Proceedings of The Institute of Acoustics

THE AUTHENTICATION OF TAPE RECORDINGS: FURTHER CONSIDERATIONS

Brian Klepper

Forensic Communication Associates $ Institute for Advanced Study of the Coomunication Processes, University of Florida, Gainesville, Florida.

INTRODUCTION

High quality tape recording technology is now readily available to the general public. Recording systems that would have been considered laboratory quality 15 or so years ago are now relatively inexpensive to obtain and simple to use. Furthermore, tape recordings are convenient: they are easy to produce, can be reproduced without a significant change in the signal, are capable of holding a great deal of information, take up little storage space, and provide a highly accurate and nearly permanent record of a recorded event. Even better (and worse) they can be rerecorded again and again with little deterioration in the quality of the signal. As a result, there has been an explosion in the number of recordings which are made each day -- investigative recordings, recordings of important meetings, recordings of telephone conversations.

Naturally, it is inevitable that some of these tapes become crucial in legal proceedings, and in some percentage of these cases, claims will be made that an evidentiary tape does not faithfully represent the events as they occurred. That is, the authenticity of the recording, and the recording's concomitant legal admissibility, may be brought into question. Unfortunately, this is a simple claim to make, for the ease with which tapes can be manipulated make them vulnerable to attack and difficult to defend. Indeed, any individual with a few pieces of inexpensive equipment, a little technical knowledge, the time and the proper motivation can change a recording in signficant but subtle ways: portions of speech or other signals can be added or deleted to alter content, noise can be added with the result that intelligibility can be obscured, and so on.

By contrast, a forensic examination to determine the authenticity of a tape recording is a complex, time consuming and expensive process. To date, two excellent articles (Weiss and Hecker, 1976; Hollien, 1977) have outlined in some detail the procedures essential to the authentication examination. This paper provides a brief description of those procedures, and a disussion of two quasi-legal issues which we have encountered in our authentication examinations.

Legal Criteria for Tape Authenticity

Generally, before a tape recording can be introduced into evidence in a Court of Law, its authenticity must be established. That is, it must be demonstrated to the Court's satisfaction that the history of the recording in question is exactly what its proponents claim it to be. In the United States, establishment of a tape recording's authenticity is bound to four criteria: (Fishman, 1978):

1) that the equipment used was capable of making the recording in question. That is, that both the exhibit tape and the purported original recorder are

compatible (e.g., both cassette or reel-to-reel); that the device was in working order when the recording was made.

2) that the individual making the recording was competent. Was that person familiar with the machine? Had he used it before? Had he been briefed about its operation?

3) that the recording has been preserved in a manner that can be documented. That is, was the chain of custody intact? Had an accurate log been maintained? Was there an obvious opportunity for tampering to occur?

4) that changes, additions or deletions had not been made in the recording.

In most cases, the first three conditions may be established through the testimony of the individuals involved with the process (or their superiors). However, there are times when the fourth criterion becomes critical: i.e., when one of the relevant parties questions the integrity of the recording. At that time, the technical and philosophical issues inherent in a forensic examination of a tape recording must be addressed.

The Forensic Tape Examination

The Examiner. Because tape recorders and recordings are widely used, it may be tempting to assume that an adequate tape examination can be carried out easily by technical or minimally trained personnel (by a recording studio technician, for example). Not so. The range of cues which enter into the detection of tape recording manipulation covers a broad spectrum of disciplines, including Phonetics, Linguistics, Electronics and Electrical Engineering. Thus, an examiner must have a reasnably broad base of knowledge from which to draw. That is, the competent examiner must:

1) understand and strictly adhere to the principles of scientific inquiry.

2) possess the objectivity and patience to address each potential problem encountered with the tape -- seeing all through to their resolution.

3) be thoroughly acquainted with tape recorder operation, the principles of acoustic signal transduction, signal transmission and magnetic recording.

4) have experience in all levels of acoustic signal analysis, and be familiar with calibration procedures.

5) be a critical listener, sensitive to transient pulses, ambient noise levels, and incongruities in the flow of information.

