Aan: Prof. mr. Y. Buruma, 15 Nov. 2009
Voorzitter toelatingscommissie CEAS,
p/a Faculteit der Rechtsgeleerdheid,
Radboud Universiteit Nijmegen.

Geachte collega Buruma,

Ziehier het gevraagde rapport over het audio onderzoek in de zaak Baybaşin. De rapporten van de twee audio experts (BEK TEK LLC en Peller) zijn als bijlagen toegevoegd. Voor nadere informatie of toelichting ben ik desgewenst beschikbaar.

Met vriendelijke groeten,

Prof. dr. B. Jacobs

Audio Investigations Review

Baybaşin case
Date: 15 Nov. 2009

Author: Prof. dr. B. Jacobs,
Institute for Computing and Information Sciences,
Radboud University Nijmegen,
Nijmegen, The Netherlands.
Webaddress: `www.cs.ru.nl/~bart`

Contents

1 Background

Hüseyin Baybaşin (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 transparancy (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 represenative 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 webpage[2], 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

[1] See `http://www.tapeonline.com/products/sony-mo-magneto-optical-discs-edm1200c`

[2] See `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 compnay 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 accompagnying 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 professionality. 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 establised 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 comparsion. 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 withe "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 heared 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.

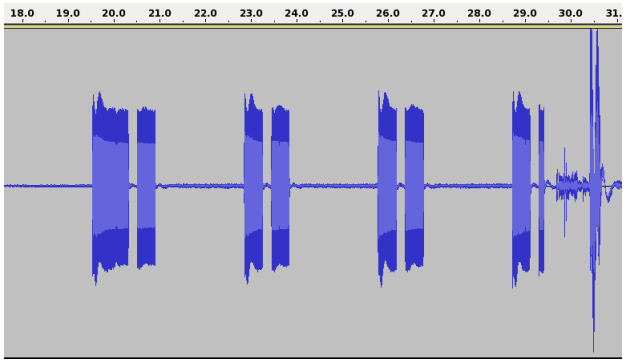

Figure 2: UK cadence at the beginning of the conversation in file a1-3

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 web[3]. 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

[3]See `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 occurances. 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.

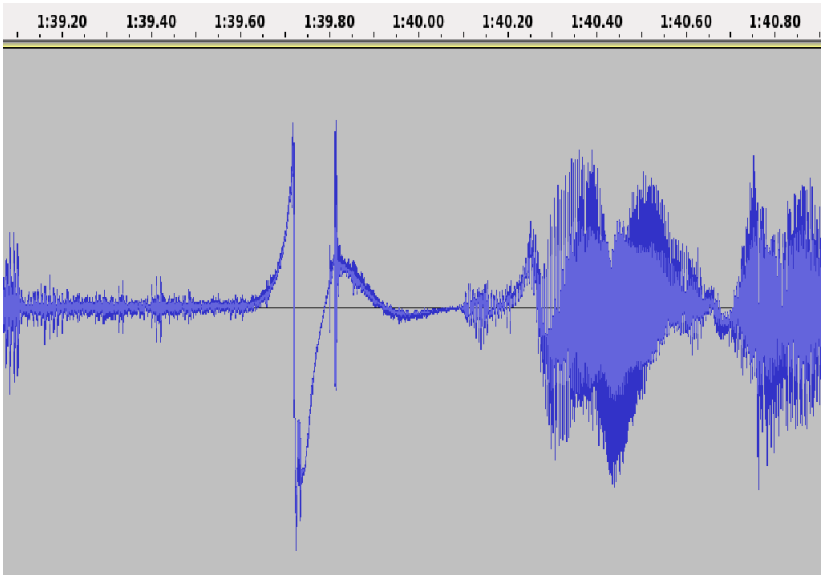

Figure 5: Controversial fragment in file a1-5, at 1:39.7

> 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 $\sim$ 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

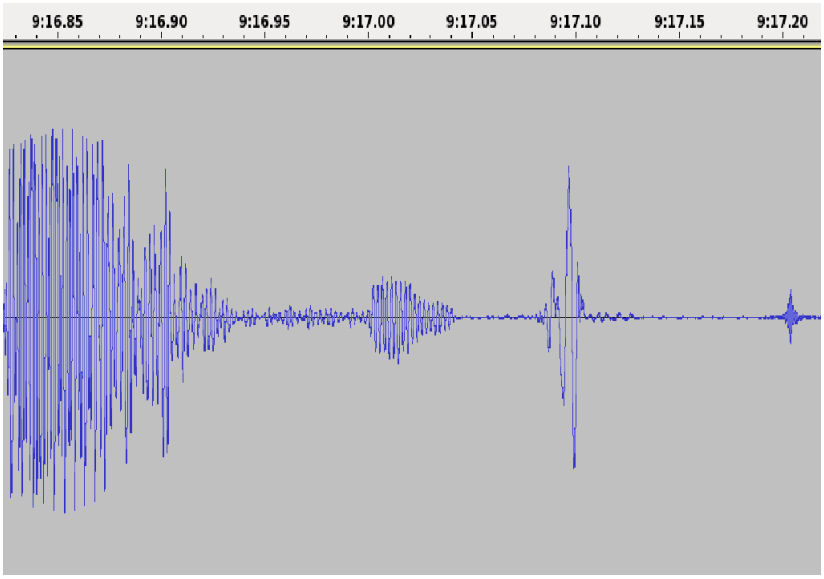

Figure 6: Controversial fragment in file a4-34, at 9:17.08

> 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.

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.

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. Printthrough 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. Printthrough 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.

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.

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.

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.

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.

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.

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.

RECORDINGS EXAMINATION REPORT

BY

SHLOMO PELLER, MSC.

SEPTEMBER-OCTOBER, 2009

CONTENTS

1. Investigated Material:

In June 2009 I received an envelope containing a DVD-ROM and an instructions letter. The DVD included audio material of 8 tapped conversations and a readme file. The audio content was arranged in 8 separate WAV files.

The audio content I received was claimed to include tapped telephone calls held in October - November 1997 between a person I shall call "B", the subject of the tapping, using one or more cellular phones, and other parties, using a landline or cellular phones.

The tapping method and the location of the tapping system were unknown to me. The recording was used as part of evidence in legal proceedings held against "B".

According to the readme file, out of the 8 conversations there were 2 digital recordings (i.e. digitally encoded and stored in digital media) and 6 analog recordings (i.e. intercepted and recorded on analog tape recorders).

The digital recordings were supposedly those which I copied myself from the presumably original digital storage media, by playing the digital media on a similar tapping system into an analog output and then re-digitizing and collecting the analog signal into digital form.

As opposed to this copying process, the analog media was described to have been converted to digital form by a Dutch expert lab using the following process:

1. The analog tapes were played on a tape recorder with motor speed much higher than the original recording speed (about 8 times faster).
2. The magnetic head of the playing machine had twice the width of the recording machine's head, but supported stereo recording. The original recordings were performed in mono, but used half the tape width and the recording tape was "flipped" when one side was complete. As a result, the produced signal had "forward" and "backward" recording sessions as the left and right channels of the stereo playback, where the right channel was reversed in time.
3. The analog signal was sampled at a rate of 44.1KHz into digital form
4. In order to compensate for the increased playback speed, and in order to separate the "forward" and "backward" sessions and reverse the "backward" session, the expert lab used professional audio processing software called "ProTools", which is commonly used in recording studios.

Reviewing the material I first received, I noticed clear signs of frequency aliasing in the analog material, indicating improper processing of the original material.
Exploring the process performed while digitizing the material, I could point out as follows:

1. The material was digitized at 44.1KHz, implying a Nyquist anti-aliasing low-pass-filter of 22.05KHz was applied prior to sampling. As the original material was played at a speed 8 times faster than the recording speed, the frequency band was stretched by a factor of 8. If the original signal had telephone signals with bandwidth up to 3.6KHz, as is customary for telephone channels, then the stretched signal had frequency contents up to 3.6 x 8 = 28.8KHz. The frequencies above 22.05 were cut in the sampling process. Effectively, the original signal was low-pass filtered at an equivalent frequency of 22.05 / 8 = 2.756KHz.
2. The speed of the digitized material was altered using ProTools, however not by changing the sampling rate but by using some proprietary voice manipulation feature of ProTools used for pitch changing. Such processing introduces non-linear affects, warps the time domain and could generate diversified and unknown artifacts into the signal.

As a result, I have requested the material to be resent as it was after digitizing, without separating the left and right channels, without reversing the left channel and without changing the playback speed. I have performed all of those steps myself, using CoolEdit software.

I would like to emphasize, however, that since the sampling of the original analog recordings could not be repeated, the spectrum of the material I received was effectively cut at about 2.7KHz (as explained above), which chopped off some part of the relevant telephone frequency band (and of course the frequency band above 3.6KHz, which was supposed to have no contents, however this could not be verified).
As a result, I could not search for anomalies in the upper band contents of the analog material, which I would consider a natural and principal part of my examination.

2. Investigation Target:

In the letter attached to the DVD and the readme file, I was asked to provide an opinion, based on my expertise, regarding possible manipulation of these taps. For some of the material the target questions were explicitly specified as follows:

#	File	Analog / Dig.	Specific Questions
1	a4-34-20h45-1dec97.wav	D	
2	a3-24-22h24-14nov97.wav	D	
3	a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav	A	Are there (signal) indications about the source of the call?
4	a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav	A	Is this possibly a concatenation of two separate conversations?
5	a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav	A	Is this possibly a concatenation of two separate conversations?
6	a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav	A	
7	kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav	A	
8	kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav	A	

In addition, I was asked to provide my opinion for each of the calls regarding the following questions:

1. Are there clear signs of alterations and/or discontinuities? If so, their precise location and the nature of the anomaly.
2. From telecom perspective, are the dial tones and other audio characteristics (frequencies, signal-noise ratios) as they should be in the relevant countries at that time?

3. Caller Identification (CID) Information

A possible way to identify the identity of the parties of each call and the date and time of call is by decoding the CLIP (also called Caller ID or CID) signals transmitted on the telephone network before- or immediately after the first ring (depending on the applied telecom standard). The CLIP signal includes digital data such as the calling telephone number, and, sometimes, also the caller's name (as registered in the public telephone directory), the date and time of the call, and possibly additional data.

In special cases like a private caller, or a long distance call, the CLIP data will still be transmitted and provides a reason for the absence of information (such as "private caller").

CLIP information is a standard applicable for many years, including both domestic and international telephony, and defined by several international standard institutes, such as ITU, TIA, ETSI and BT (British Telecom).

Unfortunately, although (to the best of my knowledge) telephone exchanges in the NL were already all digital in 1997, **there is no sign of CLIP data transmission in even a single call of the 8 tapped calls I received**. Such a CLIP signal would have been very instrumental in the authentication of these calls, especially their origin, destination, date and time..

The lack of any sign of CLIP transmission could be explained in one of two ways:

1. The CLIP data not being available at the interception point.
2. The CLIP data having been removed artificially from the tapped material by manipulating the audio data.

Consider option 1:
We know there is CLIP data available to the call interception point, since (a) digital calls intercepted only one month later by the digital system (replacing the analog tapping system in the middle of November 1997) had CLIP data available and logged; and (b) the CLIP data must have been available also to the analog tapping system in order to generated a log of the call activity (like the presumed call's date, time and parties' numbers).

We know that the exchange nearest to the call destination can block the CLIP signal to the destination depending on whether the user is subscribed to the CLIP service. However, the playback of ringing tones on a wireless line before the call starts proves that the interception point is in the telephone network and not the "last mile", since a cellular audio link does not play ringing tones for an incoming call.

The calls were therefore intercepted on the digital telephone network, where the CLIP data is available (and call activity was also logged by an unknown mechanism). A typical connection node into a digital PCM trunk behaves like a small and autonomous exchange: it streams out the requested audio channel-of-interest and adds the proper exchange signaling associated with this channel to convert it into a simple analog line. CLIP is a part of that signaling, providing the call details. We expect that the CLIP signal had been super-imposed on the analog line used for the tapping, however there is no CLIP signal in any of the calls.

We could therefore conclude the following:

1. The CLIP information was available during the recordings
2. The CLIP information was logged by both the analog and the digital tapping systems. Yet, I did not see any explanation of how the call activity log was generated for the analog calls, since CLIP is missing from ALL the analog recordings. If it was registered somehow automatically by a "side logging channel" then there should have been additional logging media documenting the alleged calling numbers, destinations, dates and times. I have not been provided with such media, and I have not been notified of its existence.
3. If a standard interface node was used to stream out the analog data from the digital telephone trunk, then we would expect to see CLIP signals in all the recorded calls. The explanation for their absence could be that the CLIP signals had been removed at a later stage to erase traces of the call details.

I cannot find a satisfactory explanation for the absence of CLIP information from all the recordings. Either the CLIP data was erased from the recordings, or there should be another media which was not made available to me that logged the call activity. In the latter case a non-typical interface was used to connect into the telephone network, which needs to be further investigated.

4. Analog Call Termination Signals:

Throughout the analysis presented in this report, and specifically in the calls recorded by analog tapping system on magnetic tapes, I have repeatedly had to address the signals associated with call termination. Since this issue has a significant impact on the conclusions of my analysis, and since there is importance in comparing the call termination pattern of the various calls (recorded during a short period of several weeks) I shall provide here a focused discussion of analog call termination, and shall cite it later in my analysis.

While a digital tapping system records the tapped material with a log of the time and numbering information, an analog system records calls serially on an analog media. I did not have access to the analog system used to collect the analog material, and therefore needed to apply common practice to figure out some of its characteristics. In the analog tapping system, the call timing was attached to each call by recording an audio "talking clock" before and after each call. The talking clock did not have date information, only time information, and included information on neither the called nor the calling number. This prohibits the authentication of the call schedule, identity and location of the parties compared to the claimed data.

On some – but not all – of the ANALOG calls, there is a "busy tone" played after the termination of the call. Here is the description of these signals by call identification:

Call	File	Analog / Digital	Termination tone	Freq	On	Off
1	a4-34-20h45-1dec97.wav	D	NO			
2	a3-24-22h24-14nov97.wav	D	NO			
3	a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav	A	YES	~417Hz		
4	a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav	A	YES	~417Hz	0.25s	0.25s
5	a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav	A	NO			
6	a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav	A	YES	~417Hz	?	?
7	kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav	A	YES	425Hz	0.25s	0.25s
8	kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav	A	YES	425Hz	0.25s	0.25s

The source of this signal is unknown. We should therefore consider two options:

1. The standard "busy tone" marks a known situation in landline phones, where the calling party hangs up the line, and the called party leaves his phone offhook. After a certain delay the exchange nearest to the called party starts playing a busy tone to alert the called party of the termination of the call. In cellular networks the call is terminated and hung-up automatically.
2. The "busy tone" is generated by the interception system to alert the recording system of the termination of the call, so the recording system can switch on the "talking clock" and stop the recording.

