

Audio Investigations Review

Baybaşın case
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1 Background

Hüseyin Baybaşın (HB, for short) serves a life sentence in the Netherlands. His conviction depends on phone taps. Their authenticity has been contested by HB and his defense. This case has been brought to the attention of the Committee on Closed Criminal Cases (in Dutch: *Commissie Evaluatie Afgesloten Strafzaken*, CEAS). This committee operates with a three-person Entry Committee chaired by Prof. Buruma. The Entry Committee must advise the larger committee on whether certain closed criminal cases require re-investigation.

Late 2008 the chairman of the Entry Committee asked me to help look into this matter. In my inaugural speech from May 2003 I briefly discussed the HB case as an illustration of how lack of software transparency (here: in tapping systems) may lead to controversy. Later, in 2006, I brought the HB case to

the attention of CEAS, but at the time the Entry Committee decided not to investigate the matter. Throughout the years I followed the case from a distance, via the press, but without further involvement. In 2008 the Entry Committee had apparently decided to actually look into the HB case (on someone else's request). As part of an earlier arrangement the Prosecution Service can also be seen as one of the principals for this investigation

In the trials of HB in the late nineties audio tapes (supposedly) of the phone taps were given to the defense. This was low quality material, on audio cassettes. The requests of the defense to get access to the original material—in order to investigate its authenticity—were consistently turned down. The very presence of this original material became a question itself.

The Entry Committee decided on the following scenario.

1. Visit the Public Prosecution Service in order to select and make copies, preferably digitally, of crucial phone taps—if present.
2. Hand these selected taps over to two audio experts for close investigation, where one expert was proposed by the defense and one by the Prosecution Service.
3. Summarise and evaluate these technical findings in an independent review.

The current paper is an elaboration of this last step. It is important to emphasise that my professional background is in information security and not in audio forensics. Hence I will not interfere with the audio-related findings of the experts.

The Entry Committee decided to carry out (only) the first step transparently, in presence of a representative of the Prosecution Service and of HB's defense lawyer Mrs. A. van der Plas. They were involved in, and agreed to, the selection of specific phone taps for further subsequent investigation by the experts.

It was further agreed that at this stage the topic of investigation is restricted to: possible signs of manipulation. How such manipulation, if any, took place, or how manipulated files, if any, ended up in Dutch tap records is beyond scope.

Note: Later on in this review I cite both experts' judgements on each others findings. I'm doing so only in order to create clarity, with good intentions, and not in order to affect their reputation in any way.

2 Time line

An overview of the course of events may contribute to the proper understanding of this report.

2.1 Optical discs copied at Arnhem

As part of the first phase of the scenario mentioned above, a first meeting took place on 20 Jan. 2009, at the Prosecution Service in Arnhem. A safe was opened

containing a shoe box with relevant audio material (digital discs plus magnetic tapes). It was handed over to Buruma, temporarily: it had to be returned at the end of the day. The authenticity of this material itself was not questioned.

A representative of the lawful interception department of the national police was present with one of the few remaining computers that could play the special optical discs. The device could produce per disc an overview of its content—making search easier—and of relevant meta-data such as recording dates/times and telephone numbers involved. The device did not allow direct digital copies. Copies had to be made via its analog audio output, thus involving first a digital-analog conversion, and then again an analog-digital conversion. The audio expert of the defense, S. Peller, tuned the signal strength in such a way that optimal copies (given the circumstances) could be made. This resulted in copies (in digital .wav format) of two conversations, labeled **a3-24** (of 14 Nov. 1997) and **a4-34** (of 1 Dec. 1997).

As an aside, the magneto optical disc containing the taps was of type Sony EMD1200 with a capacity of 1.2GB. The police representative claimed that it was a write-once disc, that could not be altered anymore once data had been written on it. However, the webpage of this product calls it “rewritable”¹. There is a similar but different Sony product CWO1200 that is called “write once (WROM)” on its webpage², but that is not the one that was read in Arnhem. This observation does not play a role in this review but is included for the record.

Since there was no equipment available to copy the magnetic tapes, it was decided to organise another meeting.

