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## **Internet Radio and the Implications Surrounding its Preservation**

### **Introduction:**

Internet radio or web radio is audio broadcasted over the Internet with the radio frequency being relayed through the World Wide Web. “Internet radio takes the form of traditional radio broadcasts in terms of content, style, and program format, but uses a completely different form of transportation.”<sup>1</sup> However, there is another dynamic to Internet radio that further distinguishes itself from traditional radio, and that is the process known as webcasting.

The appeal of webcasting is that it can distribute multimedia content to audiences via the computer from anyplace in the world; there are no geographic limitations. Additionally, traditional broadcast radio is solely sound based, but webcasting has the capability of distributing multimedia content, which includes supplying digital texts, graphics, video, links, and interactivity such as message boards and chat rooms. The attributes of webcasting have resulted in its appeal to a wide audience where it creates an intimate user experience. Webcasting is an exciting and burgeoning medium that is believed to have the potential of being “the most powerful medium yet invented for delivering

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<sup>1</sup> Sawyer, Ben and Dave Greely. *Online Broadcasting Power!* [Electronic resource]. Cincinnati, OH: Muska & Lipman Publishing, 2000, p. 1.  
Internet: <http://www.book24x7.com/marc.asp?isbn=096628898X>

information and entertainment that people need or want.”<sup>2</sup> However, as a digital medium, challenges arise in terms of how this ephemeral form can be archived and preserved for future generations. This paper will discuss the origins of Internet radio, the functionality of Internet radio, address some of the preservation challenges of Internet radio and webcasting, and attempt to present possible preservation actions.

### **The Origins of Audio Streaming Technology and Internet Radio:**

Rob Glaser, a former manager at Microsoft, founded a company named Progressive Networks in 1993 with political advisor and writer, David Halperin. The initial mission of the company was to provide outreach on progressive issues via a new medium. This information originally was to be disseminated via cable or CD-ROM. However, this idea was abandoned because Glaser and Halperin were eager to identify a source that could relay their outreach to the widest audience possible. They were soon introduced and trained to use the Mosaic technology and the Web.

Mosaic was the first significant graphical Web browsing tool created by students at the National Center for Supercomputing Applications (NCSA), led by Marc Andreessen who was inspired by Tim Berners-Lee’s work.<sup>3</sup> Upon this introduction to Mosaic technology, Glaser recalled a demonstration he saw at Microsoft prior to his departure where low-bit-rate audio was distributed over an internal network. Thus, he wanted to find a way to get low-bit-rate audio distributed over the Internet and the Web. Glaser believed that

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<sup>2</sup> Miles, Peggy. *Internet World Guide to Webcasting*. New York: Wiley Computer Publishing, 1998, p. 2.

<sup>3</sup> Saywer and Greely, *Online Broadcasting Power!* Chap. 1.

streaming audio over the Internet could be the solution to Progressive Networks' goal of providing its ideas to a mass audience via a new medium.

Glaser soon hired programmers and Progressive Networks went on to develop RealAudio 1.0, with the first prototype being introduced in 1995. It was a highly compressed audio format that enabled audio to be streamed over the Internet. Audio streaming allowed listeners to hear audio continuously on the Web minus a few seconds of delay as a result of "buffering," which is the pre-storing of the audio file. The audio quality that RealAudio 1.0 produced was low (considered AM quality) and did not relay music well, but spoken word was listenable given that the connection did not break and the file continued to provide data. Eventually, Progressive developed a server (entitled RealServer) that would broadcast RealAudio, and a player (RealPlayer) for audiences to install on their end in order to listen to broadcast files from the server.

Ultimately, other proprietary streaming audio technologies emerged simultaneously or subsequently to RealAudio's introduction. These included Streamworks from Xing (which is now a subsidiary of RealNetworks), Windows Media Audio (WMA) from Microsoft, Shockwave Audio from Macromedia, and TrueSpeech from the DSP (Digital Signal Processing) Group to name a few. Today, Progressive Networks, now known as RealNetworks, is the considered the most successful company in their field.<sup>4</sup>

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<sup>4</sup> Ibid, Chap. 1.