Assuming option (1) creates some un-explained peculiarities which makes this option unlikely:

(a) Why were the calls not terminated automatically, since at least one of the parties, "B", is using a cellular phone.

(b) The busy tone does not match the local telecom standard of "busy tone" for the claimed call destination, which means either this is not a telecom signal or the call destination is different than the claimed.
Moreover, all the busy signals have the same frequency and pattern.

(c) There is no delay at all from the call termination to the start of the busy tone. This would not be possible by telecom standards, since in the telecom world a temporary hangup has a legitimate meaning, so there must be some delay before a hangup situation is interpreted as call termination.
(d) In some calls the call termination is abnormal, in the middle of the talk. This would not be typical to a case of unilateral hangup.
(e) Why do all the "busy tones" have approx. the same frequency and cadences despite the fact the calls are made with several different countries?

If the case is (2), it cannot be explained:
(a) If the signal is generated by the tapping system, why is it missing in one of the calls?
(b) Why were some of the calls (more than one!) cut in the middle of a sentence or a word?
(c) Why does a signal generated by the same system have different characteristics – in one call it has an AGC pattern with increasing gain, while in other calls it has a constant amplitude?

I therefore conclude that there is no satisfactory unified explanation for the pattern of the termination signals demonstrated in the calls. Based on this conclusion and the questions it creates, the termination of at least some of the calls is unreliable.

5. Disclaimers:

1. I approached this analysis with limited knowledge about the case history, and especially the background of the material I have analyzed and its collection.

2. Most of the material includes conversations using unknown language(s) that I am unfamiliar with. The translation of these conversations was not available to me during my analysis, which could have had limited affect on my opinion.

3. The total time I was given to investigate the material and write this report was limited to 40 hours. I have made every effort to complete my work within this time scope, however more time would have allowed a more in-depth investigation and possibly more findings.

4. Occasionally I have had to make observations based on my subjective expert opinion rather than based on objective facts. I have tried to point out to such subjective assessments.

5. Certain observations related to telecom signals are based on international telephony standards. The investigated material presumably includes taps made in 1997 in Europe. During the 90's Europe has undergone substantial changes of its telephone network infrastructure, driven by the replacement of analog switches by digital systems, and the simultaneous installation of cellular networks and their gradual upgrade from analog standards to digital standards. As a result, some of my observations have limited certainty, since they may be overlooking some non-standard networks which were later abandoned and phased out.

Call no. 1, File: a4-34-20h45-1dec97.wav
December-1-1997, 20:45
Reportedly outgoing conversation from "B" mobile phone 06-51357183 in NL to mobile phone number 0090-53-23217789 in Istanbul, Turkey.

Observations:

1. The signal has very high distortion on both parties' phones. The distortion does not demonstrate clipping or amplitude limiting, but simply inherent distortion. This is abnormal for digital recording intercepted from a digital cellular network. There is no explanation for this distortion.
   Having been present on site when this call was played from the optical disk on a tapping system, I recall that the distortion was not due to the signal duplication setup but was already present in the original playback. The heavy distortion makes deeper analysis of the call very difficult.

2. The ring cadence is ~ 1.7s on and at least 1.957s off (after which the call was answered). The ringing tone is 403Hz =~ 400Hz.
   The ringing tone standard in Turkey is 450Hz with cadence=2s on, 4s off.
   The Dutch ringing tone is 425Hz.
   The ringing in this signal matches neither the destination telephone network in Turkey (which is supposed to be generating the ringing signal), nor the Dutch network.
   A Ringing tone of 400Hz would be possible either with a call destination other than Turkey or with an old exchange in Turkey, which would have then taken place earlier than 1997[1]. Hypothetically, the ringing signal could have been spliced and artificially attached to the recording, or the call's destination is simply not Turkey.

3. There is some low level speech present after the first ring, mixed with various 'click' noises. It seems the call was not yet answered at that time, since there is no signal indicating that. According to the title, "B" was calling another party, and in such a case it would be impossible to hear the other party's speech before the call was established. On the other hand, the low level speech prior to the beginning of the call does not sound like "B"'s voice. There are therefore three options:
   - The call was answered before the low level speech. Then, there is no off hook signal seen before it.
   - The low level speech is generated on the other party's side. Since there is no signal indicating the off hook before this speech, it could mean "B" was not the one who initiated the call, unlike the claim, and in contradiction to the identity of first party saying "hallo" (which would naturally be the called party – in this case not "B" but the other party).
   - The low level speech is generated on "B"'s side. However, not only this speech signal does not sound like "B"'s voice, some cellular phones do not transmit audio before the call was established and the cellular audio link was opened.

   In view of that, the low level speech remains unexplained.

4. There are 'click' noises spread along the call, such as 2:04.854s after the beginning of the call. There is another click at 9:33.88s and the signal fades around it, indicating this is not an acoustical noise.

5. At 2:10.814s ~ 2:10.937s the signal is cut, but it does not seem that any part of the signal is missing(!). In addition, the other party's pitch changes sharply from 130Hz to 103Hz, which is quite irregular. This could potentially be a trace of splicing.

[1] http://www.itu.int/ITU-T/inr/forms/files/tones

6. 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.

7. At 14:10.71s the recording is cut abruptly in the middle of the conversation, after what sounds like "B" posing a question. This is quite irregular for a call termination.

8. The noise spectrum seems to be constant along the call.

Conclusions:

1. Based on the above observations, the signal shows several different anomalies with respect to both international telecom standards and audio signal analysis. As a result, it is argued that the call was likely not made from NL to Turkey as claimed.

2. Some of the discrepancies establish concerns for potential splicing of the call

Call no. 2, File: a3-24-22h24-14nov97.wav
November-14-1997, 22:24
Reportedly outgoing conversation from "B" mobile phone 06-51357183 in NL to mobile phone number 0097-250-200000 in Israel.

Observations:

1. The ringing tone is approximately 400Hz with a cadence of on/off=1s/3s. This suits the standard in Israel, the claimed destination of the call. While the country code matches Israel and the area code matches the prefix of the cellular carrier then active in Israel (called “Pelephone”), the cellular number seems invalid. If the call was initiated by the other party we could have potentially explained it as a Caller ID data malfunction, but in this case it is claimed that "B" initiated the call, so the number data came from "B"'s dialing which was available to the tapping system. It therefore remains unexplained why this awkward number was registered as the destination of this call.

2. The background noise level changes sharply in many places, such as at 5:52.74s. This however could potentially be the impact of half-duplex communications, where the side of "B" had a lower noise level.

3. At 0:47.765s there is a major signal discontinuity – the signal and pitch are instable. Then, at 0:48.6s~0:49.42s the signal is garbled and non-continuous. The word "hallo" is followed by a syllable "yie" which is chopped and out of context. This could be an indication of splicing or manipulation.

4. At 1:29.887s there is an unexplained click noise

5. At 1:30.35s there is a strong interference

6. At 2:13.05s there is a major signal discontinuity: the background noise level changes abruptly and the speech seems to be garbled and un-intelligible. The speech cannot be understood.

7. At 2:13.05s the other party's signal level increases abruptly by about 6dB until about 2:18.4s where it slides back to the previous level. The spectral characteristics of the speech also change during this period. At the same time the noise level also changes, implying that the increase in signal level is not a result of the other party raising his voice. This could be an indicator of splicing, unless the recording level or the playback level were changed during this time. However, due to the garbling of the speech at 2:13.05s and the change in signal characteristics the option of change in playback level is unlikely, and signal anomaly would be a more reasonable option.

8. At 2:23.777s and until 2:23.981s a part of the signal is missing. This seems like an interference of an unknown source causing the masking of the signal. It sounds to me like the time axis is continuous, i.e. no indication of splicing.

9. At 3:56.647s and 3:56.925s there are audible clicks. Between them the background noise level is decreased. The speech is cut, and speech on both sides of the gap does not connect smoothly. The pitch is different before and after the gap. It seems that the time axis is not continuous. This could be an indication of splicing.

10. At 6:46.54s there is a major signal discontinuity – the signal fades out nearly to zero, and then the pitch is inconsistent and some part of the speech is clearly missing or garbled. This could be an indication of splicing or manipulation.

11. At 10:03.159s and 10:03.57s there are clicks which, unlike the previously mentioned clicks do not present a change in background noise level or any speech cutoff.

12. At 12:34.012s there is a click with sudden fade out. The speech is not continuous before and after the fade. This could be an indication of splicing.

13. At 13:25.47s to 13:26.52s the other party's speech is cut. Although this is not a regular pattern in this call, this could be due to half duplex communications.

14. At 13:40.37 the recording is terminated abruptly in a most un-natural way. "B"'s speech prior to termination of the call sounds un-natural and un-intelligible. "B" is cut while speaking although as the calling party he could decide when the call is terminated. It is very unlikely that this is the natural end of the call. It seems either the recording was terminated un-naturally, or that the end of the call was tampered with.

15. From approximately 10:30 minutes the other party says “and all, all you need is to locate (…?) him and make him call, that’s all?” and "B" answers “that’s all, that’s all, yeh, that’s all”.
    At the time point 10:36.703s , in the middle of the third time "B" says “that’s all”, there is a discrepancy in the signal, sounding as a mild ‘click’ sound.

Conclusions:

1. The destination number is unlikely a real Israeli cell-phone number, hence the call data is unreliable. Since there is no CLIP data available it cannot be verified.

2. This call shows many discrepancies and anomalies with respect to signal continuity, noises, pitch curve, etc. Some of these discrepancies are major, and create grave reservations for signal manipulation and splicing.

3. Clearly, some segments of the speech are non-continuous, and could be spliced from separate speech segments.

4. The call is terminated un-naturally, in a way that is un-reasonable especially given the caller allegedly hung up while he was talking.

Call no. 3, File: a1-1-kant-2-b-3281-tijd1.31-1.33-gesprek-17h16-9nov97.wav
November-9-1997, 17:16
Reportedly incoming conversation to "B"'s mobile phone 06-55382210 in NL, from an unknown source.

Observations:

1. This is an analog recording. The proper calculated sampling rate based on the recorded time stamp is 5430Hz.

2. The ringing tone is 421Hz and has a cadence of on/off = 0.6s / >3s. According to the international inter-switch protocol dominant in 90's the ringing tone is generated by the switch closest to the destination. In this case, we would expect the frequency and cadence to match the standard of NL which is 425Hz 1s/4s. However, the ringing cadence does no match NL. It could therefore be argued that the call was not made to a NL telephone network. Either the call was made to a different destination, or the ringing segment was spliced to the rest of the recording, or the first "on" segment was cut to 0.6s for an unknown reason.

3. There is no CLIP signal present before or during the rings, which could have indicated the source of the call. Please notice my detailed discussion of this point above.

4. There is crosstalk present in various locations along the call, such as 1:19.749. The presence of crosstalk implies an analog system, since crosstalk would not be expected in a digital telephone networks. However, to the best of my knowledge, in 1997 all the NL telephone network was already completely digital. This may indicate that the call was made from a country where some of the network was still analog (and had crosstalk leakage into this call), or the call was actually performed before 1997.

5. When "B" answers the call there is a short tone of 1894Hz and 0.184s length. That tone is connected to the pickup pulse. According to my inquiry, this tone has no meaning associated with telecom signaling. It could be the result of an acoustic feedback created in some cheap landline telephone models when lifting off the handset from its cradle. This would not be seen with a cellular phone that "picks up" the phone electronically and therefore has soft, noiseless switching. This does not match the claimed distance of the call being "B"'s mobile phone.

6. At the beginning of the call "B" says "hallo" and the signal has a strong echo, but this echo then disappears abruptly when he speaks again. There is no sign of adaptive convergence of an echo cancelling algorithm. On the other hand, there are two clicks right after the "hallo". This could imply splicing.

7. During most of the recording "B"'s voice is heavily distorted. However, at 1:14.383 there is a short extraneous harmonic sound of an unknown nature, followed by a segment of speech signal with different spectral characteristics and sound color, and nearly no distortion. This segment ends around 1:19.686. Then, there is a slight change in the background noise signal and a start of some cross talk signal (which is not heard before).
   If the translation of "B"'s speech does not show that he was talking during this time to someone else away from the telephone (and then still the

harmonic sound at 1:14.383 remains un-explained), this could be a spliced segment.

8. At time 2:08.03 the call is hung up, followed by a busy tone signal marking the call termination, as discussed in detail at the top of this report. It should, however, be notified that the busy tone demonstrates an AGC pattern which was not seen anywhere else in the call, nor in other calls. This is unusual, and I cannot find any explanation to that.

9. Many clicks are scattered along the recording.
   Strong click at 1:40.828, the voice of "B" changes its color before and after the click (for the same word: "he?").
   Very strong click with discontinuous bias at 1:45.50 having a strong low-frequency contents well below 300Hz, which indicates that the click was not present on the frequency-limited telephone line but was introduced later.
   Another adjacent pair of clicks at 1:46.294 and 1:46.450 without any speech between them, implying signal discrepancy and potential splicing.
   A click on 1:44.417 followed by exceptionally low SNR and an abrupt signal ramp up at 1:44.478, imply signal discrepancy and possible splicing.
   Additional clicks measured at:
   1:06.948 click
   1:12.424, followed by 1:12.583 click pair
   1:13.096 a click with 4 sub-clicks in a raw having similar characteristics
   1:18.136, followed by 1:18.292 click pair
   1:23.767, followed by 1:23.297 click pair
   1:24.310 click
   1:25.308 click with mechanical nature
   1:29.33 - a series of dense clicks, sounds like electro-mechanical switch
   1:29.556, followed by 1:29.628 click pair
   1:30.477 click
   1:31.080, followed by 1:31.182 followed by 1:31.256 triple click
   1:34.202 click
   1:35.032, followed by 1:35.188 click pair

10. The signal-to-noise (SNR) occasionally exceed 52dB (including the noise of the analog recording and the tape duplication and sampling), which seems to be somewhat too good for a GSM phone line

11. There are abrupt changes in the characteristics of the background noise – including both crosstalk and level of background noise – such as from 1:48.079 to 1:48.882

Conclusions:

1. This call shows many discrepancies and anomalies with respect to standard telecom signaling, date of recording, SNR, etc. Some of these discrepancies are major, and create grave reservations for signal manipulation.

