Updating and Modernizing WICN's Music Library

WPI

WICN.ORG 90.5FM Jazz+ for New England

Updating and Modernizing WICN's Music Library

An Interactive Qualifying Project Report

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Submitted to

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Abstract

The goal of the Modern Music Library IQP team is to help WICN to create, organize and diversify their digital music library to better serve their audience. Currently they have a library of about 30,000 Compact Discs (CD) that they want to convert to a new library system. In order to accomplish this task, we researched solutions that other music libraries and radios stations have used to transition from a physical storage medium to a computer-based system, we determined database systems that would accommodate WICN's organizational needs, and we found external sources of music that would allow for WICN to expand their library. We made recommendations based on WICN's needs for the best method to convert their library.

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Worcester-Inter Collegiate Network

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- Radio host and member of the WICN Executive Board, Mr. Brian Barlow, for giving us the opportunity to discuss of the future of WICN radio so that we could plan a durable solution for WICN's digital library.

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- Mr. Travis Ryder, program director of Jazz 88 FM Minnesota public radio station, who we interviewed for their process of digitization.

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Executive Summary

Worcester Inter-Collegiate Network (WICN) is a local radio station that specializes in Jazz radio. WICN intends to convert their physical collection to a computer-based system to allow for preservation and better organizational flexibility.

Project Goal and Objectives

The goal of this project was to recommend options and solutions for software, hardware, and procedures to help WICN with the conversion of their collection. We determined that the following objectives were important to help us provide them the best information.

- Research options that other institutions have made to transfer from physical medium to a computer database**.** In order to achieve this goal, we interviewed with a series of radio stations to gain information and advice from their own experience.

- Recommend database system that will allow WICN to have an easy transition for both DJs and music. To reach this objective, we assessed WICN's Djs' needs and researched database systems that would satisfy those needs.

- Find supplementary sources of music for WICN's digital library. To fulfill this task, we determined the universal Legality and Copyright laws then explored potential options of acquiring music in order to supplement WICN's library.

Background

We started by investigated the current situation of WICN's physical library. At that time, the contents of WICN's physical library was composed of about 30,000 CDs and a small collection of vinyls. We then found everything that is common to radio stations, from the roles of DJs to equipment and compared it to WICN's studio. For digitizing music, we determined multimedia parameters which included how different waveforms affect the quality of stored music. Along with this, we investigated equipment options that are available to rip physical data storage such as, the Bravo 4202 XRP Discs Publishers & digital video (DVD) Duplicato and the Primera Disc Publisher Pro Xi2 both from Primera Technology Inc. Which are able to convert and transfer 100 CDs and 50 CDs respectively at a time. We also explored ways to digitize vinyls records for which we found that you would need: a standard record player with phono level outputs, a phono preamp, and a computer audio interface (USB, FireWire). Due to the fact that there are many types of audio format available in a database library, we studied the different audio file formats; MP3, WAV, ALAC and FLAC. For the remainder of this chapter, we researched history of data storage such as physical and cloud storage. Research finally ended up with ways that some institutions, The Variations Digital Music Library of Indiana University, the U.S Library of Congress, and the Spain's premier radio network, digitized the contents of their physical data storage.

Methods

We took time to create a table, **Table 1** (Page 38), which helped us organized and prioritized our ideas. We than elaborated on the interview process that we would be using. We continue on to our method of assessing data transfer options. We decide to assess different hardware options and develop a method with which WICN can choose the most important songs

to download. Our next section was our method involving music database needs and storage options. For this we decided that we needed a way for WICN DJs to give us feedback on what they wanted to see in the library database. After that, we created a method for investigating different databases that are available based on the criteria of user interface, metadata, price, the availability of a free trial. We then proposed finding ways for WICN to find metadata in case a metadata library was not available in the system that they had chosen. To finish the section, we outlined how we would find ways for spinitron to interact with our software options. At the end of the methods, we showed how we would look for options to expand WICN's library after digitizing. For this section, we elaborated on a method to study the legality and copyright laws on using songs for commercial purpose. This was to make sure that WICN does not get into legal trouble for using downloaded songs. Following that, we described two ways of expanding WICN digital library: using internet sources websites and using direct communication with artists.

Results

We elaborate on the research found using our methods. We started the analysis with case studies of radio station, KEXP 90.3 FM, KBEM 88.5 FM and KZMU 90.1 FM. In the case studies, we outline their process of digitization and ask them to give specifics of what they use. After the case studies, we found and evaluated data transfer options. Within this section we evaluated hardware options and organized them into a table that listed their price, speed, whether it was automated, and modability. We elaborated on how we had discerned a core group of discs that WICN should download first. Lastly for this section we evaluated ripping software that could be used to help with the transition. We continued the results by presenting options that would solve WICN's database needs. To start we presented the results of a survey that we had used in order to evaluate the needs and abilities of the WICN's DJs. We also researched radio software

we suggested to WICN in the survey: Dalet, AudioVault Flex (already owns by WICN), Sam Broadcaster Pro, PlayoutONE, and Virtual DJ. We researched one more software option, but due to the restriction of time, we could not get feedback from WICN's DJs MediaMonkey. Evaluation was based on the user interface of the software, the metadata integration, price, and whether or not it had a free trial. For external sources of metadata API sources were looked at in order to provide more data that WICN could use to update their libraries information. To finish database needs we looked at how Spinitron would be able to interact with each of the suggested softwares. We ended the results section by providing resources and legals answers for WICN to supplement its digital library from either internet sources or direct communication with artists.