Despite RealNetworks dominance in the streaming audio and Internet Radio market, currently there are other streaming audio and MP3 affiliated products and services that compete adequately with RealNetwork. These include Nullsoft's Winamp for Windows, the server SHOUTcast, and the SHOUTcast DSP plugin that delivers MP3 audio at higher bit-rates. RadioDensity is another digital radio server. Live365 is proprietary and is one of the most widely used formats (especially by private webcasters) for streaming audio. Live365 is also the largest Internet Radio Provider with users getting free access to approximately 27,000 simultaneous broadcasts worldwide. Moreover, iTunes for Macintosh and Windows, and XMMS for UNIX/Linux are additional MP3 players. Finally, there are open source alternatives available that include the servers Icecast, Streamcast, and Xiph.org, which utilizes the Ogg Vorbis audio stream, and open source audio players stream-db, and IceS.<sup>5</sup>

The first radio station on the Internet was *Internet Talk Radio*, which began operations in 1993 and was established by Carl Malamud. *Internet Talk Radio* utilized a technology called the Multicast Backbone on the Internet, or more commonly referred to as Mbone. Developed in 1992 by Steve Deering at Xerox PARC, Mbone is a network integrated into the Internet to provide the best possible two-way transmission delivery of real-time multimedia data between Mbone connected hosts.<sup>6</sup> Malamud's foray into broadcasting on the Internet would be the beginning of a rapidly growing trend.

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<sup>5</sup> Ibid, Chap.1. and *Wikipedia: The Free Encyclopedia*. Definition of Web Radio. Internet: [http://en.wikipedia.org/wiki/Web\\_radio](http://en.wikipedia.org/wiki/Web_radio)

<sup>6</sup> Almeroth, Kevin C. and Mostafa H. Ammar. *Multicast Group Behavior in the Internet's Multicast Backbone (Mbone)*. Networking and Telecommunications Group, College of Computing, Georgia Institute of Technology, November 26. 1996, p. 2.

Samuel Brylawski, head of the Recorded Sound Section in the Library of Congress Motion Picture, Broadcasting and Recorded Sound Division, stated in his 2002 report entitled, *Preservation of Digitally Recorded Sound* that prior to April 2001 more than 2,500 radio stations and more than 30 radio networks were streaming audio on the Internet.<sup>7</sup>

### **How Internet Radio is Broadcasted:**

Internet radio is a transmission of audio that has previously been stored in a type of format that is compatible for transmission over the Internet, or that can be converted into a format that is recognized by a server. Primarily, digital audio goes through a process called rendering that converts the digital information into a format a server can read.

There are various types of digital audio formats, which will be discussed in detail subsequently. Servers recognize these audio formats, but upon their transmission into the server the audio format becomes one universal format. Streaming audio is mostly transmitted over a TCP/IP (Transmission Control Protocol/Internet Protocol) connection. This is a set of networking protocols that allows two or more computers to communicate. The Defense Data Network, a division of the Department of Defense, developed TCP/IP in the early 1980s, and it has since been used as the networking standard. The information that is streamed over the TCP/IP connection consists of small bits of data known as packets. These packets traveling through the Internet are being coded and then reassembled into a file that the computer can recognize and locate for retrieval. There are

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<sup>7</sup> Brylawski, Samuel. *Preservation of Digitally Recorded Sound*, 2002. Internet: <http://www.digitalpreservation.gov/index.php?nav=3&subnav=7>

a variety of forms of Internet Transmission Protocols that include UDP (User Datagram Protocol), RTP (Real-time Transport Protocol), RTSP (Real-time Streaming Protocol), and others.<sup>8</sup>

There are two digital audio file formats in use: raw audio formats and specialized audio formats. Raw audio formats are identical clones of the digitized audio with no loss of information (otherwise known as lossless formats), but result in large files that create major challenges in streaming over the Internet due to their size, amount of available bandwidth, and the frequency in which users currently access the Internet. Bandwidth is the amount of digital information (or bit-rate) that can be transmitted over a digital connection at any given time.<sup>9</sup> Specialized audio formats are digital files that are stored in a compressed form to create smaller files. Processing of compressed digital files results in a loss of information or quality of the audio (otherwise known as lossy formats), but creates smaller files that are able to effectively stream over the Internet. Therefore, the Internet requires the use of these compressed formats in order to stream.