2. Some segments of the speech are non-continuous, and could have been spliced from separate speech segments.

3. The recording has many irregular noises like clicks, bias changes, out-of-

band signals. Some of the clicks come in pairs located before and after a non-speech period. We would not expect to find such noises in a regular telephone call.

4. Some findings doubt whether the call destination was indeed a Dutch telephone and the date of recording was 1997. Furthermore, there is a reason to argue that this call was made to a landline phone rather than a mobile phone.

5. The beginning of the call and the end of the call show specific inconsistencies, and pose concerns that these specific parts have been tampered with.

Call no. 4, File: a1-3-kant-1-b-3285-tijd3.09-3.17-gesprek-21h59-9nov97.wav
November-9-1997, 21:59
Reportedly outgoing conversation from "B"'s mobile phone 06-51357183 in NL, presumably to London.

Observations:

1. The proper sampling rate based on the recorded time stamp is 5414Hz.

2. The ringing cadence is: 0.8s on, 0.2s off, 0.4s on, 1.98s off, 0.4s on, 0.2s off, 0.4s on, 1.98s off. The ringing includes DTMF frequencies. This matches the ringing signaling standard in the UK.

3. The call's termination is followed by a busy tone signal, as discussed in detail at the top of this report.

4. At 6:51.604, just prior to the end of the call, there is a click, followed by a sudden drop in noise background level, and another click at 6:51.719, followed by a short segment of speech which seems to be out of context. Then, at 6:52.210 there is a series of 5 adjacent clicks, then followed by a ramping up signal of unidentified nature from 6:52.521. This signal is cut sharply at 6:52.714, and is followed immediately by the busy tone that marks the end of the call.
   This sequence of events at the end of the call is abnormal, and does not seem to be a regular call termination pattern, neither from speech contents nor from signaling point of view. A correlation with the translation could further strengthen this point.

5. Typically, the busy tone starts after some delay from the end of call. The actual line disconnection would typically be identified by a click (for mechanical hangup) or sudden decrease in background noise (for electronic hangup, like in cellular phones). Typically there is some delay from the time the call ends until one of the parties first hangs up. Then it would take some time until the telephone network responds to the hangup event. In our case, the busy tone starts while the speech is still active (and the call audio stops in the middle of a ramp up signal). This again marks an abnormal and unrealistic call termination signal.

6. I have pointed out additional locations of irregularities throughout the call:

1:39.818 - the voice of the distant side bursts in abnormally, irregular volume and ramp-up characteristics

1:58.212 – a strong click just before the start of speech, with sharp change in background noise intensity

2:02.737 – sudden change in background noise level and color.

2:53.575 – sudden change in background noise level and color

3:21.332 click, then at 3:22.563 followed by a sudden increase in the distant caller's speech level, with a change also in voice color. At the same time, decrease in "B"'s voice level. It could be correlated with the transcription of the call to see if the sudden change in speech characteristics are supported by the speech contents.

3:41.251 to 3:42.175 abnormal speech segment, sounds like repetition or fading with a "vocoder" (robotic sound) effect. This could be the result of an interference which caused some lost data to be artificially restored at the cellular base station connected to the interfered telephone (if indeed a mobile phone).

3:44.382 to 3:47.010 completely abnormal speech segment, speech garbled for both sides of the call (which eliminates the possibility of mobile interference that is very unlikely to occur on both sides of the call simultaneously!). The noise level is unstable, and changes abruptly on 3:45.931. Then some background voices also suddenly appear in the background. On 3:46.723 there is another speech segment which sounds un-naturally cut, with abnormal ramp-up and ramp-down dynamics. Unless the physical tape is damaged at this point, this could be the footprint of rough manipulation

4:06.921 strong click

4:08.957 – sudden change of pitch and voice level during a long and stable vowel of "B". This would not be found in normal speech patterns.

4:55.990 to 4:57.165 distorted speech, musical effect (vocoder)

5:11.453 a strong background conversation is introduced, which then completely disappears after 5:16.078, where a signal distortion appears with abrupt change in the pitch pattern.

5:30.937 to 5:31.847, "B" says "ehhhh" which should be a stable and smooth vowel, but the recording sounds as if it is composed of three different segments like "eh—e—e". Furthermore, the background noise level and color change in the middle of this segment at 5:31.418, and is significantly higher after it.

6:04.248 the noise level increases abruptly. The increased noise spectrum has a flat band under 350Hz (where it should have been reduced substantially under 350Hz) down to around 60Hz, which would be impossible for a noise intercepted from a telephone line.

Conclusions:

1. The call has many types of anomalies including sudden changes in speaker's pitch and color, un-natural speech patterns such as sudden termination or sudden ramp-up of speech, sudden changes in background noise level and color, sudden introduction and disappearance of background voices, un-explained clicks and distortions in the middle and between speech segments, as well as some very un-natural artificial speech effects like "robotic" speech and repeated segments.

2. Furthermore, the call termination is abnormal, and creates a concern that the call consists of more than a single call.

3. Even without having access to the transcribed contents of the call and correlating it with the un-natural patterns demonstrated in the call, the above findings put a question mark over the reliability of this call. The number of findings, their nature and diversity put a heavy concern whether the call was not "cooked" by splicing segments from more than one (and possibly more than two) calls, while overlaying the splicing points (to blur the gluing

points) and possibly adding some artificial noise to cover splicing marks.

Call no. 5, File: a1-4-kant-1-b-3285-tijd3.17-4.03-gesprek-22h53-9nov97.wav
November-9-1997, 22:53
Reportedly outgoing conversation from "B"'s mobile phone 06-51357183 in NL, probably to Turkey.

Observations:

1. The proper sampling rate based on the recorded time stamp at the end of the call is 5472Hz. However, due to the length of the call and the fact it was recorded on a magnetic tape recorder it is possible that the speed of the tape at the beginning of the call was different than at the end of the call.
   The time stamp at the beginning of the call has only one "beep", and hence does not allow calibration of the speed by measuring the 10s gap between beeps. Instead, we compare the tone frequency of the beep between the time stamp at the end of the call and the time stamp at the beginning of the call. This is important to calculate the frequency ad cadence of the ringing signal. Based on sampling rate of 5472Hz at the end of the call, the time stamp at the end has a tone frequency of 793Hz. Based on the same sampling rate, the time stamp at the beginning has a tone frequency of 798.8. We should therefore compensate our measurements at the beginning of the call by a factor of 1/1.0073.

2. The ringing signal has a frequency of 438Hz (resembling 440Hz) with cadence of 1.67s / 3.23s. This cadence is very rare and special.
   The ringing signal in Turkey, the claimed target of the call, is 450Hz and 2s / 4s.
   The ringing signal in the NL, the originator of the call is 425Hz, 1s / 4s.
   The call was therefore not made to Turkey, or hypothetically the call is very old, before Turkey adopted its ringing standard. I could not find traces to specific time in the past in which Turkey had different ringing standard.
   The countries which use similar ringing standard are Republic of Benin, Burkina Faso, Cameroon, Chad, French Polynesia, Gabon, Madagascar, New Caledonia, Niger and Rwanda. All of them use 440Hz with cadence of 1.7s / 3.3s.

3. At 3:33.368 a sound similar to "nord" is repeated twice, with irregular pitch pattern and abnormal signal pattern. This looks like un-normal speech segment, possibly a splicing of two separate signals.

4. From 3:35.320 to 3:36.885 there is some click noise and background speech.

5. At 4:08.794 "B" finishes saying "ehhh", but there is a sudden increase in pitch followed by an abrupt cut of the speech signal. This looks like the speech was cut in the middle of a word, where some part was erased.

6. At 4:12.612 there is a click, followed by a change in the pitch that is so dramatic that a "Donald Duck" effect can be heard. The voice sounds very un-natural, not human.

7. At 4:43.706 there is a strong click, and is followed by a segment of speech that has completely different color than any other speech segment around the same time. It sounds almost as a different speaker. This speech segment does not look belonging to this call.

8. At 4:54.934 there are three consecutive clicks sounding like lips smacking noise. This is followed by a change in background noise.

9. At 5:09.778 there is another click that sounds like lips smacking.

10. From 5:13.588 to 5:14.071 there is crosstalk heard in the background.

11. At 5:42.978 to 5:43.081 there is a very short speech segment that is out of any context or other speech pattern, since nobody speaks in that time or any time close to that. This clearly looks like a sliced piece of speech signal cut from another location. Immediately after this sliced segment at 5:43.147 there is again a lips smacking sound followed by some other low frequency noise in series.

12. At 5:43.708 the other party starts speaking, but he is heard twice, with some delay between the first and second repetition. Furthermore, the first and second signals have different pitch, so this clearly could not an echo.

13. At 6:39.748 "B"'s speech stops, and starts again at 6:39.827. The gap seems to be too short and the speech dynamics is abnormal. The noise at this gap goes almost to zero. This awkward gap looks like a connection point of two separate speech recordings.

14. At 7:20.624 there is again the lips smack noise.

15. At 7:32.909 a series of strong clicks. It could be just air puff or some crosstalk of a switching signal.

16. At 9:38.516 a segment of speech starts where both parties speak at the same time. Throughout this speech segment the background noise level gets considerably lower, yet gradually. This gradual decrease continues further for the next 20 seconds. A gradual change in background noise (such as the one we observe here) could imply that one of the parties is in movement, such as driving. A translator should be consulted for this time period to examine any anomalies in speech content.

17. At 9:54.732 there is a sudden increase in background noise level. Shortly after this increase both parties start speaking at the same time, and then the background noise returns to its previous lower value. The noise increase does not look like an AGC pattern, and there are no AGC patterns I could notice.Of course, when the two parties speak at the same time the noise level should remain the same as for one speaker. Therefore, this is a potential trace of splicing point, where the splicing was performed by 'soft switching', i.e. overlaying two speech segments instead of switching from one part to another. The increase in noise marks the point where the two parts were summarized.

18. At 10:57.216 there is a sudden increase in background noise level. Again, shortly after this increase in background noise both parties speak at the same time and then the noise level is back to its previous level, for a long time. The noise increase does not look like an AGC pattern. It is therefore a potential reminder of splicing point, like the previous one.

19. At 12:00.403 there is a click. Shortly after that, at 12:01.330 there is a short "swoosh" noise. This could have different reasons and I cannot point a specific one.

20. At 12:10.282 there is a sudden increase in background noise. Immediately after that, that other party starts speaking, but with what sounds like awkward stuttering, or some unintelligible out-of-context speech segment. A translator could help in assessing whether this is stuttering or random meaningless speech segment. However, for sure, such stuttering is very untypical to this speaker over this call, and it sounds strange even for stuttering.

21. From 13:07.239 to 13:08.044 the background noise abruptly changes its color a few times. This is unnatural for a real noise pattern.

22. At 13:13.727 speech starts abruptly with no ramp up, in a way that sounds to me unnatural.

23. From 13:41.928 to 13:42.102 and from 13:43 to 13:43.3 there is a burst of wideband background noise of an unknown nature. This could be an RF interference.

24. At 14:24.636 there is a click noise followed by a transient in the bias. This occurs in the middle of a silence interval, and has no obvious reason I could point to.

25. From 14:43.73 to 14:45.197 there is a silence period where the background noise is unstable and changes abruptly a few times.

26. From 25:03.49 to 15:03.638 there is again the "swoosh" wideband background noise.

27. 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.

28. A click is heard at 16:12.032.

29. At 16:51.637 a word spoken by "B" finishes with the syllable "et". Then just this syllable is repeated twice: "…et…et…" with a very low pitch and artificial rhythm. This already sounds neither like "B" nor like the other party. It is quite obvious that these two segments do not belong to the call.

30. The other party then says "Uh… Ehhh…" and then there is a "swoosh" noise heard while the person does not speak, at 16:54.028, followed by another "swoosh" noise at 16:55.027. These noises could be explained by RF interference, but it remained unexplained how come the noise starts and stops exactly when the other person stops speaking.

31. At 17:36.19 there is a small click. There is another small and similar click at 17:54.11.

32. Another "swoosh" noise exists at 18:26.51 there is another "swoosh" noise.Right after that, at 18:28.0 there is a click noise. Again, there is no explanation why the two noises are at the beginning and ending of a silence segment.

33. Another click is located at 18:28.27, and provides two click boundaries to the word, before and after the word.

34. At 18:44.14 there is another tiny click. After the following phrase, another click is located at the end of the phrase at 18:46.11 and another click at 18:46.17. The last click is followed by an increase in background noise that does not match the pattern of background noise demonstrated elsewhere in the file. I could not determine positively if this background noise is the line noise or a breathing sound. However, after this click the two parties start speaking together, as was demonstrated before in places where certain peculiarities were observed.

35. At 18:49.20 a "swoosh" noise is heard.

36. At 18:58.01 there is a pitch inconsistency and signal discontinuity which sound as a click.

37. At 19:02.17 there is a strong click.

38. From 19:14.06 to 19:14.17 there is a "swoosh" background noise.

39. From 19:15.10 to 19:15.16 there is a "swoosh" background noise.

40. At 19:34.11 there is a sudden increase in background noise. Immediately following this the two parties start speaking together.

41. From 20:39.01 to 20:39.08 there is an cross-fade of "B"s voice with itself. It sounds like there are two people having "B"'s voice that are talking on top of each other. I have no explanation for this cross-fade other than splicing blurred by cross-fade.

42. The phrase spoken by "B" from 20:47.10 to 20:51.23 includes three interferences that introduce a "vocoder" artifact, i.e. a robotic sound. I could not notice a missing part of speech or another abnormal effect, hence I deduct this is a genuine interference.

43. At 21:02.13 and 21:02.22 there is a pair of clicks.

44. At 2:18.23 during a silence period there is a "swoosh" noise followed immediately by a click at 21:19.09.

45. At 21:30.03 until 21:31.26 there are a series of "swoosh" noises, sounding like an RF interference.

46. From 21:49.24 to 21:50.05 there is a speech segment which sound completely out of context as well as un-natural. The pitch sounds artificial, the spoken contents is unclear and the voice sounds like not belonging to any of the speakers. The volume is also very different than the volume of the speakers.