6) be conversant with the dynamics (i.e., the acoustics and the physiology) of speech and language production, and able to address adequately such topics as coarticulation and dialect.

Procedural Assumptions. The evolution of tape examination into a discipline has necessitated the development of certain assumptions, most of which are based on the characteristics of present technology.

THE AUTHENTICATION OF TAPE RECORDINGS: FURTHER CONSIDERATIONS

1) The central question of a tape recording authentication examination is: has the integrity of the recorded event been violated? There are, in turn three predicates to this question, i.e., that: a) the tape recording of interest has not been interrupted in any manner, b) no portions of the recording have been removed and c) the recording contains only that material which was originally recorded.

2) It is impossible to determine if a given recording is the original or a copy. Therefore, an evidentiary tape must be referred to as a "purported original" (Hollien, 1976) or an "exhibit tape" (Weiss and Hecker, 1976).

3) Since the potential for tape alteration obviously is very real, the examiner must treat every observed problem as a possible sign of manipulation.

4) Even if a tape is found lacking in integrity, it will not be possible to determine whether the source of the violation is intentional or accidental. The examiner can only list his findings.

Questions to be Answered. Weiss and Hecker have posed four questions which form the core of inquiry for a tape examination:

1) "Are the properties of the exhibit tape (i.e., the purported original) consistent with what is known or can reasonably be assumed about the original tape?" For example, if it is known that the original recording was made on a new 90 minute tape with a polyester base and a chromium dioxide emulsion, then the exhibit tape must have the same characteristics. For example, if it is found to contain only 78 minutes of playing time, then an incongruity has been identified.

2) "Are the properties of the exhibit recording consistent wih what is known or can reasonably be assumed about the original tape recorder and the original recording?" Different brands of tape recorders and other magnetic devices (e.g., bulk erasers) have been shown to have characteristic electrical signatures for starts, stops and pauses. If possible, exemplars from the purported original recorder should be obtained for comparison to "signature transients" from the exhibit tape. Similarly, the purported original recorder may have been a full track, half-track, or quarter track machine, and the track width on the exhibit tape must be appropriate.

3) "Are the properties of the exhibit recording consistent with what is known about the original signal transducer and the original intervening equipment?" That is, what were the properties of the equipment between the acoustic source and the recorder? Microphones, telephone lines, FM transmitters, and amplifiers each have different signal shaping characteristics, and the recorded signal must reflect those characteristics. For example, if a recording was made on a tape recorder coupled to a telephone transmission line, it would be expected that the bandwidth of the signal would be severely limited. If an FM transmitter was used in an undercover investigation, a good deal of static interference might be expected.

THE AUTHENTICATION OF TAPE RECORDINGS: FURTHER CONSIDERATIONS

4) "Are the properties of the exhibit recording consistent with what is known or can reasonably be assumed about the acoustic sources?" What were the acoustic characteristics of the recorded event? If, a tape recording consists of conversations obviously recorded in a bar with loud background music, and a portion of the conversation suddenly shifts to a quiet environment, it may be safe to assume that the incongruous portion represents tampering. Similarly, if it is known that an interrogation lasted for 39 minutes, but the timed recording is found to be only 25 minutes, then it may be concluded that the recorder was turned off and on during the proceedings -- or that a portion of the recording had been removed.

Procedures. Three types of analyses can be applied in order to evaluate the authenticity of a tape recording.

1) Physical examination of the tape. For this set of procedures to be appropriately conducted, the purported original tape must be examined. Cassette casings should be checked for signs of entry (e.g., scratched screws); the tape should be measured or timed to insure appropriate length. Moreover, the magnetic orientation of the oxide surface should be inspected for proper track width, and the entire tape should be examined for evidence of adhesive or heat splices. The tools needed for these operations include a tape recorder with a counter or timer, a microscope or strong magnifying glass, a thin plastic glove, and a method of visualizing the magnetic orientation of the oxide surface (Weiss and Hecker suggest immersion in a "magnetic" solution, but we use a device manufactured by the 3-M Corporation; it consists of a glass plate filled with an iron filing solution).