2.2 Digitising magnetic tapes at Arnhem

On 15 May 2009 another meeting took place in Arnhem to copy two magnetic tapes. Buruma had asked an expert from the national sound and video archive *Beeld en Geluid* to be present with a tape recorder that could still play the magnetic tapes from the mid-late nineties. I was not present myself, because it was expected to be a routine digitisation job.

It turned out that the taps were recorded at extremely low speed, probably for reasons of efficiency. Even at the lowest speed of the available equipment only very high, ununderstandable tones could be heard. Additionally, only one (mono) channel was used in one direction of the tape, and the other channel in the other direction. It was decided on the spot that the best way to proceed was to digitise the entire tapes in one go, thereby recording both mono channels in a stereo recording, where one channel was reversed. The technician from *Beeld en Geluid* reported that digitisation happened at 48kHz sampling rate with 24 bit depth. Peller later found (see point 3 on p. 3 in his report) that the digitisation actually took place at 44.1 kHz with 16 bits (which is CD-quality).

Three tapes were digitised, where the third one turned out to be only partly

¹See <http://www.tapeonline.com/products/sony-mo-magneto-optical-discs-edm1200c>

²See <http://www.tapeonline.com/products/sony-mo-magneto-optical-discs-cwo-1200b>

filled. The resulting files (in .wav format) were labeled as the tapes: 3285, 3281, and 501, the last one being the short one.

The audio in these files was separated into two tracks (A and B), the B track was reversed, and both tracks were slowed down with a factor 8, via the software of the audio expert (ProTools). The resulting files were so big that they had to be chopped up, resulting in labels like: 3285-kant-1-a, 3285-kant-1-b, 3285-kant-2-a, 3285-kant-2-b.

All this was so time-consuming that there was no time left to search for relevant phone taps. This was postponed to another meeting.

The entire digital files were copied to a separate harddisc that was kept in a safe by Buruma. The harddisc of the computer of the audio expert was cleaned at the end of the day. This person worked under a secrecy agreement.

2.3 Selecting conversations at Nijmegen

On 27 May 2009 another meeting took place, at Nijmegen, in order to search and copy four crucial (pre-selected) conversations from the files digitised and processed on 15 May. Buruma brought the hard disc and I carried my laptop with Audacity software installed. It made it possible to both play and visually inspect the audio waveform (see Figure 2 on page 10 for a example fragment waveform).

The (digitised) tapes contained no index, or any other explicit meta-data (apart from the recorded voice time signals), for instance about the source and target telephone numbers. No such meta-data was provided at Arnhem. Some of it is contained in the case files, which was used for locating the relevant audio clips. It turned out to be relatively easy to find the pre-selected audio clips. The conversations were recorded in chronological order, with voice time signals inbetween (taken from an automatic service), inserting the time at the end of each conversation. At some stage van der Plas was even able to predict time signals on the basis of her case files. The interpreter that was present translated portions of the conversation, giving additional confirmation.

Apart from four conversations, denoted as **a1-1** (of 9 Nov. 1997), **a1-3** (of 9 Nov. 1997), **a1-4** (of 9 Nov. 1997), and **a1-5** (of 10 Nov. 1997), two reference files were stored for comparison. These files, together with the earlier selected ones (a3-24 and a4-34) were copied to a fresh USB stick and stored in Buruma's safe box. They remained as back up on my laptop but only in encrypted form, with a password only known to Buruma.

2.4 Audio experts start working

The two audio experts are (1) Shlomo Peller, founder and CEO of Rubidium Ltd., an Israeli company specialising in digital speech processing since 1995 (see www.rubidium.com), proposed by van der Plas, and (2) the company BEK TEK LLC from the US (see www.bektekllc.com), proposed by the Prosecution Service. Early june they both received a DVD from Buruma with the selected audio files, together with an accompanying text containing the assignment:

"It is known that the quality of these recordings is suboptimal, but it is the best that is available at this stage. You are asked to investigate these audio files as they are, focusing on possible signs of manipulation, using especially:

- signals analysis. E.g. are there clear signs of alterations and/or discontinuities? If so, you should explain in your report their precise location and the nature of the anomaly.
- telecom analysis. E.g. are the dial tones and other audio characteristics (frequencies, signal-noise ratios) as they should be in the relevant countries at that time?