47. At 21:57.29 the other party stops speaking and at 21:58.03 he starts again. However, during this short time the speaker's pitch period has been raise very sharply, from 139Hz to 319Hz (!). Not only a pitch of 319Hz would be exceptionally high for this speaker, it is unrealistic that a speaker would make such a sharp change in pitch in the normal course of speech. Again, this could be an indication of splicing or manipulation.

48. At 22:11.207 and 22:12.322 there is a pair of "swoosh" noises.

49. At 22:51.108 and 22:51.180 there is a pair of clicks. Following the next spoken confirmation "heh", there is another click at 22:52.277. Then another pair of clicks follows the next phrase at 22:54.671 and 22:54.744.

50. From 22:57.318 to 22:59.390 somebody is speaking which is not the other party, but it also sounds very different than "B"'s voice, especially compared to the 'neighboring' speech of "B" at 22:51.532 and 23.04.10. Who is talking here?

51. The speech segment at 23:08.597 to 23:09.649 is garbled. It does not sound to me like normal continuous speech. A translator could further stress this point in view of the content of this segment. Furthermore, the background noise level before this segment and after the end of this phrase (from 23:10.35) is different. And, after the segment with increased noise, there is (again) a segment of mixed speech of both parties, as we already met before. The increased noise returns shortly after that to normal level.

52. At 23:26.633, exactly at the end of a speech segment, a strong hum noise appears with frequency of 50Hz. This noise disappears at 23:31.216, again just at the end of a phrase. Such noise is not passed through a telephone line, and was therefore generated either in the recording or during the playback and duplication process. The questions are: (a) how did this hum noise enter the recording? (b) why does it start and stop in the middle of this recording? Could it be an indication that the segment with the hum was spliced into the call? (c) how come is starts and stops right on the edge of a recorded prompt?

53. The hum noise appears again at 23:41.838, at the end of a word, and disappears again at 23:46.789.

54. The hum noise appears again at 23:57.183 and disappears again at approx. 24:02.621.

55. The hum noise appears again at 24:27.801 and disappears again at 24:33.462.

56. Following this phrase there is a "swoosh" noise at 24:33.750, then "B" says "mmm" and then there is a click at 24:34.554 followed by a "swoosh" noise at 24:34.742.

57. At 24:38.343 the other party's speech is cut in the middle and "B"'s voice barges in. This sounds quite awkward and unrealistic. The line has full-duplex characteristics, so the switching is not due to switching from one party to another.

58. At 24:55.982 the background noise increases. Shortly thereafter, the two speakers are heard talking simultaneously.

59. At 25:15.702 the background noise increases and after "B" says "eh" there is a click at 25:16.338.

60. A click appears at 25:27.632. Following, hum noise appears at 25:28.441 and ending at approx. 25:33.535.

61. A click appears at 26:33.877.

62. A pair of clicks appear at 29:19.792 and 29:20.093.

63. At 31:32.261 and 31:33.506 there is a pair of "swoosh" noises.

64. At 31:58.821 there is a click and the background noise level decreases.

65. Between 33:08.800 and 33:11.169 there is a long silence period. The background noise changes its level and color abruptly four times during this period.

66. The speech segment from 33:27.802 to 33:28.334 has an irregular pitch, and sounds to me out-of-context and abnormal. A translator should further assess if this speech segment sounds natural in the spoken language and in view of the spoken contents.

67. At 33:39.802 there is a click.

68. From 33:50.107 to 33:50.248 there are three very strong clicks which were not demonstrated before in this file. Their nature is unknown.

69. From 35:25.721 to 35:25.883 there is a noise which masked the audio link. A translator should judge if the spoken contents is continuous and no part is missing also considering the noisy period.

70. At 35:33.237 to 35:33.490 "B" is saying "pis". Then at 35:33.490 there is a click and "B" is heard repeating this part "pis", this time connected to the next of the phrase. The transition from the first pronunciation of "pis" to the second pronunciation seems to me to be un-natural and forced. A translator could apply better judgment to this point

71. At 35:54.854 there is a click and a speech segment is heard. This segment is out-of-context, its beginning is cut, and its pitch, volume and color are different from the connected preceding phrase. Furthermore, the articulated syllables sound like the preceding syllables, but have different intonation pattern, so this is not a plain repetition of syllables. It is a spliced part of speech which has the same contents as the preceding speech segment.

72. From 36:40.511 to 36:42.437 there is a silence period. However, in the middle of the silence, at 36:41.026, the color of the background noise changes. Then, the speakers do not sound the same before and after the silence period. For example, compare "B" voice before the silence at 36:38.312 and his voice after the silence at 36:44.632 which sounds louder,

more excited and having substantially higher pitch. These two parts before and after the silence could belong to different calls.

73. The speech segment from 37:51.418 to 37:51.822 has an exceptionally low pitch to a level it does not sound natural human voice. This sounds like a manipulated speech syllable.

74. At 38:23.034 the background noise increases, where it sounds like wind noise or an aircraft takeoff. This noise changes slowly throughout the rest of the file

75. At 40:33.595 and 40:33.815 there is a pair of clicks.

76. At 4:45.423 the background noise increases abruptly, then at 41:45.686 "B" confirms saying "mmm.." and then the noise decreases again. This points out that the speech segment could have been spliced here.

77. A series of three clicks at 42:55.497, 42:55.581 and 42:55.664

78. The speech from 44:19.054 to approx. 44:19.473 sounds out of context. A translator might be capable of judging it better.

79. At 44:25.255 the call is terminated prematurely in the middle of a speech segment. Unlike other calls, there is no busy tone, which poses the question what caused the talking time stamp to be switched in. This call termination is abnormal.

Conclusions:

1. The number of abnormal observations in this call, their type and diversity speaks for itself.

2. Even when ignoring all the unexplained click noises and "swoosh" noises, and after considering the length of the call, the number of peculiarities is remarkably high. From my point of view, some of them have unquestionable meaning as to the call being a manipulated voice track cooked from speech fragments taken from different sources.

3. Some of the observations are so exceptional and obvious that the conclusion as to the authenticity of the call is essentially inevitable.

4. The call termination is abnormal from both speech content and termination sequence perspectives

5. Based on the ringing pattern, the call was either made to another country (and not Turkey) or it consists of an old recording, or it was artificially spliced into the call

Call no. 6, File: a1-5-kant-2-b-3281-tijd1.49-1.57-gesprek-11h51-10nov97.wav
November-10-1997, 11:51
Incoming conversation to "B"'s mobile phone 06-55382210 in NL, unknown source.

Observations:

1. The proper sampling rate based on the recorded time stamp is 5427Hz.

2. The ringing signal consists of tones at 421Hz with cadence of 0.6s on and >3s off. The frequency resembles the NL ringing cadence, being 425Hz, but the cadence in the NL is 1s / 4s, and here the 'on' time was just 0.6s. The call was answered after just one ring. It could therefore be argued that the call was not made to a NL telephone network. Either the call was made to a different destination, or the ringing segment was spliced to the rest of the recording, or the first "on" segment was cut to 0.6s for an unknown reason.

3. There is no CLIP signal present before or during the rings. Please notice my detailed discussion of this point at the beginning of the report.

4. The speech of "B" has strong echo throughout the call.

5. The call has a high SNR, sometimes exceeding 56dB. At certain points throughout the call the noise level nears zero (despite the playback and duplication of the material, and the background noise of the original recording). This would be a slightly too good SNR for a cellular GSM call.

6. At 1:05.805 the speech of "B" is cut abnormally in the middle of a word. There is no sign of interference causing this cut.

7. At 1:45.809 there is a sudden and unnatural increase in background noise by more than 0dB. This strong background noise then ramps down gradually and at about 1:47.5 is goes back to the previous level.

8. At 1:50.026 and 1:50:965 there are clicks. Between these clicks there is a garbled speech segment which sounds like an overlay of spliced segments that have partial speech data.

9. From 1:52.280 there is a series of clicks, followed by "B" saying some garbled speech segment and the from 1:53:531 there is a short, out of context segment of the caller's voice saying something like "taa". This again sounds like an overlay of several segments.

10. At 1:55.472 the caller is saying something that starts with the sound "kh", but the sound appears twice, as if the caller was stuttering.

11. At 2:02.808 the noise level increases abruptly, followed by a pair of clicks at 2:03.078 and 2:03.203.

12. At 2:05.016 there is a garbled and out-of-context speech segment which has irregular pitch contour and ends at 2:06.051.

13. At 2:37.526 there is some noise (like a swoosh noise, not a click), and then "B" says "hallo" without any specific cause. Furthermore, the caller continues to speak freely but "B" says "hallo" again. This sounds as if the two parties

are not on the same call. The pattern is strange and seems out of context. It should be judged with respect to the transcribed contents of the call.

14. From about 2:38.274 the caller says a word that sounds to me like "azaana". The word is repeated twice. The rhythm and pitch pattern of the two repetitions sound to me robotic and unnatural.

15. These two words are then followed by a speech segment from 2:38.993 to 2:39.261. Although I do not know which language is spoken, this segment sounds to me out of context. It should be reviewed with respect to the transcribed contents of the call.

16. At 2:39.693 there is cross talk in the background, implying the call was at least partially transferred over an analog network. Since the calling location is unknown, either the call was originated from a location where the telephone network has not been upgraded to digital (probably outside of Europe), or the call was recorded before 1997.
Notice that the crosstalk signal and rotary switch noises do not show up at the first part of the call, before "B" says "hallo". This implies that the part before the "hallo" could potentially be a different call, with respect to the previous points discussed.

17. At 2:41.631 a segment of the caller's speech starts abnormally, without a natural ramp up. This sounds like the speech is chopped. The segment continues until around 2:42.35 with a speech rhythm that sounds abnormal.

18. At around 2:44 there is rotary switching noise in the background which again implies an analog line.

19. At 3:34.718 there is a click noise.

20. At 3:49.691 there is a click noise.

21. At 3:50.769 there is a click noise.

22. At 3:53.796 there is inconsistent pitch, which sounds like a connection of two speech segment having different pitch. The pitch is inconsistent again at 3:53.865.

23. At 3:58.467 the signal has some interference.

24. The speech segment from 4:11.755 to 4:13.469 has a metallic coding effect and a sound color different than the rest of the signal. I cannot see why the color of the signal coding effect would change in the middle of the call.

25. 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 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.

26. At 4:36.22 there is a click noise.

27. 6:46.267 crosstalk with some digital transmission, sounds like a modem.

28. At 7:20.025 the call is terminated abnormally in the middle of a word while "B" is talking. Usually there is then a busy tone marking the termination of the call and consisting of several cycles with cadence of 0.25/0.25. In this case, the busy signal is extremely short, and does not even have a single "on" segment of 0.25s. This is awkward, since how did the system identify the termination signal and activate the time stamp recording?
    It seems possible that there is a missing part of the call, from the time the speech is cut and until the end of the call including some part of the termination busy tone.

Conclusions:

1. This call shows many discrepancies and anomalies. The call termination is abnormal, and creates a concern that the recording possibly consists of more than a single call.

2. Furthermore, the call has many anomalies including sudden changes in speaker's pitch and color, un-natural speech patterns such as sudden termination or sudden ramp-up of speech, sudden changes in background noise level and color, un-explained clicks and distortions in the middle and between speech segments, as well as some very un-natural artificial speech effects like "robotic" speech and repeated segments.

3. The "hallo" pattern in the middle of the call and the appearance of crosstalk noise only after this point marks this point as a possible connection between two separate calls.

4. Even without having access to the transcribed contents of the call and correlating it with the un-natural patterns demonstrated in the call, the above findings put a question mark over the authenticity of this call. The number of findings, their nature and diversity makes it realistic that the call was actually "cooked" by splicing segments from more than one (and possibly more than two) calls, by overlaying the splicing ends and occasionally adding some artificial noise to blur the splicing points.

Call no. 7, File: kant-1-a-3285-tijd0.45-9.45-gesprek-20h45-5okt97.wav
October-5-1997, 20:45
Several Call Setups with "B"'s mobile phone 06-51357183. Start of tape.

Observations:

1. For this file I did not receive the raw playback recording. Therefore, please refer to the introduction to this report for the implications of analyzing the material after the processing of the Dutch lab. As a consequence, I did not refer to the spectral contents of this recording. I further assumed that the change in sampling rate was performed correctly, so the time scale for 44.KHz sampling rate has been preserved.

2. The file starts with an unanswered call following "B"'s dialing, made to an unknown country. I assess the automatic answering has some German / Austrian / Swiss accent. The ringing tone has a frequency of approx. 440Hz and cadence of approx. 1s / 3s. I could not find a country with such a ringing cadence. This cadence could be the result of the processing by Pro Tools.

3. The call termination is normal, and the following time stamp is complete.

4. At 1:46.421 there is a click followed by a call termination signal. It seems that "B" dialed a number and hung up.

5. At 2:04.489 another recording starts, and terminates without any significant signal.

6. At 2:42.801 another recording starts, and terminates after 12 rings without being answered. The ringing signal has a frequency of approx. 440Hz and a cadence of 1.67 / 3.2. This suits some countries with ringing of 440Hz 1.7/3.3, such as Republic of Benin. Burkina Faso, Republic of Cameroon, Republic of Chad, French Polynesia, Gabonese Republic, Madegascar, New Caledonia, Niger and Rwanda. Notice again, the ringing signal may have been distorted by the Pro Tools processing.

7. At 4:29.283 another recording starts, and terminates without any significant signal.

8. At 4:48.951 another recording starts. The call was unanswered. The call termination is normal with complete time stamp.

9. At 5:37.407 another recording starts. The ringing signal is distorted and incomplete. It is impossible to decode the destination of the call by the ringing signal. This call was answered.

10. At 6:01.457 the distant party says "hello". The pitch is very low and abnormal. At 6:02.188 there is another "hello". This time the pitch frequency is very high and abnormal. At 6:04.053 there is again another "hello" with unrealistically high pitch.
    These voices were clearly changed, although it could be a result of the ProTools manipulation. I would need to see the raw signal before it was processed by ProTools to see if this abnormal pitch is present also in the original recording.

11. From 6:06.935 to 6:07.055 there is a short speech segment which seems to be out of context, and have a different amplitude than the rest of the speech. This speech fragment should be inspected against the transcription to identify if it has a meaning. Otherwise it could point out to potential splicing.

12. At 6:20.177 there is a fast series of clicks which sound like switching noise of an analog exchange or rotary switch. This would not be possible in the NL in 1997, so either the call is older or the other party was located in a country which still used analog telephone network.

