

An Open-Standard File Format for Forensic Audio

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Monday, July 24, 2006
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- **Introduction**
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Need for Standardization

In forensic audio processing, it is necessary to ensure that

- the integrity of the original sample is maintained.
- details of the case and the specialist examining the sample are logged at every stage.
- audio data is appropriately tagged.

Audio Engineering Society (AES) - guidelines for managing forensic audio recordings (AES27-1996)

- ‘ensure the chain of custody’
- ‘to properly identify and maintain the physical integrity of the evidence’
- ‘to document technical and non-technical actions taken with the evidence’

Digital Audio Data as Evidence

- Audio recordings are increasingly going digital, because of the ease of manipulation, software, etc.
- The 'digital' nature of new audio, photo and video evidence means a departure from the notion of a physical piece of evidence.
- A process analogous to identifying and classifying physical pieces of evidence into sealed evidence packets and marking out those packets with the initials of the examiner is required.
- It is more difficult to 'vouch' for the content of a file.
- Once any digital exhibit leaves the analysis bench, the expert has little or no control over the way it is later transmitted to the eyes and ears of the end users (jurors/judges, etc.)

Digital Audio Data as Evidence

- An objective measure like a checksum or a hash, preferably written by the recording equipment itself, would be useful.
- This is the digital equivalent of making markings like initials on the CD/tape.
- Data is useful for book-keeping, maintaining records.
- The proposed standard could be directly embedded into acquisition hardware, eliminating the need for individual users having to manually input and check the data.
- Integrity checking of the file is not a 'crooked cop' check; it would help in situations where the recording instruments failed or some inadvertent mistakes were made.

An Open-Standard Forensic Audio File Format

- Forensic audio specialists as well as vendors of audio recording hardware can include additional information that is useful for forensic and law enforcement purposes.
- To be used in
 - **Acquisition** (first digital download of evidence data)
 - **Processing** (analysis, enhancement, authenticity, speaker recognition)
 - **Archival and retrieval** (storage, transmission to court/clients, searching of the audio-files at later date)

Forensic Meta-Information of Interest

Case-Related Information

- Case serial numbers
- Time of acquisition or receipt
- Identifying information about specialist analysing the case
- Call record information and other details
- Annotation and transcription

Technical Information

- Sampling rate
- compression algorithm used
- number of channels
- number of bits/sample

Remote Audio and Video Acquisition

Digital audio and video collection is done from remote locations and transmitted to a base station where the samples are collected.

- How can one claim that a particular sample came from a specific camera/microphone used by a specific officer in a particular operation?
- One way of getting around this is to include device-, time- and case-specific information within or accompanying the transmitted sample.

- **In the field:**
 - e.g. A suspect may claim to have uttered an incriminating statement 'just to wind up the police', and claim to have seen a certain bugging device there, which was not in fact the real recording device. How can this be proved?
 - Equipment identifiers, date and time stamps are thus important and useful to have for recordings.
- **In the laboratory:**
 - It is important to be able to verify whether the file presented to the court and analyzed really corresponds to the original recording made in the first digital download

Acquisition

- This standard could be embedded directly into acquisition hardware, eliminating the need for individual users having to manually input and check the data.
- This data is also useful for book-keeping and maintaining data records.



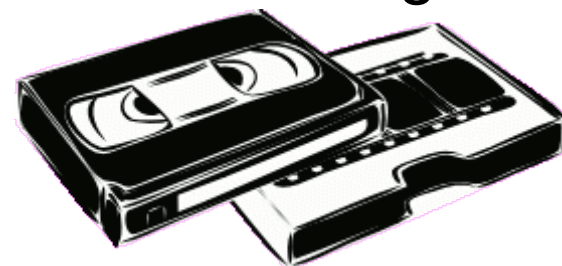
Processing

During forensic audio analysis, the expert has to?

- take care to ensure the integrity of the audio.
- maintain detailed records pertaining to the analysis.

It has become increasingly easy with modern audio-editing software to:

- alter an audio recording in ways that may make it unacceptable in the courts as evidence.
- inadvertently or maliciously tamper with a recording.



- Storage of digital audio evidence; searching for and retrieving specific desired audio recordings is becoming increasingly difficult.
- Possible to export the embedded meta-information about the case in an accompanying file which can be indexed and searched.
- Forensically relevant information can be embedded into audio files in a way that does not affect the playback or use of the file in any other software.