2) Auditory examination of the recording. In this and the following set of procedures, it is wise to utilize a copy of the recording, since the risk of damage to the exhibit tape is always present. If a violation of the integrity of the tape is found during this examination, then the existence of the event should be confirmed on the exhibit tape as well. The auditory examination allows the examiner to familiarize himself with the recording, to make an log of potential problems (such as transient clicks or sudden shifts in intensity level), and to make decisions as to which portions of the recording deserve concentrated effort. The only tools needed here are a tape recorder and headphones.

3) Electroacoustic examination of the signals. An instrumental analysis can determine the nature of signals on the tape in three dimensions: timing, intensity and frequency. Naturally, the instruments utilized will vary with the experience of the examiner and the facilities available to him -- as well as with the specific problems posed by a given recording. Accordingly, a short summary of the tools and their uses will have to suffice. A visual/auditory impression of the signal may be gained from the combined procedures of watching its oscilloscopic trace while listening to it; moreover, the instruments which provide hardcopy graphs permit examination of the trace in greater detail. For example, a high speed oscillograph (time by amplitude) produces a trace which is useful in comparing waveforms. By this means, an electrical pulse may be

differentiated from an environmental sound (signal rise time is important here). Another useful tool in this category is the Fast Fourier Transform (FFT) which provides a frequency by amplitude display. These units can be used to determine the spectral range and distribution of acoustic events (e.g. a transient pulse or the entire recording). Properly applied, the FFT can be utilized to compare signals (and the hypothesis of identical sources), discern spectral bandwidth, and so on. In turn, the time/frequency/amplitude spectrograph allows the gross specification of signals over time and is particularly useful for the identification of gaps or breaks in the continuity of an event. Finally, the graphic level recorder (time by amplitude) provides a trace of the overall intensity of the recorded signal. Sudden shifts in intensity level are easily identified and calculated using this tool.

It should be noted that this review has been by no means exhaustive; rather, it is designed to provide a listing of the approaches that can be employed in the authenticaion process.

Quasi-Legal Questions Facing the Examiner

In addition to the purely technical aspects of the authentication of tape recordings, there often are circumstances which require the examiner to make difficult but non-technical decisions -- or, perhaps it is the courts and juries that shoud do so. In any case, two such situations are described below.

The first occurs when one portion of a tape can be shown to be lacking in integrity while the rest (which incidently may contain the incriminating information) is shown to be without problem. The question arises then: does a violation in one portion of a recording generalize to the entire tape, or may an intact portion of the tape be authenticated independently from another segment -- one that potentially has been manipulated?

An illustration is appropriate here. Suppose an authentication examination has been carried out on a tape recording of an illegal drug purchase and off-on recorder activity is observed at the beginning of the recording. At this juncture, the examiner is forced to conclude that the integrity of the recording has been violated. However, assume also that another part of the same recording is quite intact and free from problems -- and it is within this portion of the tape that the crucial evidence can be found. Should this tape, and specifically, the incriminating section of it, be admissible into evidence.

As would be expected, the arguments from each party may be quite convincing. The prosecutor may argue that, since the critical section is intact, it is reasonable to assume that it is an accurate representation of the events in question. He may argue further that the degraded sections of the tape are, in fact, unrelated to the intact section -- or that they were damaged by accident. By contrast, the defense attorney could claim that the gaps represent passages which have been purposefully deleted, but which are pertinent to the greater sense of the case, (and would show, if they were only still there, that his client was an innocent by-stander rather

than the criminal). Thus, the court has two choices available. If it rejects the tape, then it has made the assumption that all parts of the tape are related to all other parts. If, however, the court chooses to admit the tape, i.e, select only that part of the tape which it deems relevant, then the "modified" portion of the recording has been discounted, and the possibility of tampering has been discounted as well. Moreover, this view, that one portion of the tape may be divorced from another, depends on speculation which is independant of the evidence. That is, since there is no way of knowing precisely how the gap arrived on the recording, it is potentially incorrect and unjust to create a scenario about the generation of the off-on clicks upon which the courts judgement of guilty or innocent will be based. It is our position, then, that the tape expert must assume that any violation of the integrity of a recording taints all the information in that recording, and that a tape which has been recorded as a unit cannot be arbitrarily segmented to suit a particular argument.