13. At 7:08.508 a period of silence starts. At 7:12.055 "B" says "hallo". There is a shadow of another "hallo" in the background, having a much lower pitch (hence not being an echo of the first "hallo"). This is very unusual, and the only explanation I could find is that the other party was saying "hallo" at the exact same time, and was masked by the half-duplex communication dominated by "B"'s "hallo". It Should be inspected in the raw file before processing by ProTools.

14. At 8:13.530 there is a very strong 'click' sound. The speech signal is discontinuous. Immediately, at 8:13.603 there is yet another click. This could be either a strong interference or a manipulation trace.

15. The call terminates at approx. 8:24.427 by a termination busy tone. However, there is no hangup signal, and there is very short delay from the end of speech to the start of the termination signal. The speech ends at approx. 8:24.3, only about 0.13s before the termination signal starts. This would be unreasonable time to hangup the call.

Conclusions:

1. This file has several unsuccessful calls without any special observation except some peculiar ringing signal in one of the call attempts.

2. There is one call in this file which shows a few discrepancies. Some of these discrepancies could be associated with the ProTools processing, and this could be compared against the raw files which were not available to me.

3. Main findings are several click-pairs with discontinuous speech. This could be a trace of splicing, and should be examined by comparison to the transcription of the call. Another major finding is an un-natural pitch (sometimes too high, sometimes too low). This could be the result of the Pro Tools processing, or some other manipulation of the signal. It is for sure not a normal speech signal.

4. The call termination is too short, and creates a concern that the call was actually dropped or cut in the middle.

5. It is recommended that the raw file is revised before it was processed by ProTools, like I did with the other files.

Call no. 8, File: kant-2-b-3281-tijd3.48-3.52-gesprek-15h24-12nov97.wav
November-12-1997, 15:24
Outgoing conversation from "B"'s mobile phone 06-55382210 to the UK.

Observations:

1. For this file I did not receive the raw playback recording. Therefore, please refer to the introduction to this report for the implications of receiving the material after processing by ProTools. As a consequence, I did not refer to the spectral contents of this recording. I further assumed that the change in sampling rate was performed correctly, so the time scale for 44.KHz sampling rate has been preserved.

2. The last call starts with a ringing tone consisting of DTMF frequencies, and with cadence of 0.4s / 0.2s / 0.4s. This matches the ringing according to the UK standard, being 0.4s on / 0.2s off / 0.4s on / 2.0s off. The call was therefore presumably made to the UK, and this matches the British English dialect spoken by the other party.

3. The call was hung up by both parties at 4:10.333, with a preceding mechanical noise denoting on-hook. A busy tone follows 0.785s later. The time stamp is complete and has several cycles. This sequence demonstrates a normal call termination.

4. The rest of the call does not demonstrate any special findings.

Conclusions:

1. This file does not demonstrate any questionable or suspicious findings.

Report_Oct_09.docAppendix:

Shlomo Peller - Resume

Shlomo Peller received a BSc degree in Electrical Engineering from Tel Aviv University, and an MSc degree in Electrical Engineering from Tel-Aviv University, where he graduated both with honors. He was a Research Assistant and a Teaching Assistant for 5 years with the Department of Electronic Systems in the Engineering Faculty, Tel Aviv University, specializing in digital signal processing and digital speech processing. His MSc dissertation considered improvements of digital speech compression algorithms.

In 1995, Mr. Peller founded Rubidium Ltd. (www.rubidium.com). In his capacity as the company's founder he developed by himself the first generation of the company's proprietary technology, consisting of miniaturized speech recognition and speech compression algorithms and chips. Mr. Peller is heading the Company's R&D, focusing in speech processing chips and software, mostly for telephony and Bluetooth applications.

Mr. Peller's prior experience include management of Digital Signal Processing (DSP) related software and hardware projects in leading Israeli companies such as Teledata Communications and Tadiran Telecom, now part of ECI Telecom (NASDAQ: ECIL).

Mr. Peller also served as a DSP Algorithm Architect with Nexus Telecom (NASDAQ:NXULF), and a member of the founding team of Algotec, a medical imaging startup, now a subsidiary of Kodak.

Prior to that, Mr. Peller served for 4 years in the Israeli Defense Forces, were he was part of an elite R&D team.

Aan: Prof. mr. Y. Buruma, 16 Augustus 2010
Voorzitter toelatingscommissie CEAS,
p/a Faculteit der Rechtsgeleerdheid,
Radboud Universiteit Nijmegen.

Geachte collega Buruma,

In uw brief van 20 nov. 2009 (kenmerk CEAS/362) legde u mij een viertal vragen voor, waaronder een verzoek tot het instellen van een nader onderzoek gericht op telecom signalering, volgend op de eerdere rapportage van Peller en BEK TEK LLC, en mijn begeleidend schrijven daarbij. In mijn brief van 10 dec. 2009 ben ik reeds op de eerste drie vragen ingaan. Bij deze kan ik ook op de vierde vraag reageren. Ter bevordering van de overzichtelijkheid zal ik bij deze alle vier de vragen beantwoorden, waarbij ik mijn eerdere reacties (van december 2009) op de eerste drie vragen reproduceer.

In de tekst die volgt zal ik de volgende afkortingen voor de verschillende documenten hanteren.

Afkorting	Omschrijving
PR	Peller's rapport, van sept.-okt. 2009
BTR	BEK TEK LLC's rapport van 14 aug. 2009
JR	eigen begeleidende rapportage bij PR en BTR, van 15 nov. 2009
FRR	het rapport van Fransen en Rijnders, zie de bijlage.

Voor de goede orde citeer ik uw vragen in schuinschrift.

1. *In aanbeveling 1 wordt gesproken over optical discs, maar de grootste analoog → digitaal omzettingen hebben plaatsgevonden bij de audiobanden. Die kopieën zijn ook het slechtste. De TC begrijpt daarom (de porte van) deze aanbeveling niet zo goed. Kunt u die verhelderen?*

Ik vrees dat hier sprake is van een misverstand, dat hopelijk eenvoudig te verhelderen is. Mijn aanbeveling 1 (aan het eind van JR) heeft geen betrekking op de audiobanden, maar op de optical discs. Voor het onderzoek van PR en BTR zijn de daarvan afkomstige gesprekken a3-24 en a4-34 pas na digitaal → analoog → digitaal omzettingen bij de audio experts terechtgekomen. Doordat de door de politie beschikbaar gestelde uitlees-PC niet over een directe digitale kopieermogelijkheid voor deze optical discs beschikte, was het nodig om via de (analoge) audio uitgang van de PC te kopiëren, zie de beschrijving in JR:2.1. Indien de fabrikant van de gebruikte tapsystemen medewerking verleent is het in principe echter ook mogelijk met speciale apparatuur van de fabrikant de gesprekken van de optical discs rechtstreeks (zonder omzettingen) digitaal te kopiëren. Mijn aanbeveling was erop gericht om deze mogelijkheid bij eventueel

later onderzoek van gesprekken die op optical disc opgeslagen zijn te benutten. BEK TEK LLC gaf immers aan terughoudend te zijn in het formuleren van bevindingen juist vanwege deze (digitaal → analoog → digitaal) omzettingen.

2. *Er is een verklaring waarin X2, een politiefunctionaris die werkzaam is geweest bij de technische afdeling van de politie in Istanboel, uitlegt hoe hij gemanipuleerd heeft met geluidsopnamen om Baybasin woorden in de mond te leggen. Kunt u een inschatting (laten) geven van het realiteitsgehalte van het gestelde tegen de achtergrond van de stand van de techniek (in Turkije) ruim 10 jaar geleden?*

Ik heb de 2 pagina's die u mij voorgelegd heeft aandachtig gelezen. Er staat echter weinig concrete informatie in over de werkwijze van X2. Eind jaren negentig waren er software pakketten beschikbaar waarmee manipulaties van gesprekken digitaal (op een PC) uitgevoerd konden worden. Het is aannemelijk dat daar destijds gebruik van gemaakt zou zijn. Het op primitieve wijze "plakken en knippen" van audiobanden is niet aanemelijk, omdat zulks to harde discontinuiteiten aanleiding geeft, die door de geraadpleegde experts opgemerkt zouden zijn. Bij software-matige audiomanipulaties kunnen geleidelijke overgangen gecreëerd worden.

3. *Als het technisch mogelijk was om de gesprekken zo te manipuleren als X2 beweert, is de volgende vraag of dergelijke manipulaties passen in de bevindingen van BekTek en Peller over de gesprekken A4-34 en A1-5.*

Aan het eind van de eerste pagina spreekt X2 over onregelmatigheden bij de montagewerkzaamheden in de archieven. Hij weidt echter niet uit over de precieze aard van die montagewerkzaamheden. Dit zouden de mogelijke *splicings* kunnen zijn waar de audio experts in PR en BTR van spreken. Zulke *splicings* zijn mogelijk te herkennen via discontinuiteiten (bijv. in toon of achtergrondruis) of via inconsistenties (bijv. in de signalering). In JR:4.3, waar twee mogelijke manipulaties expliciet besproken worden (in punten 1 en 2), citeer ik de experts met omschrijvingen als *editing artifacts*, *record start or stop*, en *the signal is cut*, die in algemene zin consistent zijn met de genoemde manipulatie activiteiten van X2. Echter zonder nadere informatie van X2 over de precieze aard van deze montagewerkzaamheden kan ik vooralsnog niet wijzen op een meer directe samenhang met de bevindingen van de audio experts.

Het is hierbij relevant in herinnering te halen dat de expert Peller in PR vele bevindingen noemt die volgens hem op mogelijke manipulatie wijzen. Vanwege het gebrek aan overeenstemming (in PR en BTR) tussen de twee geraadpleegde experts ben ik hier zeer terughoudend mee omgegaan. Men zou kunnen speculeren dat nadere informatie van X2 over zijn werkwijze de aannemelijkheid van de bevindingen van Peller zou kunnen vergroten. Het lijkt mij immers onwaarschijnlijk dat, indien er daadwerkelijke gemanipuleerd is, dat slechts op een tweetal plaatsen in het zestal onderzochte gesprekken heeft plaatsgevonden.

4. *Verder verzoeken wij u een Nederlandse telecom-deskundige om opheldering en zo mogelijk een verklaring te vragen over de "cadans", ofwel het*

belpatroon dat je hoort voordat de telefoon wordt opgenomen (zie aanbeveling 2 van Jacobs), en over de aanloop- en stopgegevens van de gesprekken (aanbeveling 3).

Ik heb twee gerenommeerde telecom experts bereid gevonden mee te helpen aan de beantwoording van deze vragen. Dit nadere onderzoek is gezamelijk uitgevoerd, op persoonlijke titel, door de volgende twee Nederlandse telecom deskundigen.

- De heer J.D. Rijnders, werkzaam bij KPN Security op de afdeling Justieel Aftappen en Monitoring (JAM), die vaker als telecom deskundige optreedt in rechtszaken.

- De heer F. Fransen, werkzaam als Senior Scientist op de afdeling Security bij TNO Informatie- en Communicatietechnologie in Groningen, en gespecialiseerd in beveiliging en justitieel aftappen van communicatienetwerken.

Deze deskundigen kennen elkaar goed en werken vaak samen. Het was hun eigen initiatief om het onderhavige onderzoek gezamelijk uit te voeren. Ik ben ze zeer erkentelijk voor hun rapportage (FRR) die hier als bijlage toegevoegd wordt.

Daarnaast hebben deze deskundigen commentaar geleverd op de tekst en conclusies die ik u hieronder voorleg. De eindverantwoordelijkheid daarvoor is en blijft echter de mijne.

Voor het uitvoeren van dit onderzoek heb ik, in overleg met u, Fransen en Rijnders strikt vertrouwelijk inzage gegeven in de audio rapporten PR van Peller en BTR van BEK TEK LLC en in mijn eigen rapportage JR dienaangaande. Hierin is de naam van de betrokkene, volgens afspraak, verwijderd.

Het nader onderzoek FRR ter beantwoording van uw vierde vraag heeft zich toegespitst op een drietal punten.

1. Signalering bij het begin van een gesprek, in het bijzonder de frequentie en het patroon van in- en uitschakelen (*cadence* genaamd) van de beltonen (ofwel *ringing tones*);

2. Signalering bij gesprekseinde;

3. Nummerherkenning (*caller identification*, CID of CLIP).

Over het derde punt kan ik kort zijn. Zoals in JR:4.1 reeds opgemerkt werd, is nummerherkenningsinformatie (CID) in het GSM netwerk gescheiden van het audio kanaal. Een tapaansluiting in het mobiele netwerk vindt plaats op het zogenaamde *mobile switching center* (MSC) en zal daar geen CID informatie in het audio kanaal aan kunnen treffen. FRR is hier duidelijk over. De verbazing van Peller over het niet aantreffen van CID informatie (PR, p.4-5) is dus niet terecht.

Met betrekking tot het tweede punt dient allereerst opgemerkt te worden dat bij GSM geen “einde gesprek” tonen bestaan. De tonen komen echter wel voor bij de getapte gesprekken (op een na) die op audio band zijn opgenomen.

Daarbij komt de frequentie van sommige van die tonen niet overeen met de Nederlandse standaard (voor landlijnen). PR noemt als optie dat deze einde-gesprek tonen gegenereerd worden door het tapsysteem, daarbij inbegrepen de communicatielijn tussen mobiele operator en de tapkamer van politie[1]. Ook in FRR wordt deze optie expliciet genoemd.

Ik zie dit verder als een dood spoor: ik verwacht niet dat er betrouwbare informatie achterhaald kan worden over de precieze werking van het tapsysteem van destijds, temeer daar dat systeem zich in een overgangsfase van analoog naar digitaal bevond ten tijde van de opname van de onderhavige gesprekken. FRR biedt hierbij geen enkel aanknopingspunt. Expliciet: mbt. einde-gesprek tonen bestaan er vragen die onbeantwoord maar ook onbeantwoordbaar zijn, waardoor er naar mijn mening onvoldoende grond is om te spreken van een al of niet verdachte situatie.

Het eerste punt hierboven betreft de beltonen die aan het begin van een gesprek hoorbaar zijn. Die tonen worden, bij een mobiele telefoon, gegenereerd door het nabije schakelcentrum (MSC) waarmee de gebelde telefoon verbonden is (zie FRR). Omdat er per land onderscheiden internationale ITU[2] standaarden bestaan voor de frequentie en voor de duur (aan/uit) van deze beltonen (de zogenaamde *cadence*), geeft de aard van deze tonen informatie over de locatie van de mobiele telefoon waarop een gesprek binnenkomt. De *ringing tone* die voor Nederland genoemd wordt in de ITU standaard is 1.0 on 4.0 off met een frequentie van 425Hz (zie Figuur 3 in JR).

