

Confidential & Personal

**BEK TEK LLC**

---

**Audio/Video Forensic Consultants**

**Bruce E. Koenig  
Douglas S. Lacey  
Steven A. Killion  
Suzana Galić Price**

**Tel (703) 631-7099  
Fax (703) 266-4461  
BEKTEK@cox.net**

**LABORATORY REPORT**

August 14, 2009

**To: Dr. Bart Jacobs  
Institute for Computing and Information Sciences  
Radboud University Nijmegen  
Heyendaalseweg 135  
6525 AJ Nijmegen  
The Netherlands**

**Re: Digital Audio Authenticity Analysis**

**Laboratory Number: 0906120**

**Specimen received: June 12, 2009**

**Qc1 One Sony 4.7 GB DVD+R disc marked "CEAf INVESTiGATiON  
COPY 3, 3 JUNE 2009 SOURCE : B. JAWBS UNiV. NijMEGEN,  
NL".**

**Item received: July 6, 2009**

**NE1 An email message from Bart Jacobs titled "NL case; further  
explanation".**

**Results of examination:**

As previously advised, conclusive audio authenticity analyses can only be conducted of original recordings, or clone copies in their original file format. The recordings on specimen Qc1 have been represented to us as being duplicates.

## Confidential & Personal

Specimen Qc1 contains a "README.txt" file and eight wavefiles with the following characteristics (time in a minute:second format referenced to the beginning of the specific file):

1. "a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 02:45.98.
2. "a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 08:02.98.
3. "a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 46:10.99.
4. "a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 07:59.00.
5. "a3-24-22h24-14nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; two channel; length of 0:13:49.55.
6. "a4-34-20h45-1dec97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; two channel; length of 14:17.41.
7. "kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 08:57.99.
8. "kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav"; sampled at 44.1 kHz; 16-bit PCM quantization; monaural; length of 04:59.00.

The eight wavefiles on specimen Qc1 were subjected to critical listening, digital data, high-resolution waveform, narrow-band spectrum, and spectrographic analyses, which revealed the following:

1. Pre-recorded, voiced time recordings, followed by a nominal 810 Hz sine wave tone plus harmonics, were present at the beginnings and ends of "a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav", "a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav", "a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav", "kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav", and "kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav"; and at the end of "a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav". These recordings were consistent with being approximately ten (10) seconds apart.
2. Severe aliasing artifacts, especially obvious at approximately 3 kHz and harmonics, are present on all of the recordings, except for the "a3-24-22h24-14nov97.wav" and "a4-34-20h45-1dec97.wav" files. Aliasing is the addition of frequency components that were not part of the original recording, and probably occurred during the duplication process due to improper digitization.
3. Printhrough was noted in low-amplitude portions throughout all of the recordings, except for the "a3-24-22h24-14nov97.wav" and "a4-34-20h45-1dec97.wav" files. Printhrough is normally associated with recordings on analog tapes, and is the unwanted magnetic transfer of higher-amplitude information on one layer of tape to an adjoining layer.

## **Confidential & Personal**

4. There is no embedded metadata information in any of the recordings, which could indicate the method(s) of transmission, incoming/outgoing telephone numbers, and other information regarding the production of the recordings.
5. The telephone signaling in all of the files is generally consistent with the GSM (Global System for Mobile communications) frame structure that is carried over the PSTN (public switched telephone network) after being handed over by the wireless network equipment. This is indicative of the recordings having been made at the switches/routers used at the core of the Netherlands PSTN. Some of the signaling is identifiable as one of the supervisory tones used in the Netherlands network (for example the ring tone); however, it is not possible to determine the exact function of every set of tonal sounds present in the files.
6. For wavefile "a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav" the following characteristics were noted:
  - a. There are a number of transient events and noise-level changes following the time recordings and preceding the telephone conversation, which are probably indicative of recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. There is a ring/ring back tone just preceding the beginning of the telephone conversation.
  - c. The telephone conversation starts at 01:08.59 and ends at 02:08.74, and it is unknown if the conversation ended prior to the termination of the telephone call.
  - d. The recorded voices in the telephone conversation are very distorted.
  - e. There are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - f. There is a sharp transient event following the end of the telephone conversation, which could be consistent with system signaling or a possible recorder stop or start. Then there is a series of nine (9) tonal sounds consistent with telephone network signaling.
  - g. There is no obvious signaling indicating the source of the call.

**Confidential & Personal**

7. For wavefile "a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav" the following characteristics were noted:
- a. There are several transient events and noise-level changes following the time recording and preceding the telephone conversation which are probably indicative of recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. There is a set of four (4) ring tones just preceding the beginning of the telephone conversation.
  - c. The telephone conversation starts at 00:30.39 and ends at 06:45.89, and it is unknown if the conversation ended prior to the termination of the telephone call.
  - d. The recorded voices in the telephone conversation are very distorted.
  - e. There are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - f. There are no obvious transients, system termination, or record events following the end of the conversation.
  - g. Then there is a series of nine (9) tonal sounds consistent with telephone network signaling.
  - h. After the pre-recorded, voiced time signals, there is a series of transients and noise changes which are probably indicative of recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - i. Starting at about 07:39.49 there is additional telephone signaling that is consistent with a possible second telephone disconnect; this is followed by the pre-recorded time signals.