A second issue which may be encountered by the examiner concerns a tape recording which exhibits events that cannot be clearly identified either as innocuous or manipulative. The question in this case is: if a tape cannot be authenticated because of potential but undemonstratable problems, should it be considered to be lacking in validity (authenticity) -- with the implication that it may have been altered -- and therefore should not be admissible into evidence.

An example: transient pulses (i.e., clicks) are particularly difficult to identify when they occur on a tape. They may be generated by any type of electrical signal -- such as a short circuit or an FM transmission (both are innocuous) or stops, starts and pauses in the operation of the tape recorder (damaging). In the case of a recording of an FM transmission, the background noise caused by static interference can be both pervasive and of high intensity. If a specific transient pulse is identified during the course of an examination as potentially problemmatic (because of its intensity or location in time), it may be difficult to ascertain the actual source of that pulse -- that is, whether it was generated after the original recording was made or if it is simply part of the general recording environment. Obviously, the examiner cannot perform a spectral analysis on each pulse on the recording in an attempt to make a match with a source signal. However, if there is some extrinsic reason to believe that a particular pulse may indeed be indicative of manipulation, then the examiner is left with a dilemma -- he cannot authenticate the tape because of possible problems and yet he cannot demonstrate that the tape was tampered with (and thus testify that the tape is inauthentic). Thus, the examiner's only course of action is state the facts and explain why his findings are inconlusive. Then, it is up to the legal system to weigh those findings and render a decision.

The problems inherent in tape authentication often are virtually unmanagable because tapes are easy to impugn, hard to defend and expensive to process. Moreover, the range of claims which can be leveled against recordings places a onus on the law enforcement community to be scrupulous in their recording operations, and thorough in their examinations of tapes

which have been challenged. Not only are such problems costly to address in the courts, but they can neutralize the tremendous effort that is expended in getting a case to the courts in the first place. Unfortunately, the necessary balance betwen cost and work load has forced many agencies to adopt a policy of only examining specific places on a recording -- i.e., those which are challenged by the opposing party or where the integrity is obviously questionable (Aperman, 1978; Koenig, 1982). While such policies may discourage frivalous claims against authenticity, they also tend to foster non-objective refutation of such

Although fundamental tape authentication procedures have been carried out for several years by a number of individuals/agencies, to date there has been no consensus among the general law enforcement community as to the procedures that should be routinely applied to this special class of investigation. Indeed, at this point in time, few agencies are equipped to deal with this growing problem. We believe that the rise in the use of tape recordings necessitates the establishment of standard recording and examination procedures as outlined above. Furthermore, law enforcement organizations must recruit appropriately trained personnel to deal with the multiple issues involved in authentication.

References

Aperman, A. (1982) Examination of Claims of Inauthenticity in Magnetic Tape Recording, Proceedings of the 1982 Carnahan Conference on Crime Countermeasures, Lexington, KY.

Fishman, C.S. (1978) Wiretapping and Eavesdropping, The Lawyers Co-operative Publishing Co., Rochester, N.Y.

Hollien, H. (1977) Authentication of Tape Recordings, Proceedings, 1977 Carnahan Conference on Crime Countermeasures, 19-23, Lexington, KY.

Hollien, H. (1978) Forensic Phonetics: A New Dimension to the Phonetic Sciences, Hamburger Phonetische Beitrage 25, 157-190,

Koenig, B.E. (1982) Deposition of the Federal Bureau of Investigation's Senior Tape Examiner, Florida vs. Garmise.

Weiss, M.R. and Hecker, H.L. (1976) The Authentication of Magnetic Tapes: Current Problems and Possible Solutions, in National Wiretap Commission Studies, 217-240