PR wijst op inconsistenties in deze beltonen. BTR heeft deze beltonen niet onderzocht, maar de onderzoeker Lacey van BEK TEK LLC sprak later, na het inzien van PR, desgevraagd, van een "*compelling argument regarding the cadence issue*" (JR:p.8 bovenaan). De inconsistenties waar PR op wijst betreffence de inkomende gesprekken a1-1 en a1-5 en de uitgaande gesprekken a4-34 and a1-4, zie het overzicht in JR:4.2.

FRR bevestigt dat de door Peller gemeten[3] frequentie en *cadence* van de twee inkomende gesprekken (420Hz, 0.6 on, > 3 off) niet overeenkomen met de Nederlandse standaard, noch met die van enig ander land ter wereld. Eventuele doorschakeling van de telefoon biedt geen verklaring voor de afwijking van deze beltonen.

Van de twee uitgaande gesprekken merkt FRR op dat ook van één daarvan (a4-34) de beltonen niet in de standaards voorkomen. De andere (a1-4) komt wel voor, en betreft een aantal mogelijke landen in Afrika, zie de tabel in FRR. In hoeverre deze locatieaanduiding consistent is met andere informatie in het gehele strafproces kan en wil ik niet beoordelen.

De bevestiging door FRR van de bevindingen van Peller mbt. de afwijkende aard van de beltonen geeft deze kwestie veel gewicht. Om die reden, en

[1] Aan het eind van FRR zijn plaatjes opgenomen. De bedoelde communicatielijn bevindt zich tussen de MF en de LEMF.

[2] ITU staat voor de *International Telecommunication Union*, zie `www.itu.int`.

[3] Fransen en Rijnders zijn uitgegaan van de meetwaarden van Peller; deze waarden zijn door mij zelf in een eerder stadium geverifieerd.

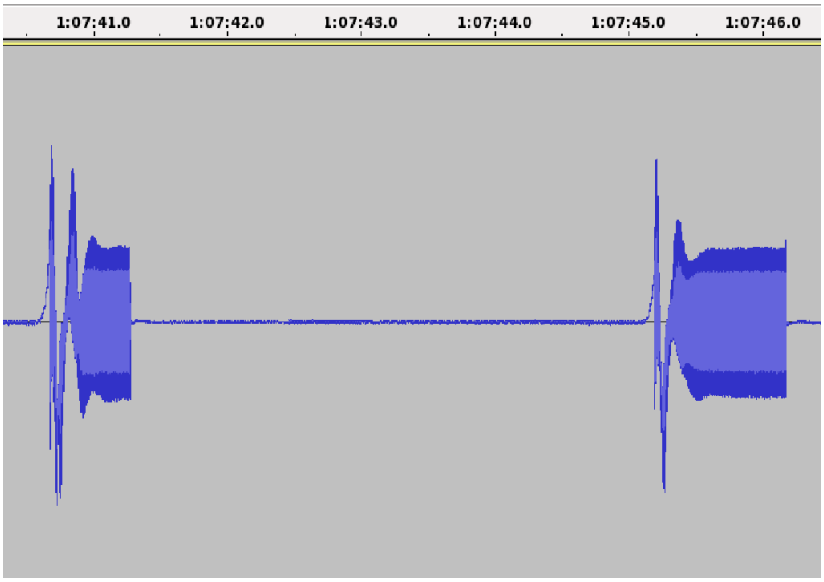

Figure 1: Two ringing signals, in audio fragment A3.18

omwille van de zorgvuldigheid, wilde ik graag een extra controle uitvoeren, in lijn met aanbeveling 2 aan het eind van JR. De inkomende gesprekken a1-1 en a1-5 zijn allebei afkomstig van de gedigitaliseerde audiobanden. Om precies te zijn, ze komen allebei van kant 2-b van band 3281. Deze banden zijn geheel gedigitaliseerd, zie de beschrijving in JR:2.2, en de digitale copieën zijn door u bewaard. Voor het onderzoek zijn er alleen deze twee fragmenten uitgehaald.

Derhalve heb ik u na het bestuderen van FRR verzocht of van de andere gesprekken in het gedigitaliseerde bestand 3281-kant-2-b alsnog de beltonen bekeken mochten worden. Wat mij namelijk niet helemaal lekker zat was het feit dat de telefoon zeer snel opgenomen wordt in de gesprekken a1-1 en a1-5, waardoor er maar korte fragmentjes met beltonen beschikbaar zijn. Die fragmenten heb ik tot mijn beschikking, maar niet de gehele band.

Op 23 juni heeft u mij toegang gegeven tot de audiofile 3281-kant-2-b waarin gesprekken a1-1 en a1-5 voorkomen. De gehele file bevat bijna 4 uur aan gesprekken. Hierin komt a1-1 voor van 1:31 tot 1:33 en a1-5 van 1:49 tot 1:57. Gezamelijk hebben we de file gescand (met Audacity audiosoftware) en verschillende beltonen bekeken. Bij de meeste gesprekken werd de telefoon snel opgenomen, waardoor er maar kort beltonen te zien waren. Bij een aantal gesprekken was er sprake van twee beltonen, waarbij zich het volgende patroon leek voor te doen.

0.6 on, 3.9 sec off, 1.0 sec on, 3.9 sec off, 1.0 on, 3.9 off, etc. (1)

U heeft mij daarna de beschikking gegeven over een copie van 3281-kant-2-b,

waardoor ik preciezer onderzoek kon doen. Een voorbeeld van een gesprek met twee beltonen staat in Figuur 1. Het betreft hier het gesprek met label A3.18 dat verder geen rol in de rechtszaken gespeeld lijkt te hebben. Het is duidelijk zichtbaar dat de eerste beltoon korter is dan de tweede.

Ik heb een vijftal van zulke gesprekken met twee beltonen aangetroffen. Ik heb de begin- en eind-tijden van de beltonen gemeten, met een nauwkeurigheid van enkele hondersten van seconden. De resultaten zijn weergegeven in Figuur 2. Ze bevestigen (het begin van) het bovengenoemde patroon (1) op pagina 5. De frequenties die ik in al deze tonen aangetroffen heb is 427Hz, wederom met enige marge. Dit wijkt niet (noemenswaardig) af van de Nederlandse standaard 425Hz[4].

De band bleek één gesprek te bevatten waar het erg lang duurde voordat de telefoon opgenomen werd. Een plaatje daarvan staat in Figuur 3. Nadere meting van de tijden bevestigt dat na de eerste beltoon van 0.6 sec het patroon 3.9 off en 1.0 on optreedt, zoals in (1).

Op dit punt aangeland blijkt dat de beltonen van de gesprekken a1-1 en a1-5 niet afwijken van de andere gesprekken op de band 3281-kant-2-b: het begin 0.6 on $>$ 3.0 off past in het geconstateerde patroon (1) op pagina 5.

Een subtiel punt is dat het patroon (1) enigszins afwijkt van de ITU-standaard voor Nederland van 1.0 on en 4.0 off, namelijk:

- het geconstateerde 'off' deel is 3.9 sec ipv. 4.0, een verschil in de orde van een paar procent;
- de eerste beltoon wijkt af: die is namelijk 0.6 sec, ipv. 1.0 sec.

Met deze bevindingen heb ik wederom contact opgenomen met de telecom deskundigen Fransen en Rijnders. Ik heb ze de hierboven geschetste nieuwe situatie voorgelegd met als conclusie dat er in de beltonen van de gesprekken a1-1 en a1-5 geen sprake is van (significante) afwijkingen van het Nederlandse patroon. Daarop kreeg ik van Fransen de volgende reactie (op 1/7/10).

> "Ik ben het met je nieuwe conclusie eens.
>
> De cadence die je hebt geconstateerd is niet afwijkend van NL. Voor de eerste toon (0.6 sec) kunnen best plausibele redenen zijn (denk niet alleen aan starten van tape, maar ook bijv. aan opzetten van het pad waarover communicatie wordt afgeleverd)."

Ik kom hiermee tot een aantal concluderende opmerkingen mbt. (het eerste punt van) uw vierde vraag, over de authenticiteit van de beltonen.

1. Ik zie geen redenen om te twijfelen aan de authenticiteit van de beltonen in de inkomende gesprekken a1-1 en a1-5, omdat:

[4] In PR wordt een frequentie van 421Hz genoemd voor de beltonen van a1-1 en a1-5; die frequentie is gemeten in de audiofiles die door Peller zelf vertraagd zijn (zie JR:2.5). De afwijkingen van de standaard (427 tegenover 425, en 421 tegenover 425) zijn minder dan 1%; ze zijn verwaarloosbaar gegeven het feit dat de audiofiles van spoelenbanden afkomstig zijn.

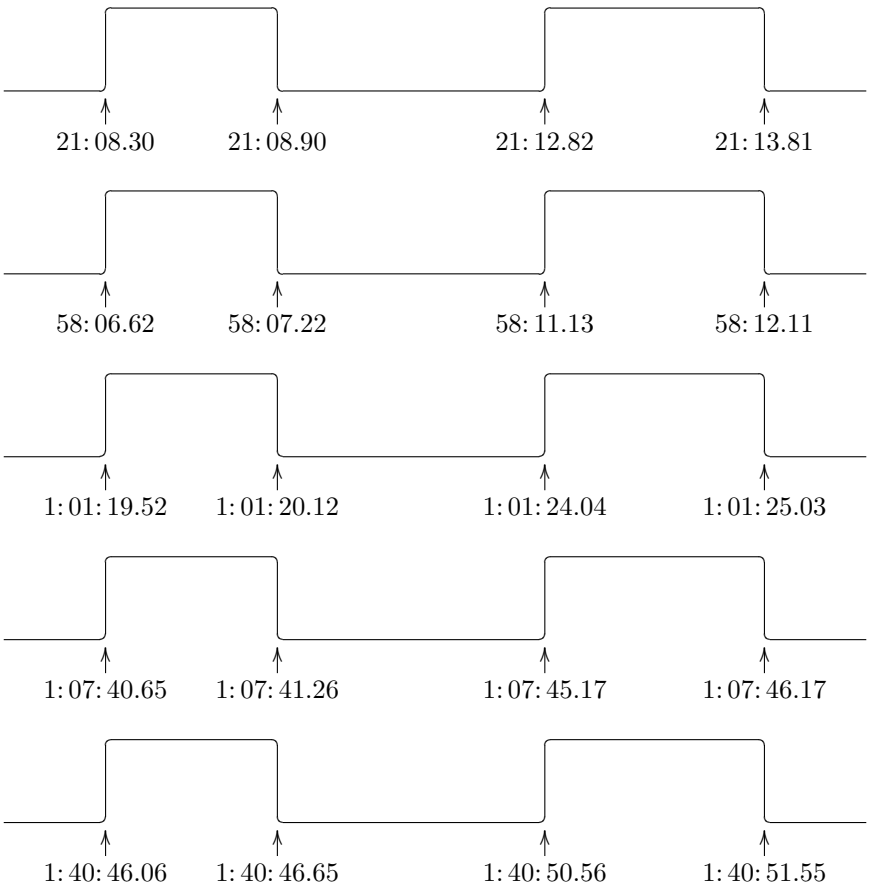

Figure 2: Tijdsaanduidingen van vijf gesprekken op band 3281-kant-2-b met twee volledige beltonen (niet op schaal).

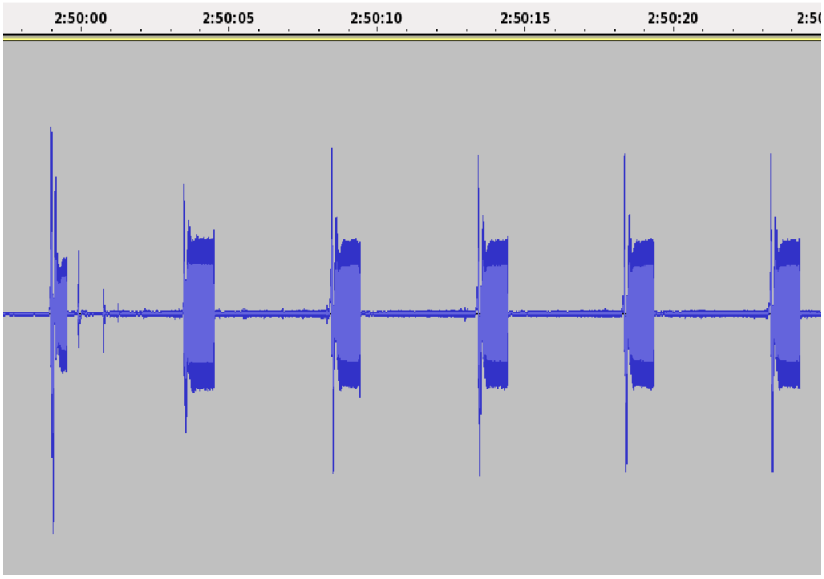

Figure 3: Herhaalde beltonen (rond 2:50)

- de beltonen niet significant afwijken van de ITU-standaard voor NL, zoals hierboven mede door Fransen geconstateerd is;
- de beltonen niet afwijken van de beltonen in de andere, ook onverdachte, gesprekken op dezelfde band. Het lijkt mij onwaarschijnlijk dat alle opgenomen gesprekken gemanipuleerd zijn.

2. Van het (uitgaande) gesprek a4-34 bevestigen Fransen en Rijnders de conclusie van Peller dat de beltoon (400Hz, 1.7 on, $>$ 2 off) niet voorkomt in de ITU-standaard. Het betreft hier een enkele beltoon, zodat het gehele patroon niet duidelijk is. Omdat a4-34 van de optical disc afkomstig is, is het voor mij niet mogelijk de beltonen te vergelijken met andere 'omliggende' gesprekken op dezelfde disc; de disc bevindt zich immers bij het OM in Arnhem, en kan alleen met speciale apparatuur gelezen worden. Verder heeft zo'n vergelijking bij een uitgaand gesprek ook nauwelijk zin, omdat er mogelijk geen andere uitgaande gesprekken naar hetzelfde land zijn opgenomen.

   De conclusie mbt. dit gesprek a4-34 is:

   - ofwel de beltonen zijn niet authentiek;
   - ofwel er is sprake van een afwijkende eerste beltoon in een verder normaal patroon (zoals bij a1-1 en a1-5);
   - ofwel er is gebeld naar een telefoon van een buitenlandse aanbieder die zich niet aan de bij de ITU geregistreerde beltonen hield.