Uncompressed or lossless audio formats such as .wav (for Windows), .aiff (for Macintosh), and .mu (for UNIX) files are used primarily for storage of digital audio content. However, these files will eventually be encoded into lossy formats such as MP3 and WMA for Internet streaming. Specifically, the MP3 format is widely used because it is a high quality storage format in spite of the fact that it is a compressed format.<sup>10</sup>

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<sup>8</sup> Saywer and Greely, *Online Broadcasting Power!* Chap. 2.

<sup>9</sup> *Wikipedia: The Free Encyclopedia*. Definition of Bandwidth. Internet: <http://en.wikipedia.org/wiki/Bandwidth>

<sup>10</sup> *Ibid*, Chap. 2.

Ultimately, Internet radio is broadcasted using three components: the encoder (the audio stream source), the server, and the audio stream player. The server plays a critical role in the dissemination of the digital audio stream. Servers can be of the control of the host radio station (known as an in-house server) or managed and housed by an outside company or third party (known as hosted servers). The majority of Internet radio stations utilize hosted servers. The management and security of servers is an expensive and time-intensive endeavor. There are several types of host servers: dedicated server, co-location server, shared server, on-demand server, hosted/live simulcast server, and repeater server.

Dedicated and repeater servers are the most commonly used servers. With a dedicated server, the broadcaster entirely owns or leases the server. After the hosting company has configured the server to the broadcaster's specifications, the broadcaster has exclusive control of the server. The repeater server (Live365 is an example of a repeater server) allows broadcasters to hear a stream from their dedicated server by re-broadcasting the content using the repeater's access to a large amount of bandwidth. The large amount of bandwidth enables broadcasters to repeat streams to their listener base that may not have been able to effectively broadcast prior due to their access to their immediate access to low bandwidth.<sup>11</sup>

Lastly, streaming audio requires a large amount of bandwidth; usually more than the standard 28.8k - 56k modem connections can provide. Therefore high-bandwidth

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<sup>11</sup> Ibid, Chap. 2.

connections are what Internet radio broadcasters seek in order to connect their stations to the Internet. There are five common types of bandwidth connections used on the Internet, and they are T1/Fractional T1, ISDN (Integrated Services Digital Network), DSL (Digital Subscriber Lines), cable modem, and wireless LAN connections.

### **The Challenges of Preserving Internet Radio:**

Archivists, sound engineers, and other dedicated professionals that are committed to the task of developing initiatives and standards for the preservation of analog and digital audio are presented with an even more challenging role in regards to how the “liveness” of streaming audio, and specifically webcasting (including all of its multimedia components) can be archived. Samuel Brylawski raises an interesting point in his essay when he states,

“... The laws and licenses that govern streaming were designed with the assumption that its use is ephemeral. It is unknown whether recording streamed audio for archival purposes is legal. However, under the provisions of the American Radio and Television Archives law, which was enacted in 1976 to support an archive of American broadcasting at the LC, the Library may be allowed to acquire streamed audio of radio broadcasts.”<sup>12</sup>

Although this comment is an encouraging one, it is an action not currently in practice by the Library of Congress, and there is no indication whether LC would indeed take on this archival initiative. Additionally, Brylawski comments,

“Web audio might also be systematically archived under the auspices of the U.S. Copyright Office, under the mandatory deposit requirements of copyright law. As subscription publications, popular radio programs such as "All Things Considered," "Fresh Air," and "Car Talk," as well as the daily *New York Times Audio Digest* and *Audible Los Angeles Times* are probably subject to legal demand by the Copyright Office. It might be argued that streamed Web content is subject to the same requirements.”<sup>13</sup>

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<sup>12</sup> Brylawski. *Preservation of Digitally Recorded Sound*, 2002.

<sup>13</sup> Ibid.

Even if subscription publication radio programs are to be held at some point to a legal mandate where they must deposit their Web content with the Copyright Office, large communities of independent webcasters do not fall in this category. Furthermore, if these independent Internet radio stations do not consider or have the means to archive their content, a major segment of our cultural heritage will be lost.