**Confidential & Personal**

8. For wavefile "a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav" the following characteristics were noted:
- a. There are several transient events and noise-level changes following the pre-recorded, voiced time signals and preceding the telephone conversation which are probably indicative of recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. Then there is a series of nine (9) tonal sounds consistent with telephone network signaling.
  - c. After the ringing sounds, the telephone conversation starts at 01:00.57 and ends at 43:47.92, and the conversation is cut off at the end; it is immediately followed by the end of the pre-recorded, voiced time recording.
  - d. The recorded voices in the telephone conversation are very distorted.
  - e. The telephone conversation contains numerous areas of reduced amplitude, which are probably artifacts of the telephone connection.
  - f. At 15:48.43 there are transients followed by each male saying "hello"; this portion could be consistent with a telephone dropout.
  - g. At 30:41.13 there is a low-frequency, low-amplitude sound that is a probable recording or telephone system artifact, possibly an erase head touch-down event that produced a short-duration, localized erasure of information.
  - h. There are five (5) areas with higher-level 50 Hz and harmonics, which may be indicative of the duplication process; the times of the areas are: 23:08.14-23:12.60, 23:23.16-23:28.00, 23:38.25-23:43.49, 24:08.39-24:12.98, and 25:07.95-25:12.79.
  - i. Other than the above, there are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - j. Following the conversation, the voiced time information signal, and some transient events, there is a series of nine (9) tonal sounds consistent with telephone network signaling; this is followed by voiced, time information recordings.

**Confidential & Personal**

9. For wavefile "a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav" the following characteristics were noted:
  - a. This file starts with voiced time information recordings, several transient events and noise-level changes, followed by additional voiced time recordings and ring tones preceding the telephone conversation; the transients and noise-level changes are probably indicative of recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. The telephone conversation starts at 00:59.18 and ends at 07:13.38, and the conversation is cut off at the end. Just after the end of the recorded conversation is a telephone signaling tone.
  - c. The recorded voices in the telephone conversation are very distorted.
  - d. The telephone conversation contains numerous areas of reduced amplitude, which are probably artifacts of the telephone connection.
  - e. At 01:38.35 there are higher-level transients during the conversation which are possible record stops or starts, editing artifacts, or telephone system events.
  - f. Other than the above, there are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - g. The conversation is followed by the recorded voiced time information, a few transients, and a telephone signal tone at the very end.
10. For wavefile "a3-24-22h24-14nov97.wav" the following characteristics were noted:
  - a. There is a series of nine (9) tonal sounds followed by three (3) tonal sounds consistent with telephone network signaling.
  - b. The telephone conversation starts at 00:28.74 and ends at 13:40.38, and the conversation is cut off at the end.
  - c. The recorded voices in the telephone conversation are very distorted.
  - d. The telephone conversation contains numerous areas of reduced amplitude, which are probably artifacts of the telephone connection. Four areas have obvious speech losses at 02:23.78, 03:56.70, 06:46.55 and 13:40.38.
  - e. Other than the above, there are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.

## **Confidential & Personal**

11. For wavefile "a4-34-20h45-1dec97.wav" the following characteristics were noted:
  - a. Prior to the telephone conversation there is a tonal sound consistent with telephone network signaling.
  - b. The telephone conversation starts at 00:12.56 and ends at 14:10.69, and the conversation is probably cut off at the end.
  - c. The recorded voices in the telephone conversation are very distorted, especially in the loudest portions.
  - d. The telephone conversation contains areas of reduced amplitude, which are probably artifacts of the telephone connection. One area has obvious speech losses at 02:10.82.
  - e. There is also a loud transient sound at 09:17.08 that could be indicative of a record stop or start, a movement/handling sound, or a system event.
  - f. Other than the above, there are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
12. For wavefile "kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav" the following characteristics were noted:
  - a. There are several transient events, noise-level changes, ringing and other signaling, various pre-recorded voice information preceding the telephone conversation which are probably indicative of system signaling or voice prompts, recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. The telephone conversation starts at 06:01.59 and ends at 08:24.29, and it is unknown if the conversation ended prior to the termination of the telephone call.
  - c. The recorded voices in the telephone conversation are very distorted, especially in the loudest portions.
  - d. At 07:54.31 there is a short segment of wide-banded noise, which is probably a telephone transmission event.
  - e. At 08:13.53 there is a sharp transient event during the conversation which could be indicative of an electronic or physical edit, or a telephone system artifact.
  - f. Other than the above, there are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - g. The telephone conversation is followed by telephone network signaling and voiced time recordings.

**Confidential & Personal**

13. For wavefile "kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav" the following characteristics were noted:
- a. There are several transient events, noise-level changes, ringing and other signaling, and pre-recorded voiced time information preceding the telephone conversation, which are probably indicative of system signaling, recorder stops or starts, system initiations or terminations, and/or manual connections or disconnections.
  - b. The telephone conversation starts at 00:36.60 and ends at 01:06.46, and the conversation is cut off at the end.
  - c. There are no obvious dropouts, transients or other sounds during the telephone conversation that are consistent with alterations, editing, over-recordings or discontinuities; however, as noted above, this is a digital copy and such authenticity results are not conclusive.
  - d. The telephone conversation is followed by telephone network signaling and voiced time recordings.

The audio authenticity examination was conducted by Bruce E. Koenig, Douglas S. Lacey, and Suzana Galić Price.