De laatste mogelijkheid is zo algemeen dat nader onderzoek zinloos lijkt.

Op dit punt aangekomen wil ik terugkijken op al het onderzoek dat ik op uw verzoek begeleid en uitgevoerd heb. Er moet dan geconstateerd worden dat gaandeweg verschillende geopperde mogelijkheden van manipulatie minder aannemelijk geworden zijn. Met betrekking tot het door het OM aangedragen audiomateriaal kunnen de volgende twee fundamentele vragen gesteld worden.

1. Komt dit materiaal overeen met datgene wat in de procesvoering gebruikt is?

2. Is het materiaal authentiek, dwz. komt het materiaal overeen met wat door de veroordeelde (en diens gesprekspartners) via diens getapte telefoons besproken is?

De eerste vraag is al snel bevestigend beantwoord: de relevante gesprekken waren aanwezig en bleken in een voorspelbare en correcte tijdsvolgorde opgeslagen. Dit is in aanwezigheid van de verdediging geconstateerd.

Voor de beantwoording van de tweede vraag is signaaltechnisch en auditief onderzoek gedaan.

- Het signaaltechnische onderzoek heeft zich geconcentreerd op de beltonen in geselecteerde gesprekken. Het zou 'harde' gegevens kunnen opleveren over mogelijke niet-authenticiteit van dit audiomateriaal. Zulke gegevens zijn echter uiteindelijk niet naar boven gekomen.

- Audio onderzoek is minder 'hard', zoals blijkt uit de grote discrepantie tussen de bevindingen van de audio experts (Peller en BEK TEK LLC). Bovendien blijkt één van de twee cruciale constateringen van de zuinigste expert (in a1-5, zie JR) gemist te zijn door de minder-zuinige expert.

Wat er in mijn ogen overblijft zijn de volgende twee punten.

(i). In gesprek a4-34 constateren beide audio experts een mogelijk geval van manipulatie, zie Figuur 6 en de conclusie in JR. Bovendien blijkt de beltoon van a4-34 niet in de internationale standaards voor te komen.

(ii). In het gesprek a1-5 constateert eerst de ene, en in tweede instantie ook de tweede, audio expert een mogelijk geval van manipulatie.

Wat daarmee overblijft is enige grond voor twijfel bij de authenticiteit van gesprek a4-34, en in mindere mate ook bij gesprek a1-5.

Tenslotte het volgende. U heeft mij niet gevraagd de recente onderzoeken PR, BTR en FRR te vergelijken met eerdere onderzoeken in deze zaak. Dat heb ik ook niet gedaan: die eerdere onderzoeken zijn buiten beschouwing gebleven en hebben geen rol gespeeld. Toch realiseer ik me dat op enig moment gevraagd zou kunnen worden om zo'n vergelijking. Derhalve wil ik nu reeds de volgende formele punten te berde brengen.

(a) Het NFI heeft veel eerder een aantal gesprekken nader onderzocht en daarvan verslag gedaan op 22 dec. 2000. Het is aannemelijk dat men daarbij over kopieën beschikte van een kwaliteit die vergelijkbaar is met die in het recente onderzoek. De NFI onderzoekers hebben destijds immers, net als u en ik in 2009, directe toegang gehad tot het originele materiaal.

(b) Het NFI onderzoek omvatte luisteronderzoek, zoals gerapporteerd in hun verslag[5]. Van enig signaal-theoretisch onderzoek (zoals in PR) of onderzoek van telecom gegevens (zoals in FRR) is geen verslag gedaan.

(c) Voor zover is af te leiden uit het NFI verslag van 22 dec. 2000 behoren de hier als meest controversieel aangeduide gesprekken, namelijk a4-34 en a1-5, niet tot de dertig gesprekken die destijds door het NFI zijn onderzocht.

(d) De aanvullende onderzoeken die de verdediging heeft laten uitvoeren, bijv. door van de Ven (in 2004) en Dickey (in 2003), zijn gebaseerd geweest op audio files van inferieure kwaliteit (op ter beschikking gestelde cassettebandjes).

Met vriendelijke groeten,

Prof. dr. B. Jacobs

[5]Daarnaast wordt "optische analyse" van de audiodragers kort genoemd, zonder verdere uitwerking of nadere informatie.

Assessment of telephone tones on audio files of intercepted communication in the report of Peller

Author: **Frank Fransen (TNO ICT) & Jan Rijnders (KPN Security JAM)**

Version: **1.0**

Date: **26 May 2010**

Background

Prof. Bart Jacobs has requested the authors of this document to assess the telephone tones reported in:

- Shlomo Peller, *Recordings Examination Report*, September-October, 2009.

Mr. Peller describes in his report that the audio files contain unexpected ringing tones, missing Caller Identification (CID), and inconsistent/abnormal tones at call termination. In this document we present our assessment with respect to these telephone tones.

In appendix A several relevant call scenario's with lawful interception are depicted.

Disclaimer

This document is based on observations by the authors, and is NOT an official statement by employers of the authors.

Ringing tones on incoming calls to NL

In the incoming calls numbered *a1-1* and *a1-5* the ringing tone does not match the Dutch Standard. In [1] the ringing tone for the Netherlands is defined as 425 Hz with a cadence of 1.0 s on and 4.0 s off. Peller has measured a ringing tone on these files of 421 Hz with a cadence of 0.6 s on and >3 s off.

The two calls are both incoming calls to 06-55382210. According to the OPTA[1], this number has been issued to Libertel/Vodafone as of 1997-07-10.

Ringing tones are generated by the telecom switch on which the called phone is connected (depicted in figure A.1). For GSM the telecom switch is called a Mobile Switching Center (MSC). GSM allows roaming to other mobile networks in other countries. In case of roaming the MSC in the visiting network will generate the ringing tone (depicted in figure A.2). Note that incoming calls to a Dutch GSM phone in a visiting (foreign) GSM network “in principal” will get intercepted at the MSC of the home network operator in the Netherlands and handed over to the Law Enforcement Monitoring Facility (LEMF). Note that outgoing calls from a roaming GSM phone are not intercepted at the MSC of the home network operator in the Netherlands (depicted in figure A.7).

We can think of three technical explanations for the fact that the ringing tone does not match the Dutch standard:

[1] http://www.opta.nl/

1. The GSM phone was connected to a visiting network in an other country. The recorded ringing tone would be that of the visited network.
2. The call to the GSM phone was forwarded to a phone number in another country. The recorded ringing tone would be that of the country to which the call was forwarded (depicted in figure A.3).
3. The MSC in the Libertel network was configured to generate the deviating ringing tone.

With respect to explanation 1 and 2, it means that the subject of interception had to be abroad during the calls. For explanation 2 it might even be possible that the call could be forwarded a second time, to another phone in the Netherlands, but in that case one should hear Dutch ringing tones.

For explanations 1 and 2 (forwarded to foreign country), we have tried to identify a country with a matching ringing tone. The ITU-T periodically publishes a document containing various tones used in national networks as a supplement to ITU-T Recommendation E.180. For this assessment we used a version from 1998 [1] and 2003 [2]. The version from 1998 was based on replies received from a questionnaire sent on 20 June 1997, and thus contains the figures that would most likely to be used during the times of the intercepted telephone calls. Note that the ITU-T documents [1] and [2] do not claim to provide a complete overview of the various tones used in networks of all countries.
We were not able to identify a matching ringing tone for any of the countries in [1] and [2]. Not even when we assume that the 421Hz could also be 420 Hz or 425 Hz. There is no matching cadence for 0.6 s on and >3 s off.

With respect to explanation 3), we have contacted Libertel (i.e. Vodafone) and asked if they were capable to find out what ringing tone was applied in 1997. So far we did not get a conclusive answer. However, we expect it to be unlikely that these ringtones deviated from internationally agreed standards.

We will not speculate on other explanations for the incorrect ringing tones.

Ringing tones on outgoing calls from NL

Peller also reports on several intercepted outgoing calls from the Netherlands with ringing tones that don't match the country to which the call is supposed to be setup or even have an unknown ringing tone. The particular calls are:

- The outgoing call numbered *a4-34* has an unknown ringing tone: 403Hz (~400Hz), ~1.7s on and ~2s off. There is no matching ringing tone specified in [1] and [2].
- The file *kant-1-a* has two outgoing calls with both unknown ringing tone. For the first ringing tone: ~440Hz, ~1s on and ~3s off, there is no matching ringing tone specified in [1]. For the second outgoing call the ringing tone 440Hz, with a cadence 1.67s on and 3.23s off. For the second one there are some countries specified in [1] and [2] that use such ringing tone. See table below.
- The outgoing call numbered *a1-4* has an unknown ringing tone: 438Hz (~440Hz), 1.67s on and 3.23s off. The document states that the call is supposedly to Turkey, but the ringing tone doesn't match that of Turkey (450 Hz, with cadence 2.0s on and 4.0s off). There are some other countries specified in [1] and [2] that do use such ringing tone. See table below.

Table 1. Countries with ringing tone 440Hz and a cadence 1.67s on / 3.23s off

Country	FREQUENCY in Hz	CADENCE in seconds
Republic of Benin	440//425*)	1.7 on 3.3 off
Burkina Faso	440**)	1.7 on 3.3 off
Republic of Cameroon	440	1.7 on 3.3 off
Republic of Chad	440	1.7 on 3.3 off
French Polynesia	440	1.7 on 3.3 off
Gabonese Republic	440	1.7 on 3.3 off
Madagascar	440//425*)	1.7 on 3.3 off
New Caledonia	440	1.7 on 3.3 off
Niger	440	1.7 on 3.3 off
Rwandese Republic	440	1.7 on 3.3 off
Senegal	440	1.7 on 3.3 off

*) The f1//f2 means that some switches use the first f1 and other use f2.
**) There are also other ringing tones in use.

We identified three possible technical explanations for the mismatch of the ringing tones on outgoing calls from NL.

1. When the phone call was made to a GSM phone that was at the time of the call roaming in another country. The recorded ringing tone would be of the visited country (and not of the home network) (depicted in figure A.5).
2. When the phone call was made to a phone for which call forwarding was enabled to a phone number in another country. The recorded ringing tone would be that of the country to which the call was forwarded (depicted in figure A.6).
3. The ringing tone on the (terminating) switch was incorrectly configured.

We will not speculate on other explanations for the incorrect ringing tones.

Tones at call termination

In the report from Peller, several of the files contain calls with strange tones at call termination. For GSM it is, however, not likely that a disconnect tone would have been presented on the audio channel to (or from) the mobile phone that was being intercepted.

In PSTN (i.e. fixed-lines analog public telephone system) a disconnect tone is generated for the remaining party after the remote party hangs up. This tone is generated by the local switch of the remaining party. The disconnect tone is typically similar to the busy tone or the congestion tone. For the Netherland typical disconnect tones are:

- 425Hz with a cadence 0.5s on and 0.5 off (busy tone)
- 425Hz with a cadence 0.25s on and 0.25s off (congestion tone)

In GSM, however, there is no tone based signaling from the MSC to the mobile phone. GSM is a digital network with separate signaling and speech communication. A GSM handset just disconnects without any tones to inform the user that the other party has hang up.

We could think of two possible sources for the disconnect tone on the files:

a) *local exchange used for delivering intercepted calls to the LEMF*
   Intercepted calls were transferred from the MSC to the LEMF via a PSTN telephone line. On this telephone line tone based signaling could have been applied. Thus when the intercepted call was terminated the local exchange informed the LEMF by applying a Disconnect Tone. In this case, the tones would match disconnect tones used in the Netherlands.
b) *monitoring equipment at the LEMF*
   The monitoring equipment at the LEMF could also have generated the tones. Since we have no information on these systems, we cannot verify this.

Peller reported that on some – but not all – of the ANALOG calls there is a "busy tone" played after the termination of the call. He measured two frequencies ~417Hz and 425Hz. The 425Hz matches the disconnect tones used in the Netherlands. The tone of ~417Hz (could be 420Hz) with cadence ¼s on and ¼s off, doesn't match any of the busy or congestion tones specified in [1] and [2]. The closest match to this is the congestion tones used in Austria 420Hz with a cadence of 0.2 on and 0.2 off.

We do not have a technical explanation why some disconnect tones deviate from the Dutch standard or are missing.

Caller Identification (CID) or Calling Line Identification Presentation (CLIP)

KPN introduced Caller Identification (nummerherkenning) for the PSTN in August 1998[2]. Before this date it was already technically available on the GSM network and ISDN. In GSM and ISDN CID is done via the signaling path, and not in band via dual-tone multi-frequency (DTMF). It is therefore plausible that there is no CID present in the audio signal of the intercepted outgoing calls from the KPN network. (in particularly the calls numbered a4-34, a3-24, a1-3, a1-4, kant-1-a and kant-2-b.