A linguistic/semantic analysis is not expected at this stage."

The experts had to send their reports to me. Payment was agreed for 40 hours investigation time. They were asked to send in their findings within one month, if possible.

2.5 Audio experts at work

BEK TEK LLC started working pretty soon after receiving the DVD, as could for instance be noticed from small additional clarifications they asked Buruma. Their report is dated 14 august, and arrived a few days later at my office in Nijmegen.

Peller made a slower start. Upon receipt of the DVD he explicitly asked for transcripts of the conversations, because he claimed they could make his work more reliable and effective, even without conducting a linguistic analysis. However, they were not provided. Early july he had taken a serious look at the material and contacted me (on 6 july) complaining about what the recording technician (from *Beeld en Geluid*) has done to fix the playback speed. He had not applied "sample rate adjustement", but some "pitch shift" function that is used for instance to adjust voices that are out of tune. It does not apply a mathematical formula (like in sample rate adjustment) but performs some ad hoc manipulation that distorts the signal. Peller stated firmly that he cannot do any meaningful investigation on these distorted files, and asked for the original versions.

I understood Peller's concerns, but felt uncomfortable with the situation. Since I had not been present at the recording session in Arnhem on 15 May (see Subsection 2.2) I had not seen what the technician had really done, and afterwards I had not questioned his professionalism. But of course, the fact that I am not an audio expert made that I was less sharp in these matters.

I decided to take this up with Buruma. He was at first reluctant to give Peller better material, but I managed to convince him that it was in the interest of the investigation to give Peller an upgrade. A nasty question remained: should BEK TEK LLC then also receive such an upgrade of the audio files? Clearly, by that time their work was already well underway and they had not raised this concern themselves and asked for an upgrade of the audio material. Of course, they were

also less likely to ask for it because they were not aware of the preparatory work in the way that Peller was. Giving it to them at that stage would constitute another delay and would lead to additional costs. It was (jointly) decided not to give BEK TEK LLC the same upgrades and to see whether they would raise the matter in their report (and if so, how).

Hence Buruma and I decided to sit together and make a new selection of the audio clips from the original recordings of 15 May, before the processing took place. This selection had to be done on the basis of recalculated timing (taking a factor 8 into account) and of audio visualisation in Audacity. It wasn't so hard. These selected files were made available to Peller on 14 July. Previously, I had established secure communication with him via PGP (which BEK TEK LLC didn't use). Peller could now do the stretching himself.

After several reminders, Peller's report finally arrived 14 Oct., via secured email. Upon receiving the reports I deposited a copy with Buruma. As agreed earlier with everyone involved, he would not share them before receiving the final version of this review.

2.6 After receiving the expert reports

As agreed earlier I had the time and freedom to ponder the reports of the audio experts, and to carry out my own limited follow-up investigation, if needed. However, given the confidential character of the matter, I could not speak openly to others, which limited what I could do.

I also decided to have separate interviews (via skype) with the audio experts, in order to ask for clarifications but also in order to speak more informally about their findings. I asked them to look further into one specific point raised by the other expert, in order to make a concrete comparison. This will be discussed further in Subsection 4.3 below.

On 19 Oct. I talked to Peller. He explained that in nature nothing happens at once: all changes are gradual, but possibly with a quick build-up or break-down of the signal. So his focus was (among other things) on hard discontinuities in the signal. But with digital (software) sound tools, which were already available in the late nineties, abrupt changes could be smoothened, making them hard to recognise. When asked how then to recognise splicing Peller replied that this was the "million dollar question". It could be a change of sound color or intensity, a sudden change in background noise, a sudden un-natural change in voice pitch, an isolated sub-syllable speech sound, or a click, or other transient sound. I asked him to point to specific smoking guns, but he said that his report includes hundreds of findings, and he would not want to prioritise them by level of importance. "There are many small smoking guns", he replied, "and I would prefer that they are all noticed instead of pointing at some of them as being 'a smoking cannon'". Peller commented on the BEK TEK LLC report that it did not dig deep into the technicalities and that he would have preferred to see more clear and precise statements. He was particularly unhappy with their frequent use of expressions with vague and ambiguous technical meaning, such as "or a system event" (Which system? What event?)