Overview of the Wave Format

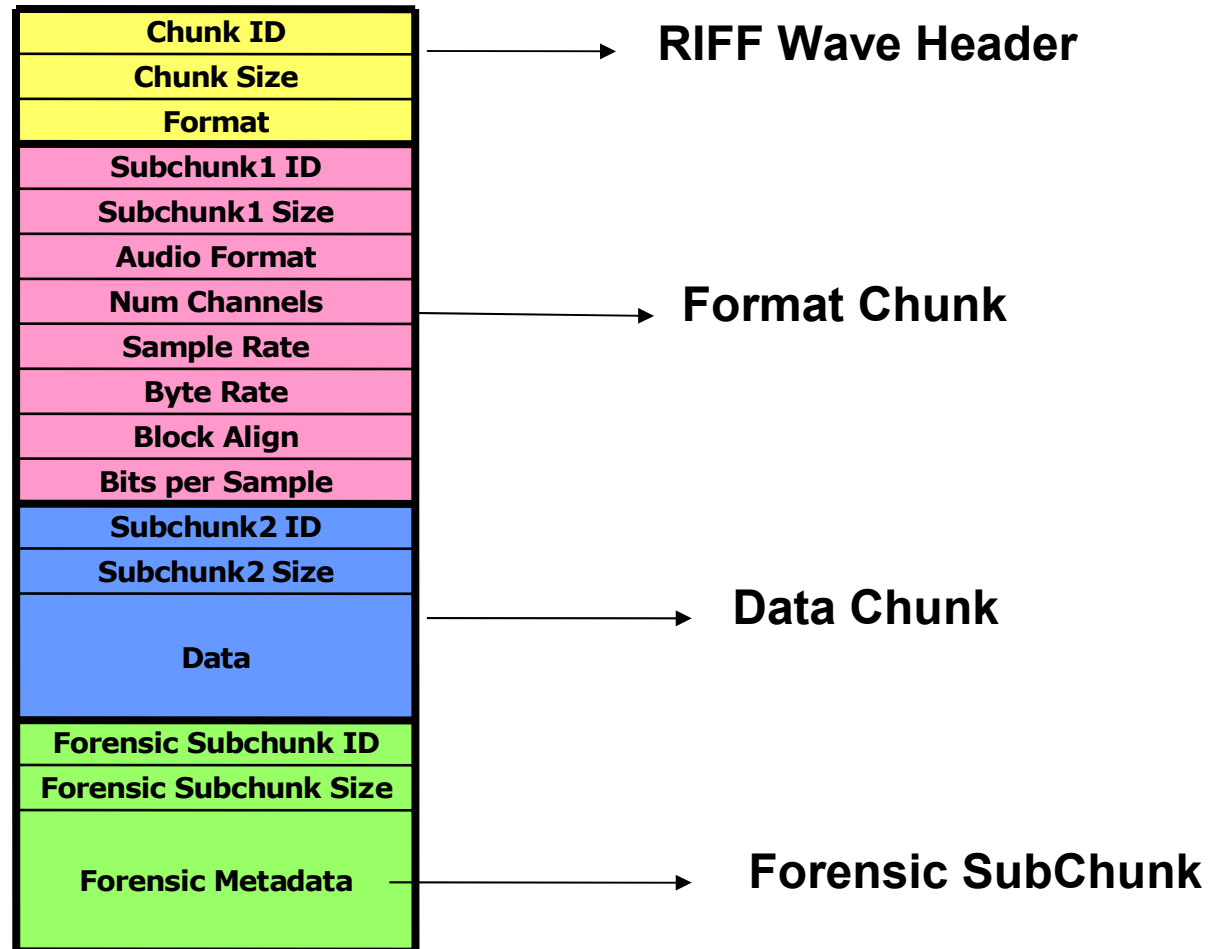
- Most common file adhering to the RIFF (Resource Interchange File Format) standard.
- Chunky format: Organizes data into blocks called 'chunks'.
- Introduced in Windows 3.1 as a multimedia sound format

Overview of the Wave Format

- Various different chunks are defined for wave files
 - labeled text, cue information,
 - data and silent regions, compression details, etc.
- Most often the wave files only have two such chunks
 - Format chunk (fmt) (information about the data format)
 - Data chunk (the actual samples contained within)

Additional chunks can be used as forensic chunks.