Moreover, the digital medium is inherent with a number of issues that further complicates the goals to preserve it. These aspects include industry driven upgrades of hardware and software that are not backwards compatible (making it difficult to playback files that were generated on older versions), the use of different browsers and operating systems and how the playback of files may be compromised if played on a platform it was not created for, and corporate changes including buyouts or bankruptcies that may result in a product not having sufficient or existent support. An example of this is the company Nullsoft (the creators of SHOUTcast and Winamp) that was acquired by AOL in 1999, but as of November 2004 is considered to be almost nonexistent as a result of neglected management by AOL.<sup>14</sup>

### **Free103point9 Online Radio: A Case Study for Preservation of Internet Radio:**

Free103point9 is a 24-hour online radio station. It was founded in 1997 as an analog pirate radio station. In 2002 free103point9 radio incorporated, and in 2003 became a 501

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<sup>14</sup> Mook, Nate. "Death Knell Sounds for Nullsoft, Winamp." *BetaNews.com*. November 10, 2004. Internet: [http://www.betanews.com/article/Death\\_Knell\\_Sounds\\_for\\_Nullsoft\\_Winamp/1100111204](http://www.betanews.com/article/Death_Knell_Sounds_for_Nullsoft_Winamp/1100111204)

(c) (3) nonprofit media arts organization. Additionally, in August of 2003 the station began streaming audio on the Internet.

This author had the opportunity to speak with the Executive Director of free103point9, Galen Joseph-Hunter. Ms. Joseph-Hunter discussed in brief the preservation program of the radio station. Ms Hunter stated that the station streams compressed MP3 files at 32 and 56 kpbs (kilobits per second). These MP3 files are then stored on an external hard drive and a 3<sup>rd</sup> party server. Free103point9 utilizes the Live365 server. For live streams, the station stores large MP3 files onto CD-Rs. The station also maintains uncompressed .aiff files by migrating the data onto CD-Rs. She also discussed the station's plans to digitize their analog audio content, which dates back to the station's founding in 1997. These audio files are stored on 1/2" VHS tapes.

When asked if she knew of any initiatives that the Library of Congress was developing to collect Internet radio content, Ms. Joseph-Hunter stated that she did not know of any preservation efforts being initiated by LC for the archiving of Internet radio. However, she did mention that a number of institutions including the University of Pennsylvania have been extremely supportive of free103point9's preservation efforts and have generously offered the station storage space for their digital content. Ms. Joseph-Hunter mentioned that the station currently has sufficient hard drive and server space, but is always in need of bandwidth.

Finally, by using the IMAP (Independent Media Arts Preservation) cataloging template, Ms. Joseph-Hunter stated that station is diligent in cataloging their collection of transmissions and live works.

**Conclusion:**

Free103point9 is an encouraging example of an independent Internet radio station committed and actively involved in the preservation of its content. Although Executive Director, Galen Joseph-Hunter admitted that the challenges of preserving streaming audio are great, it is imperative that the station explore as many appropriate means as feasibly possible to document and archive their unique works. However, what seems uncertain is whether the interface of free103point9, the daily website itself, can be preserved. This is ultimately the biggest challenge in preserving Web content.

The Internet Archive, a public nonprofit founded in 1996, is a commendable website whose goal is to build an ‘Internet library’ and offer unending access to collection created in digital format. Featured on the Internet Archive’s website is the “Wayback Machine.” The “Wayback Machine” is intended to be an archive of Internet sites. Sites are logged into the “Wayback Machine” to be archived for posterity. This author accessed the “Wayback Machine” using free103point9’s website as a model to see if archived webpages for the station were still functional. Six entries for free103point9 were founded in the archive, with the earliest page dated December 13, 2002 and the most recent page dated January 26, 2004. Unfortunately, both the 2002 and 2004 webpages malfunctioned in some manner. Either links no longer worked, or images did not display. Although this

was a minor experiment, it did identify that the archiving of websites and or webpages will require significant consideration.

It appears that more questions have arisen as result of this investigation into the preservation of Internet radio as opposed to possible suggestions for its preservation. Internet radio is still a relatively new and growing medium. Hopefully and necessarily, the archival community and relevant programs, such as NDIIPP (the National Digital Information Infrastructure and Preservation Program) are actively discussing ways in which this important content can be preserved.

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