On 29 Oct. I talked to Douglas Lacey, one of the three persons who investigated the files at BEK TEK LLC. He was reluctant to draw strong conclusions about manipulation on the basis of the audio copies that he received, in line with what he stated before starting the investigation. He stuck to this position, even for an audio file like a3-24 that came from the optical disc (see Subsection 2.1), saying that the digital-analog-digital conversions introduced too many uncertainties. When asked explicitly, Lacey said BEK TEK LLC would probably have been willing to make stronger statements if it had had direct access to the digital material on the optical discs. He did not comment on the fact that Peller requested and received upgraded files, because also in this case he would only be willing to make stronger statements on the basis of investigation of the audio tape itself. When asked about his "gut feeling" he wrote later by email (of 30 Oct.):

"The issue of the recordings being copies notwithstanding, our "gut feeling" is that the recorded conversations actually occurred as heard in the files, with the possible exceptions being the events specifically identified in our laboratory report. For those conversations which begin and/or end mid-conversation, however, we can't preclude that these segments have been removed through a duplication or possible editing process. Additionally, there are no indications that any of the conversations were pieced together from separate words to form new phrases or sentences, as this method of editing would have produced very unnatural, stilted conversations."

I subsequently asked to clarify the sentence in the middle starting with "For those ...". Lacey replied on 5 Nov. by writing:

"There are several files in which the conversations end abruptly and are cut off in the middle of a word, just prior to the termination of the telephone call. As stated in our Laboratory Report, these files are 'a1-4' (see 8.c.), 'a1-5' (see 9.b.), 'a3-24' (see 10.b.), 'a4-34' (probable cut-off, see 11.b.), and 'kant-2-b' (see 13.b.). The fact that these files end in the middle of a word indicates (1) that the telephone call was suddenly terminated during the original recording process for some reason, (2) that the original recording process was stopped or paused during the conversation and later restarted after the conversation had ended, (3) that the original recorded conversations were longer and subsequently edited to remove the original endings, thereby shortening the file and creating the abrupt endings, or (4) that the original recorded conversations were longer but were not copied to the supplied files in their entirety (not likely based on the information provided regarding the copying process). For the remaining files, it is not obvious that the conversations end abruptly prior to the termination of the telephone calls, but it is evident that they are not cut off in the middle of a word."

This issue of the abrupt endings of some recorded conversations is briefly discussed at the end of Subsection 4.2.

Lacey had looked at Peller's report. About Peller's conclusions he said that BEK TEK LLC would not be willing to make such statements. Lacey said that people at BEK TEK LLC are used to listening to poor-quality audio files and that many of the clicks and swooshes in speech they heard in the files are common artifacts that arise during the recording and copying of phone conversations. Lacey said that Peller did have a compelling argument regarding the cadence issue (see Subsection 4.2 below). He did suggest that the inconsistencies in the ringing patterns could be the result of non-standard routing of the call, but he also said that they need to be investigated further by a telecom expert.

In the end, both experts were asked to comment on a draft version of this review. Both provided useful textual corrections, improvements and clarifications, which have been accepted with gratitude.

3 About the reports

The two reports are very different. The BEK TEK LLC report is 8 pages long, with only high level conclusions, but very few details, especially regarding the second-by-second audio analysis. The fact that Peller received an upgrade of some of the files does not explain the difference, because for instance for file a3-24—that was not upgraded—the judgements differ completely: BEK TEK LLC thinks it is unproblematic, whereas Peller is concerned: his discussion of this file (pages 11-12) mentions possible splicing six times.

The BEK TEK LLC report points to three possible manipulations, in points 9.e, 11.e and 12.e, the latter being in a reference file. The report speaks about "improper digitization" (in the second point 2 on page 2) that "probably occurred during the duplication process" (as raised earlier by Peller, see Subsection 2.5). However, this was apparently no impediment to the investigation. The signalling is briefly discussed in point 4 on page 3, but is described as "generally consistent with the GSM frame structure". But: "however, it is not possible to determine the exact function of every set of tonal sounds present in the files." Abrupt termination of several conversations is mentioned, but cadence is not mentioned at all.

