

# **EXHIBIT A-1**

**EXPERT REPORT OF PROFESSOR ELLIS HOROWITZ**

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CONFIDENTIAL – ATTORNEYS’ EYES ONLY

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**I. Professional Background**

1. I have been retained by plaintiffs in the matter of *Arista Records LLC v. Lime Wire LLC* to provide expert analyses and opinions.

2. I have been asked to (1) explain peer-to-peer “file sharing” generally and, in particular, the Gnutella peer-to-peer protocol; (2) explain the functioning of the LimeWire peer-to-peer file sharing application; (3) analyze the LimeWire peer-to-peer file sharing application and related Lime Wire LLC services to determine what, if any, elements of their design and function promote trafficking in works not authorized for distribution on the Gnutella network (“unauthorized works”); (4) and analyze the LimeWire peer-to-peer file sharing application and related Lime Wire LLC services to assess defendants’ ability to use tools, such as filtering, to reduce the use of the LimeWire peer-to-peer file sharing application for traffic in unauthorized works; and (5) analyze what, if any, control Lime Wire LLC exercises over installed clients.

3. The documents that I have considered in forming the opinions expressed herein are listed in Exhibit B. I may supplement my analyses and opinions if new information, including deposition or other testimony, becomes available in conjunction with my ongoing research on the issues involved in this case. I may also develop charts or other visual aids to illustrate my testimony.

4. I am a Professor of Computer Science and Electrical Engineering at the University of Southern California (“USC”).

5. I have held the position of Professor of Computer Science and Electrical Engineering at USC since 1983, and I served as the Chairman of the Computer

Science Department from 1990 to 1999. After completing my term as Chairman, I was appointed as the Director of Information Technology and Distance Education in USC's School of Engineering. In this capacity, I directed USC's Distance Education Network ("DEN"), through which USC delivers more than 150 graduate engineering courses to more than 1,000 students across the United States via satellite broadcasts and Internet webcasts. In addition to managing a staff of twenty-seven and an annual budget of \$3 million per year, I directed the development of internal computing systems for DEN, including a database for maintaining student records. I also directed the development of an extensive website for the program, which DEN students use to communicate interactively with professors and advisors.

6. I have extensive experience in the field of software engineering, a field in which I have focused my research work for the past two decades. I am a member of the *Center for Systems and Software Engineering* at USC, a research group whose focus is the study and improvement of software development. I have developed or co-developed numerous software systems in conjunction with the Center.

7. In addition, from 1983 to 1993, I was co-founder and an officer of Quality Software Products, a UNIX application software vendor. I oversaw the design, development, maintenance, and enhancement of software systems that were sold worldwide. Over the years, I have developed numerous computer software systems in a variety of programming languages, including Java, C/C++, Visual Basic, Perl, JavaScript, FORTRAN, LISP, PHP, and others.

8. Currently, my area of specialization is software development on the World Wide Web. My research is focused on systems that search the invisible web, including the development of crawlers and indexers. I teach courses at the graduate and undergraduate level about web technologies that include languages JavaScript, Perl, PHP, Visual Basic, C++, C#, and technologies including ASP, XML, SQL, and Web Services.

9. In addition to my current position as Professor, I have held a variety of other positions in both industry and academia. For example, I have been a visiting Professor at the Massachusetts Institute of Technology (MIT), and I have worked for IBM in New York and Paris. The specific positions are described in my curriculum vitae, which, along with a list of cases for which during the previous four years I have testified as an expert at trial or by deposition, is attached as Exhibit A.

10. I am the author or co-author of over ten books and over eighty journal articles and a referee of conference proceedings articles on computer science subjects including data structures, algorithms, and software design. I am a past associate editor for the journals *Communications of the ACM* and *Transactions on Mathematical Software*. I was an IBM Scholar from 1989-1993. I have been a principal investigator on research contracts from various government agencies including NSF, AFOSR, ONR, and DARPA.

