, recording should be made via an AES-EBU interface on a 20-bit ADC which is external to the PC cabinet. Likewise, the advanced editing in production control rooms and the playout from the continuity suite must be carried out using professional audio cards.

The general-purpose PCs used by journalists and producers for easy editing will not, in future, require the use of professional audio cards. Cheap audio cards are delivered with most PCs available on the market today and these can be used for:

- ⇒ the auditioning of BWF files. This process does not destroy the audio quality of the original BWF audio file (which would have been recorded with better-quality audio cards).
- ⇒ rough editing, with no re-recording or cross fades. The editing data are simply “pointers” which select parts of the original BWF audio file. This file never leaves its original location on the server.

For a radio broadcaster with many hundreds of PCs, the method just described reduces the total investment cost significantly. The price of a high-end audio card is close to that of a complete PC already fitted with a cheap audio card.

9. Future developments

The work of the joint EBU-SMPTE Task Force on *Standards for the Exchange of Television Programme Material as Bitstreams* will also influence radio broadcasters. These forthcoming standards will make use of *wrappers*, i.e. object-oriented methods for linking audio and text with pictures. These wrappers will make use of BWF as one of their basic building blocks. Standardized metadata (data about data) transmitted over networks will describe the content and format of all the various types of files used in broadcasting.

The common way for a radio producer to compile programmes in future will be to use files from the nearest sound server, and from archives which are accessed both via the Internet and the corporate intranet. A minimum set of content information, to be used in conjunction with the BWF *broadcast chunk*, is being developed by EBU project group P/AFT (Audio File Transfer) in close liaison with the AES working group, SC-06-01. A simple project structure will be developed by this AES group, with the aim of making it possible to exchange multi-channel material between the workstations of different manufacturers.

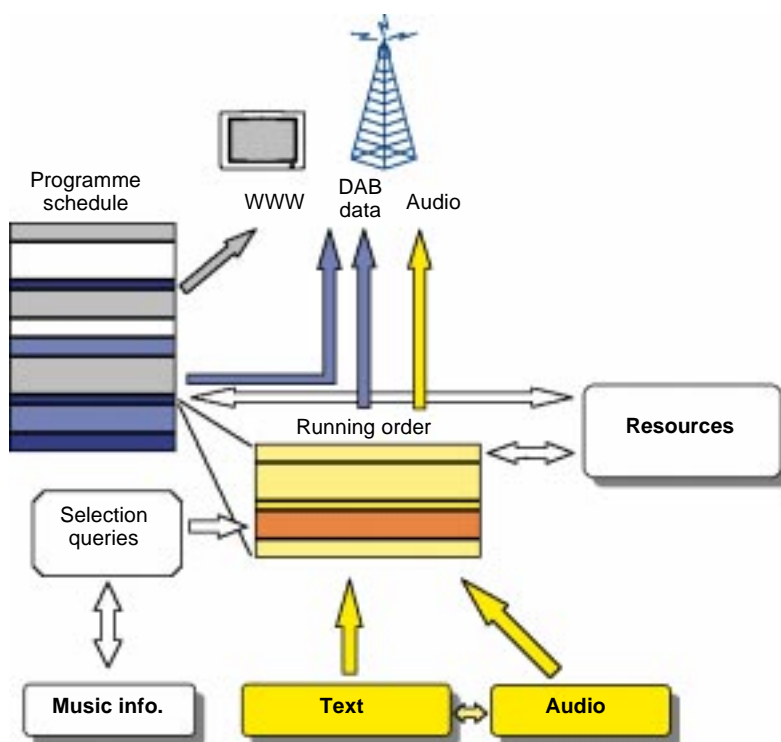


Figure 4
The *SESAM* system will integrate within SR the different subsystems used for text, audio editing, playout and legacy software.



Mr Lars Jonsson was born in 1949 and received an M.Sc. in Electronic Engineering from the Royal Institute of Technology in Stockholm in 1972. He joined the Research & Development department of Swedish Radio that same year to work on the development of video and RF systems.

For the last ten years, Mr Jonsson has worked with audio computer systems. He has been a member of several working parties of the EBU, in the Production Technology area. For the last few years, he has actively participated in the development of the BWF file.

There are proposals for an EBU Multimedia network, as an addition to the Eurovision and Euroradio networks. It could be used by EBU members on an everyday basis to exchange BWF-compliant files consisting of, for example:

- ⇒ browsing-quality audio items;
- ⇒ low-quality video clips;
- ⇒ still pictures.

The opening of broadcast archives to the public via Internet BWF-compliant files is another application to be considered. It could provide a new source of income for broadcasters.

10. Conclusions

Swedish Radio has many different types of audio software systems for various types of production. The recently-developed Broadcast Wave Format, and SR's new corporate computer network, have now provided the opportunity to interchange audio files freely across the whole company.

The BWF format has been agreed by EBU members in close conjunction with specialists from the audio software industry. More than 20 companies in this industry have rapidly adopted the new format, which will come into general use during the next few years.

With the addition of new chunks which maintain the basic WAVE format, BWF will be a first step towards the standardization of computer-aided radio production. More work will follow within the EBU on developing the standards for corporate archive databases linked to mass-storage systems.

Bibliography

- [1] Chalmers, R.: [**The Broadcast Wave Format – an introduction**](#)
EBU Technical Review No. 274, Winter 1997.
- [2] EBU document Tech. 3285 (1997): [**Specification of the Broadcast Wave Format: a format for audio data files in broadcasting**](#) (Supplement 1 to this document gives detailed specifications of how to create BWF files for MPEG audio).