The Peller report is 32 pages long, with many detailed observations and findings about the audio files. The report says in a number of places: "This could be an indication of splicing" (page 11) or: "Unless the physical tape is damaged at this point, this could be the footprint of rough manipulation" (page 17) or even: "I cannot explain the nature of the noises except splicing that was blurred using artificial noise." (page 27). The report also raises three signalling issues, namely "cadence", "caller identification" and call termination, which will be discussed briefly in the next section.

Peller received upgrades of the (original digitized) files a1-1, a1-3, a1-4 and a1-5, which he stretched himself. Together with his report he sent me the

file	source	initially	example
a3-24	optical disc	PT = BT	
a4-34	optical disc	PT = BT	
a1-1	magnetic tape	PT = BT - 2.2 sec	
a1-3	magnetic tape	PT = BT	
a1-4	magnetic tape	PT = BT - 1.7 sec	16:00.4 PT = 15:48.5 BT
a1-5	magnetic tape	PT = BT + 0.8 sec	1:39.7 PT = 1:38.3 BT

Figure 1: Translation between “Peller Time” (PT) and “BEK TEK LLC Time” (BT) for the various audio files.

resulting audio files that he used for his investigations. His timings are thus possibly slightly different for these four files from the timing used by BEK TEK LLC. By inspection of the audio files I arrived at a conversion table that is described in Figure 1. For clarity, it contains all tapped conversations. The table describes the timing difference at the start of each conversation. This difference drifts a bit (especially in a1-4) because of differences in speed. The example column refers to specific points in both files that the experts draw attention to. I checked the correspondence manually, by timeline inspection.

4 What the reports say

The two expert reports will be reviewed in this section with respect to three topics, namely caller identification, cadence, and manipulation.

4.1 Caller identification

Often when your phone rings you can already see on a display who is calling you. This is because the signal contains caller identification (CID, also known as CLIP) information. The Netherlands uses the so-called DTMF standard. It involves some special tones before the ringing signal in which the calling number is encoded.

Peller is surprised not to see any CID data in the tapped conversations. CID data does not belong to the GSM domain (but to the old land line phone) which uses digital signalling. However, the experts say that the signal is “carried over the PSTN (public switched telephone network) after being handed over by the wireless network equipment” (BEK TEK LLC, point 5, p. 3, see also Peller, on p. 5). It is to be expected that the tapping takes place while the signal is carried over the PSTN, and so the audio signal could contain CID meta-data. Such CID information could be used to establish the consistency of the recordings with the case files, esp. with respect to the telephone numbers involved.

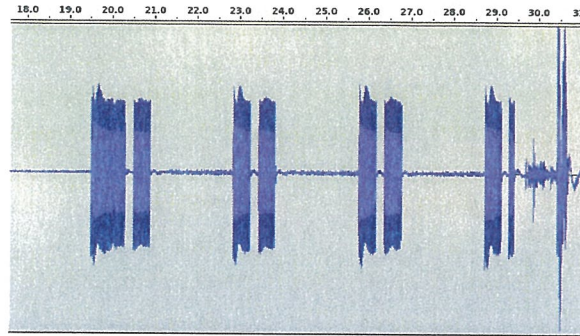


Figure 2: UK cadence at the beginning of the conversation in file a1-3

country	frequency	on	off	on	off
The Netherlands (NL)	425Hz	1	4	1	4
United Kingdom (UK)	400Hz	0.4	0.2	0.4	2
Turkey (TR)	450Hz	2	4	2	4
Israel (IL)	400Hz	1	3	1	3

Figure 3: Relevant country ringing tone frequencies and cadences, with on/off times in seconds

This matter remains unresolved at this stage.

4.2 Call initiation and termination signals

Cadence is the term used for the ringing pattern that you hear before you pick up the phone. This signal is in principle generated by the (local) switch to which the target phone is connected. There are differences in cadence between different countries, in frequency of the tone, but also in length of the on/off signal. For instance, the UK has a cadence which is 400Hz, 400 msec on, 200 msec off, 400 msec on, 2000 msec off. The pattern can be seen clearly in file a1-3, from HB's mobile phone presumably to someone in London. The cadence confirms a location in the UK, see Figure 2.