11. I am being compensated for my work in connection with this engagement at my standard rate of \$450 per hour. My assistant is being compensated at a rate of \$150 per hour.

## **II. Summary of Findings and Conclusions**

12. The LimeWire client may be used to upload, download, and offer for download files unauthorized for distribution on the Gnutella network.

13. Gnutella is generally known to be widely used for the sharing of media files unauthorized for distribution.

14. Lime Wire LLC optimized the LimeWire client specifically for downloading popular media files, and music in particular.

15. Lime Wire LLC has implemented features and functions in the LimeWire client that have the effect of encouraging users to download and offer for download content unauthorized for distribution on the Gnutella network.

16. Lime Wire LLC failed to implement features or functions in the LimeWire client that would have meaningfully reduced the traffic in works unauthorized for distribution. In particular, a hybrid system combining audio fingerprinting, keyword, and hash-based filtering would have meaningfully reduced the traffic in works unauthorized for distribution.

17. Lime Wire LLC has implemented mechanisms by which it exercises control over certain aspects of installed LimeWire clients operating on the Gnutella network, and Lime Wire LLC has the ability to expand the type of control it exercises.

18. Lime Wire LLC controls the design of the LimeWire client, controls the primary, authorized means of distributing the client and can inform users of the availability of a new version of the client.



### III. Background

#### A. Definitions

19. Set forth below are definitions of some of the technical terms that I use in my report:

20. **Acoustic fingerprint:** Acoustic fingerprinting is a technique that analyzes the actual content of an audio file rather than its description (i.e., its filename or metadata). It is a type of “content recognition” technology that, using an algorithm, creates a fingerprint for an audio or video file based on its acoustic properties. Two audio files will have the same acoustic fingerprint if they sound the same, even if, from a digital standpoint, they are different.

21. **Bitrate:** The bitrate is the number of bits, i.e., small pieces of data, which are transferred in a particular amount of time, usually a second, to represent, for example, an audio or video recording. The higher the bitrate of a file, the higher the (potential) quality of that file will be. A typical bitrate for an audio file found on a peer-to-peer system falls in between 128 kbps and 320 kbps.

22. **Digital Rights Management (DRM) protection:** DRM protection is a broad term that encompasses technologies used by content owners to control access to digital data. In this context, it typically applies to audio and video files that will not open and play unless a user accepts a license (usually with a click of a mouse) and in some cases pays a fee (e.g. by entering credit card information).

23. **File hash:** A file hash is a number that represents an element of a larger set of data, such as a music file. In effect, a file hash is used to identify a file. Unlike

an acoustic fingerprint, the file hash is not derived from a file's underlying acoustical properties. Rather, to compute the file hash of a file, a type of algorithm called a cryptographic hashing algorithm (examples include "SHA-1" and "MD-5") is applied to the file. The effect of this calculation is to produce a near-unique value (the file hash) that identifies that file. If two files have the same file hash, they are identical.

24. **Metadata:** Metadata is information that purports to describe a larger piece of data, such as an audio file. For example, the metadata of an audio file might include the artist's name, the song's title, the bitrate, the size of the file and the file hash. The metadata is embedded in, or attached to, the file in a special format that can be interpreted by, for example, software designed to play the file, or file sharing software.

25. **Swarming:** Swarming describes the ability of peer-to-peer (P2P) software to download a single file from multiple hosts in parallel. To locate hosts that are sharing the same file, a unique identifier for each file is computed. Swarming enables more efficient downloads of large files.

**B. *Peer-to-Peer Networks***

26. A computer network is an interconnected group of computers. A computer on a network is referred to as a host. The host computers are enabled to communicate with each other over the network using a set of commands known as a protocol. One well-known protocol is TCP/IP, the protocol that host computers use to communicate on the Internet.

27. The traditional model of network computing has been a central computer – the server – and a number of clients connected to the server. The server then