Wave File Format



Forensic Chunk

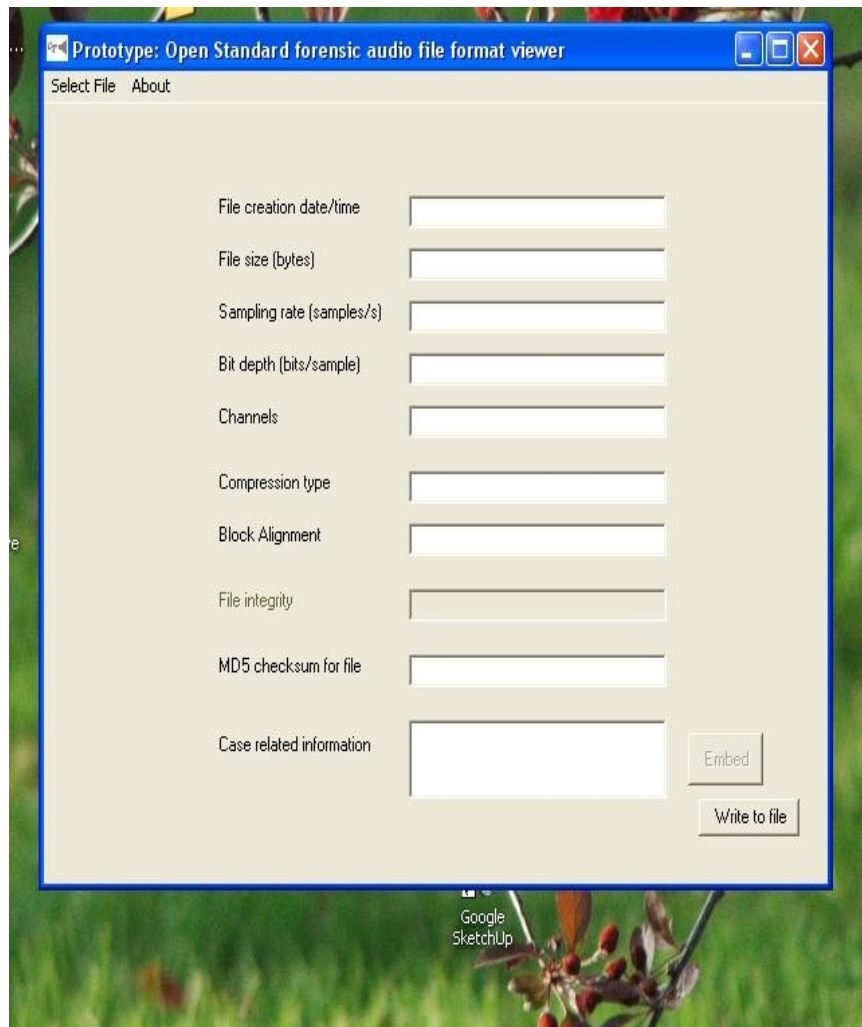
Contains forensic meta-information about the case, e.g.,

- Case serial numbers
- Time of acquisition or receipt
- Identifying information about the specialist analysing the case
- Call record information and other details
- Annotation and transcription

In addition,

- An MD5 checksum hash of the samples present in the data chunk in the audio-stream.
- Plain-text name or digital signature of the specialist (optional)

Demonstration



Other Views

Is this necessary?

A 'fair and accurate representation' standard is used in US courts for the admittance of images and audio as evidence.

Verbal validation by the witness who processed the information, or who was party to the original scene/conversation along with basic chain-of-custody procedures.

Other Positions

The imaging community's position is against the requirement of any technological hashing-style data verification. [Scientific Working Group on Imaging Technology]

Difficulties Involved

- Require a lot of 'inside' information to be able to follow the transport of audio to check its integrity.
- Re-creation of situations not possible once the operation is over to explain anomalies in a recording, because the situation might have changed.

Conclusion

- With the increase in digital audio and video evidence, it is necessary to incorporate measures to maintain the integrity of the evidence and document processes as with other physical evidence.
- We need to take a first step towards an open standard, which forensic audio laboratories as well as the providers of forensic audio hardware can use.
- The standard proposed should be 'backward' compatible with existing audio software, and audio created according to this standard should play normally in standard hardware.
- Feedback is sought from the forensic community about the kind of information that can be embedded.

Thanks

- To Jos, Reva, Greg Griffiths and Mike Piper for their valuable comments.
- To www.openclipart.org for some of the graphics used in this presentation.

Questions?

Thank you for your attention.