An overview of cadences for different countries can be found on the web³. A summary of cadences relevant for the investigated taps is in Figure 3.

An overview of Peller's findings is presented in Figure 4. If there is only one ringing cycle before the phone is picked up, like in a1-1, a1-5 (as I inspected

³See <http://nemesis.lonestar.org/reference/telecom/signaling/ringring.html> or <http://www.3amsystems.com/wireline/tone-search.htm>

file	call to	cadence found	status
a3-24	IL	400Hz, 1 on, 3 off	match
a4-34	TR	400Hz, 1.7 on, >2 off	mismatch
a1-1	NL	420Hz, 0.6 on, >3 off	mismatch
a1-3	UK?	?Hz, 0.8 on, 0.2 off, 0.4 on, 2 off, 0.4 on..	UK match
a1-4	TR?	440Hz, 1.7 on, 3.3 off, 1.7 on	no match
a1-5	NL	420Hz, 0.6 on, >3 off	mismatch

Figure 4: Cadence overview from Peller's report with on/off times in seconds

myself), the measurement of the on-part should also be read as "at least" because the tap recording could be switch on a bit too late, whereby part of the initial signaling is missed. The cadences found for these two taps, both to NL, look the same.

It is not directly clear what these mismatches mean. Surely they form "hard" data, unlike for instance audio distortions. Possible interpretations are:

- The geographical data associated in police reports to the phone calls are not correct.
- The phone call is fabricated with incorrect cadence.
- The cadence data in Figure 3 are not correct at the time of tapping (end of 1997).
- Non-standard routing (as suggested by BEK TEK LLC) leads to a deviation from the practice that nearby switches generate the ringing pattern.

Unfortunately, the present scope of investigation does not allow me to delve deeper into this issue and to consult telecom experts (and to investigate the cadence data of a few more calls).

Termination of the conversations also raised some questions. It sometimes happens seemingly in the middle of a conversation, see Peller's point 79 on page 25 and BEK TEK LLC's 8.c, both regarding a1-4. It is unknown what, at which moment, triggers the cut off of a conversation and the insertion of the automatic time signal at the end. These points, and the questions raised by Peller on call termination signals, require more input from a telecom expert.

As mentioned, the whole cadence issue does not occur in the BEK TEK LLC report. But recall that Lacey later said that Peller had a "compelling argument", see Subsection 2.6.

4.3 Manipulation

The issue here is if there are clear signs of splicing, showing that the phone conversation is a combination of two (or more) separate fragments. As mentioned in Subsection 2.6 (quoting Peller), such splices, if any, may take many forms and must be distinguished from common transmission errors or interruptions. In his report Peller is worried about the authenticity of essentially all files — one reference file excluded — but especially about a3-24 and a1-4, via many detailed comments. Only one of these many worries is shared by BEK TEK LLC. Below I will focus on four particular fragments.

Of the three points of possible manipulation described in the BEK TEK LLC report (9.e, 11.e, 12.e) the last one is in a reference file (and is also noted by Peller), but the first one is not flagged as suspicious by Peller. I will start with these two points (9.e and 11.e) noted by BEK TEK LLC

1. BEK TEK LLC's point 9.e refers to file a1-5, at time 1:38.35, which is 1:39.7 in Peller's report, see Figure 5. BEK TEK LLC says:

“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.”

Peller does not mention this point in time in his report. Upon explicit request he looked again into this point and wrote (by email of 30 Oct.):

“Around the time of 1:40 in my file there is a long and diversified series of strange, abnormal occurrences. I have referred to them in my report in points 7, 8, 9 and 10 for that call, all focused within 5 seconds of the call.

There is a typo in my report in par. 7 which says the noise is increased by 0db (0db is no change...).

I seem to have also failed to put a reference to the strong click at 1:39.7, which does NOT look like a natural disturbance of interference but like an abnormal pattern.

Furthermore, the voice of the other party (not “B”) before and after this transient seems different in pitch and characteristics, like it was another person or the same person on a different occasion.