Computable.nl 06-03-1998

Nummerweergave voor alle klanten KPN

KPN Telecom biedt vanaf augustus alle klanten de mogelijkheid om gebruik te maken van de dienst Nummerweergave. Momenteel is deze dienst al in gebruik op het mobiele GSM-net en bij Isdn-verbindingen.

display van het telefoontoestel het nummer van de beller te zien. Op deze manier weet de beantwoorder wie er belt.
KPN heeft de Opta vandaag van de voorgenomen introductie op de hoogte gesteld. Een abonnement kost een rijksdaalder per maand. Bij een telefoontje vanuit een telefooncel of vanaf een mobiele telefoon die werkt op het NMT-netwerk is geen nummer zichtbaar. De beller kan te allen tijde de weergave van zijn nummer blokkeren.

http://www.computable.nl/artikel/nieuws/214689/250449/nummerweergave-voor-alle-klanten-kpn.html

[2] http://www.computable.nl/artikel/nieuws/214689/250449/nummerweergave-voor-alle-klanten-kpn.html

References

[1] VARIOUS TONES USED IN NATIONAL NETWORKS (POSITION ON 1 APRIL 1998); SUPPLEMENT 2 TO ITU-T RECOMMENDATION E.180; ITU-T; Geneva, 1998; Annex to ITU Operational Bulletin No. 665 – 1.IV.1998
http://www.itu.int/publ/T-SP-OB.665-1998/en

[2] VARIOUS TONES USED IN NATIONAL NETWORKS (ACCORDING TO ITU-T RECOMMENDATION E.180)(03/1998) (POSITION ON 1 FEBRUARY 2003); ITU-T; Geneva, 2003; Annex to ITU Operational Bulletin No. 781, 1.II.2003;
http://www.itu.int/publ/T-SP-OB.781-2003/en

Appendix A. Depictions of relevant call scenario's with lawful interception

A.1 Call scenario's with B subject of interception

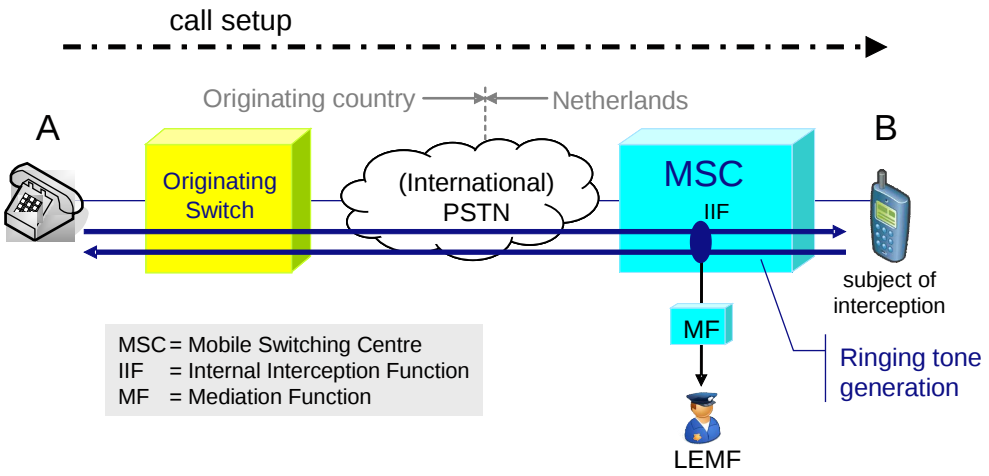

Figure A.1 Normal call setup (A to B) with B the intercept subject. The MSC generates the Ringing tone that will be intercepted and recorded at the LEMF.

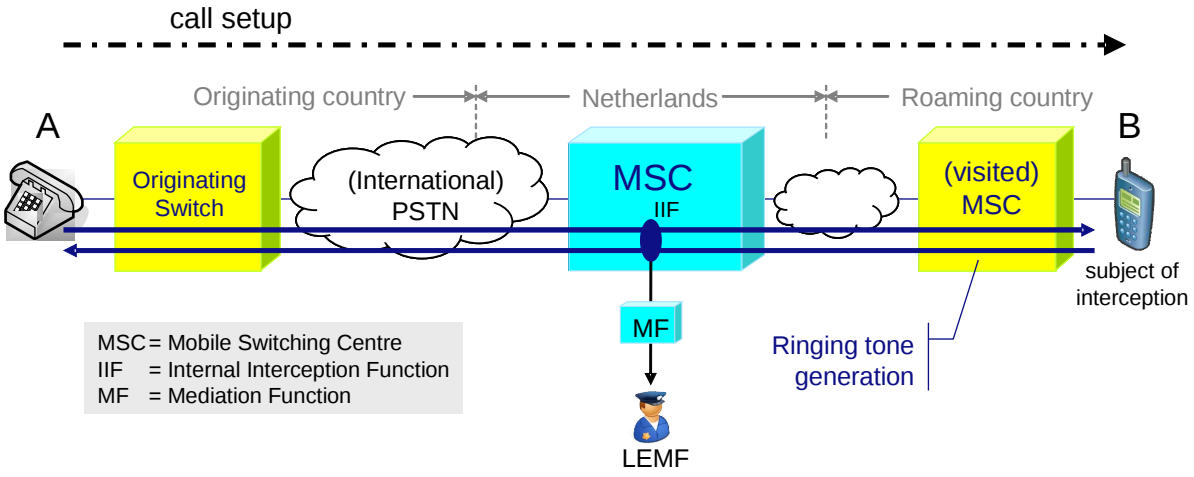

Figure A.2 Call setup from A to *roaming GSM* user *B*. B is the subject of interception. The serving MSC in the visited network will generate the ringing tone that will be intercepted at the MSC in the home network of B. The call including the ringing tone will be recorded at the LEMF.

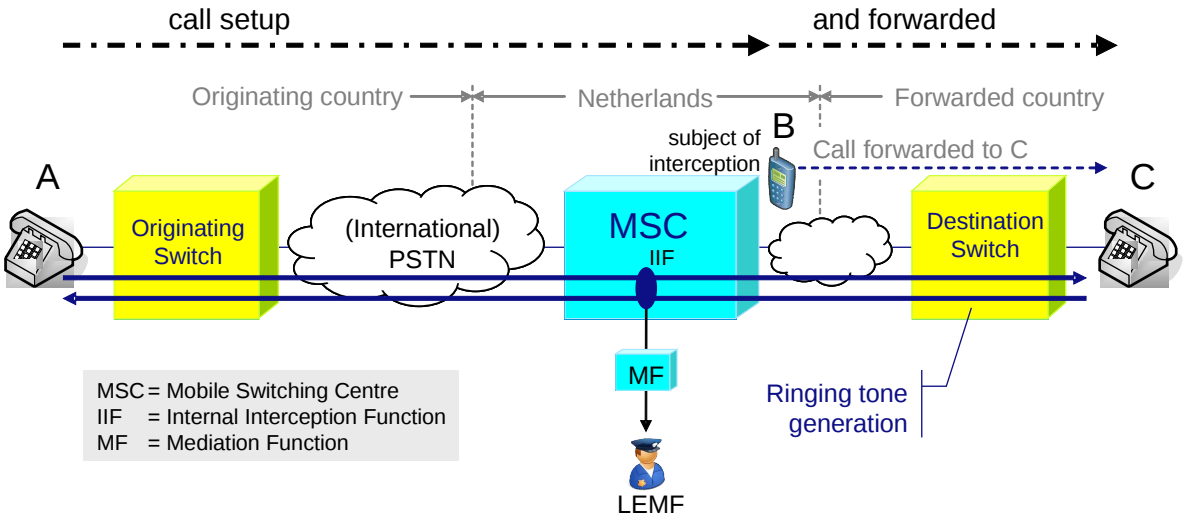

Figure A.3 Call setup from A to B, and B has call forwarding to C. B is the subject of interception. The serving switch in the network of C will generate the ringing tone that will be intercepted at the MSC in the home network of B. The call including the ringing tone will be recorded at the LEMF.

A.2 Call scenario's with A subject of interception

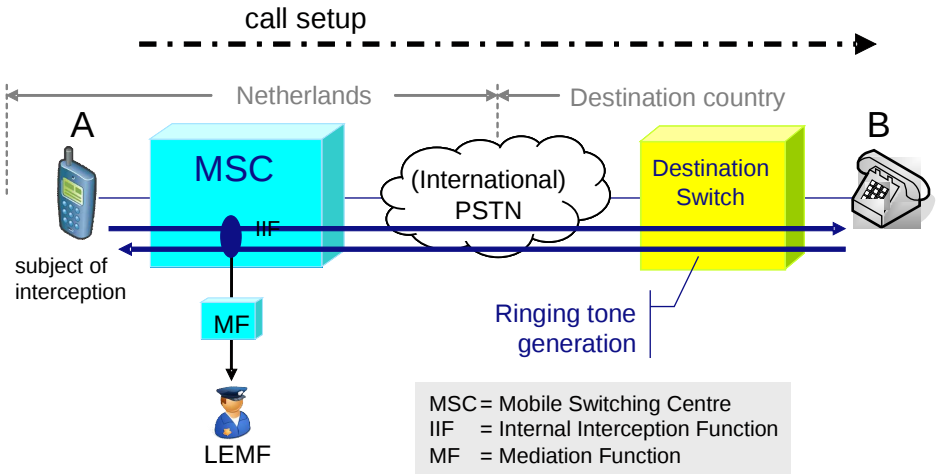

Figure A.4 Call setup from A to B. A is the subject of interception. The terminating switch in the destination network will generate the ringing tone that will be intercepted at the MSC in the network of A. The call including the ringing tone will be recorded at the LEMF.

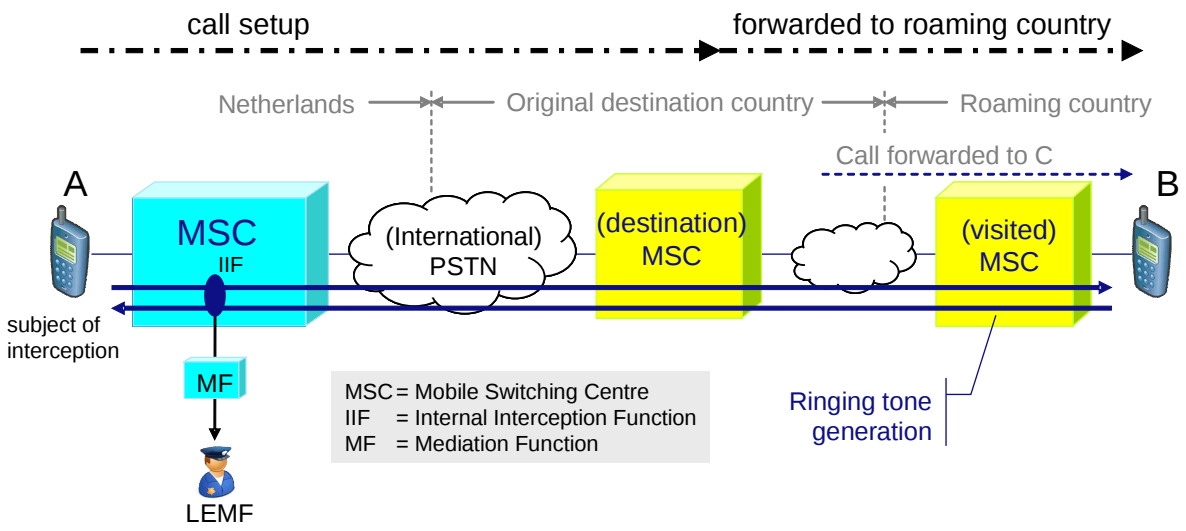

Figure A.5 Call setup from A to B. A is the subject of interception. The destination mobile phone B is roaming. The MSC in the visited network will generate the ringing tone that will be intercepted at the MSC in the network of A. The call including the ringing tone will be recorded at the LEMF.

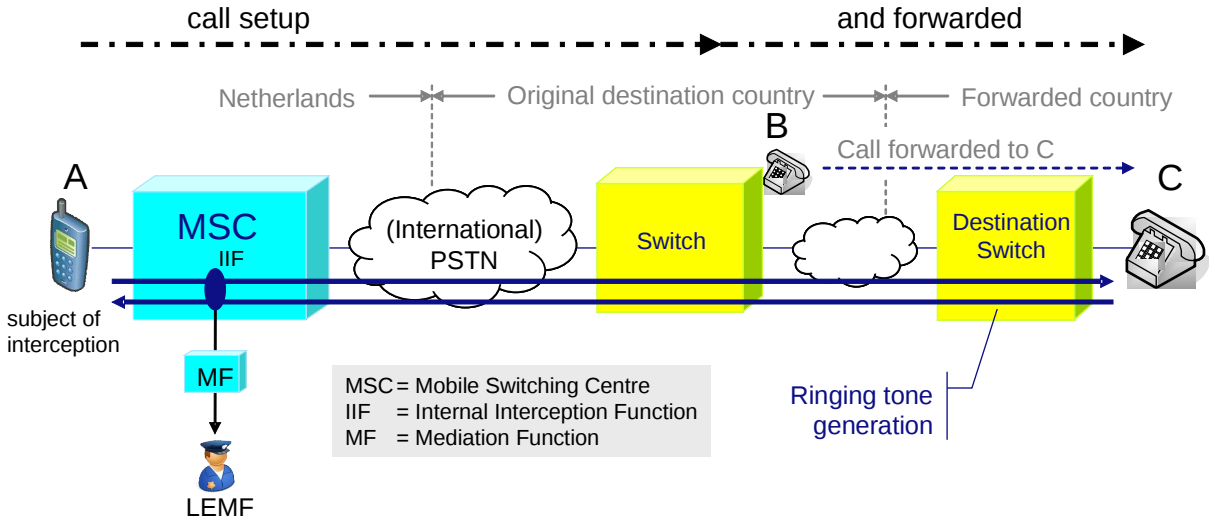

Figure A.6 Call setup from A to B. A is the subject of interception. The destination phone B is forwarded to C. The serving switch in the network of C will generate the ringing tone that will be intercepted at the MSC in the home network of A. The call including the ringing tone will be recorded at the LEMF.

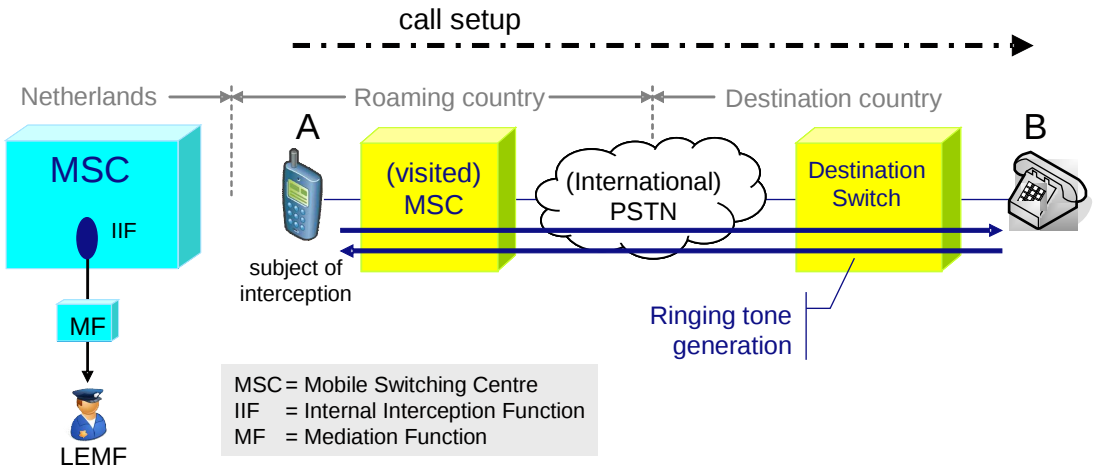

Figure A.7 Call setup from A to B. A is the roaming user and is the subject of interception. The call can not be intercepted at the MSC, since the serving MSC in the visited network will route the call directly to destination B.