And, moreover, after that party finishes confirming “B”'s statement at 1:42.166 there are several confirmations which sound odd: The other party just confirmed “B”'s statement saying something like “Harame” (I have no idea what it means, but it sounds like a confirmation and repeats often in the calls), then after the “swoosh” noise “B” is saying “ahha” — what is he confirming?, and the other party is confirming again: “mm...mm”.

I find this series of hums and confirmations quite strange, which combine with the other findings in my report.

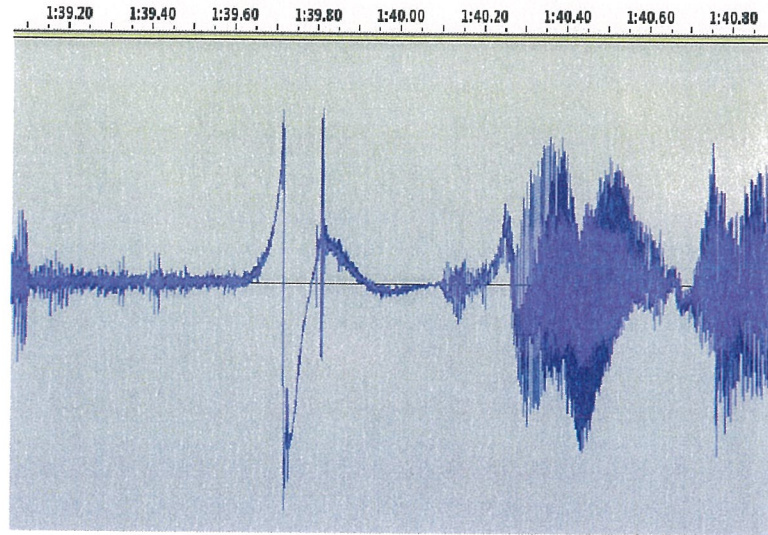


Figure 5: Controversial fragment in file a1-5, at 1:39.7

It seems the specific reference to the strong transient and the other points above have slipped from my list of findings for these 5 seconds that were so full of observations.”

2. Point 11.e in the BEK TEK LLC report refers to file a4-34, see Figure 6. It says:

“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.”

Peller says about this (same) time, in point 6 on page 10:

“At 9:17.081s ~ 9:17.381s the signal is cut. The two parts before and after the signal cut do not seem to be continuous as before, and the pitch before and after the cut are different, meaning this is a different discrepancy than the previous one above.”

3. There is a different fragment in file a1-5 where Peller is rather outspoken. He writes, in point 25 on page 27:

“At 4:33.637 there is a “swoosh” noise, but “B”'s voice is heard in the background. Still it is not a complete word, just a partial speech segment. Immediately after that, at 4:34.478 there is another “swoosh” noise, this time the caller's voice is heard

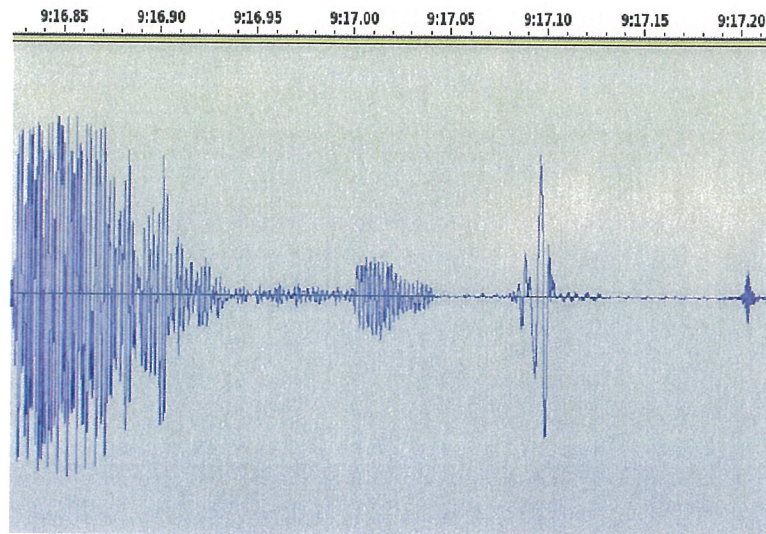


Figure 6: Controversial fragment in file a4-34, at 9:17.08

in the background, also articulating some partial and virtually meaningless speech segment. These noises are isolated from other speech segments, and are therefore out of any context. I cannot explain the nature of the noises except splicing that was blurred using artificial noise.”

This fragment is not mentioned by BEK TEK LLC. I asked BEK TEK LLC explicitly to reinvestage this particular fragment. They stood by their earlier judgment, and added that they thought Peller’s judgement to be too subjective, asking for instance: “how does Peller know that the speech segment is virtually meaningless, unless he speaks the language?”. BEK TEK LLC has a point, because the language here is either Turkish or Kurdish, which Peller does not speak or understand. When questioned about this matter Peller commented: “the voice fragments I heard were sub-syllabic, not anything that can even be described as a phoneme. Phoneme is a basic speech segment, and I don’t know any person that can make sub-phonetic sounds, like diphones or triphones.”

4. Finally I want to highlight a fragment from file a1-4, because it has been controversial in the past. It happens at the end of the 15-th minute, but the timing indications differ in this file, as described in Figure 1. The fragment involves a series of consecutive clicks. During the meeting at Nijmegen of 27 May (see Subsection 2.3) the interpreter said that one of the parties in the conversation complains about his battery being low.

Neither of the experts identify this as a sign of manipulation. BEK TEK LLC writes:

“At 15:48.43 there are transients followed by each male saying “hello”; this portion could be consistent with a telephone dropout.”

And Peller in point 27 on page 21 writes:

“At 15:58.676 ends a speech segment where both parties speak together. Then there is a series of clicks: a click is heard at 15:59.135 followed by a “swoosh” noise at 15:59.305. A click with mechanical nature is heard at 16:00.245. Then from 16:00.385 there are four clicks with a fixed distance of about 0.154s apart. They sound to me like a mechanical disturbance or RF interference. Then there is another click noise at 16:01.152. Both parties say “hallo” after this sequence.”

5 Conclusions and recommendations

The investigations described in this review lead to the following remarks.

1. Concerns have been raised in past about the existence of originals underlying the low quality audio cassettes given earlier to the defense in the HB case. However, the Prosecution Service did produce optical discs (with meta-data) and magnetic tapes (without meta-data) that contain HB's phone taps. This takes away certain doubts.

As an aside, it also means that if manipulation took place, it must have happened deep inside the police or Prosecution organisation.

2. Earlier investigation of the audio material by the Dutch National Forensic Research Institute NFI found no irregularities in the phone taps. At this stage however, there are explicit doubts, see the next two points.
3. There is at this stage no explanation for the cadence mismatches (see Subsection 4.2), which suggest that the claimed locations of the tapped conversations are not correct. More generally, the signaling at initiation and termination of calls is poorly understood (including the lack of caller identification (CID) signals).
4. The audio analyses of the tapped conversations by Peller are much more elaborate than BEK TEK LLC's and point to many unexplained phenomena. However, they remain inconclusive because they are, with two exceptions, not supported by BEK TEK LLC. Here it is relevant to note that BEK TEK LLC is a specialist in audio forensics whereas Peller is not a forensics expert but a specialist in (digital) audio processing. Hence I am not willing to conclude more than what both parties agree on. The two experts do

(eventually) agree on two particular points — in conversation a4-34 and in a1-5, see Figures 5 and 6 — which indicate with some likelihood that splicing took place there.

The two experts have focused on audio investigation, leading to questions about telecom signaling that are not answered in a satisfactory way. A follow-up investigation explicitly focusing on these telecom signaling issues (and not on audio) is recommended. In any further investigation, the following points may be taken into account.

1. In further audio analysis it is important to get access to the *digital* material on the optical discs, to rule out all issues involved with analog-digital conversions.
2. In other incoming calls on HB's Dutch mobile phone — than a1-1 and a1-5 in Figure 4 — the cadence can be investigated, to see if properly Dutch ringing patterns are present or absent there.
3. The general issue of initiation and/or termination patterns requires a review by a proper (mobile) telecom expert.