Recommendations

Our team finished the paper and wrapped up the project by analyzing the results. For hardware options, we decided that the Acronova Nimbie would be the best option for their transfer due to its speed and versatility. We also determined that if they did not want to spend the money on the Nimbie they could buy more optical disc drives to increase the speed of data transfer. We then analyzed our top choices for database softwares we found: Sam Broadcaster Pro, MediaMonkey or AudioVault Flex. Within each analysis we described their functions and user interface along with their individual interaction with Spinitron. We recommended Allmusic along with Soundcloud and Bandcamp as the best options for WICN to supplement its digital archive library with music not available inside. To finish our recommendations, we postulated on future directions that WICN and others could go in using this paper.

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1. Introduction

Data storage technology has a history that spans almost 300 years, from the creation of paper punch cards to the establishment of holographic storage (Network World, 2007). With data storage growing exponentially, formats of data and methods of storage change along with it, making it an issue for organizations to convert all their files. The Worcester Inter-Collegiate Network (WICN) is one such organization experiencing this problem, and they have reached out to WPI for advising on how to do proceed.

WICN is a radio station that was founded in 1969, and is dedicated to the "presentation of authentic, independent music" (WICN, 2012), focusing on jazz music and similar genres. We have gathered through personal communications with the WICN's General Manager, Tom Lucci, that WICN has about 30,000 CDs in its physical library that need to be digitized and put into a database to both preserve their collection and modernize the stations method of broadcasting.

Radio stations currently go through the process of conversion in order to either preserve their collection or automate their system. Most stations start by finding hardware that will aide them in the ripping process, with a set software already in mind. That way the radio station can accumulate all of their media files and have a database system that they can use to store and play the files from.

At the beginning of this project, there was not a set layout or research paper on how radio stations go through the process of library conversion. We needed to find the most important parts of the conversion process and compile information relating to all of those facets. With that information not only WICN will be able to have a smooth transition, but other radio stations will be able to take this paper and apply it to their own library.

This project's goal was to devise a way to quickly and effectively convert WICN's physical music library to a digital medium. In order to do this, we researched other radio stations that have converted their own libraries. We conducted interviews with them and find out what their process for conversion was and

see if we could apply it to our own situation. We also conducted a survey that gauged WICN's DJ's abilities and prior experience with music media software. After weighing out our options we were able to make a plan that would best work for WICN based on their own situation. It was important to do this project because for WICN to preserve the contents of their library and compete with other much larger radio stations they needed their library digitized.

2.Background

In this chapter, we provide information about WICN radio and on the current management software the station uses. We conclude by presenting logistics equipment used to digitize the common physical storages and cases of improvement made by some institutions to implement a digital archive database.

2.1. WICN

The Worcester Inter-Collegiate Network, now known as WICN Public Radio, Inc., is a local radio station in Worcester, Massachusetts. Founded in 1969, it is dedicated to the "presentation of authentic, independent music" (WICN, 2012), focusing on jazz music and similar genres.

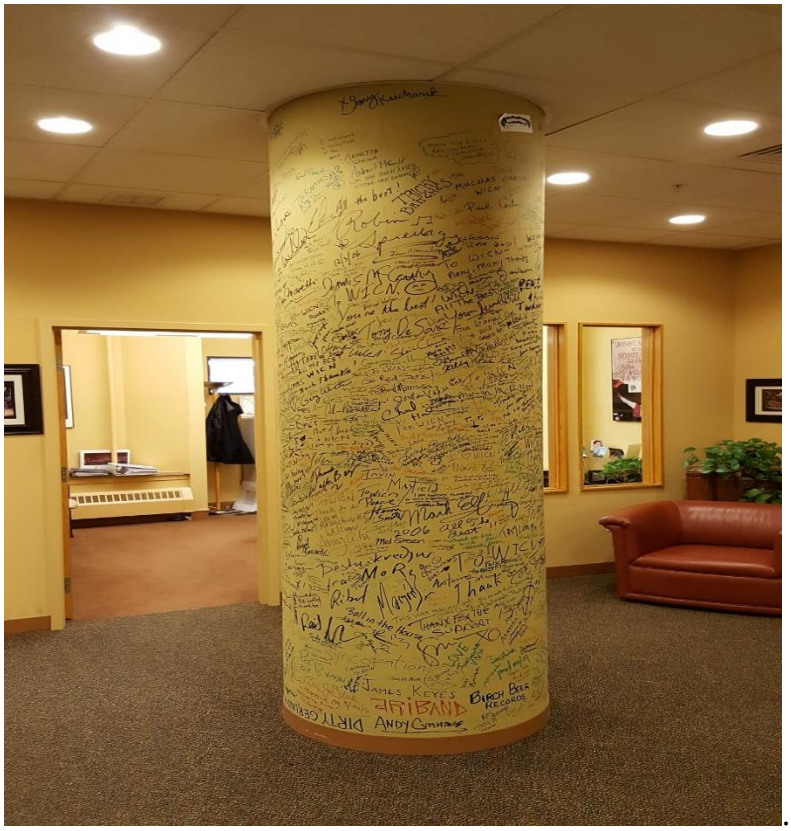

Figure 1: WICN Pillar with Guest Signatures

Originally formed as a joint station between The College of the Holy Cross, Worcester Polytechnic Institute (WPI), and other local colleges, WICN eventually became an accredited public radio station in 1987. Over the past few years, WICN has collaborated with WPI through a variety of projects such as "WICN Android Application," "Tower Broadcast Expansion," and "WICN Radio Station IOS Application" (Deans, 2016; Arnold, Sharron, Locke & Uzunoglu, 2015; Tran, Long Vu, Trinh & Ly, 2016). The current collaborative project between WPI and WICN is to digitize WICN's physical library and investigate potential sources of music to supplement their library.

2.1.1 WICN's Library

WICN's library consists of approximately 30,000 CDs and a small collection of vinyl records. Stocked on shelves, they are organized according to genre including a Blues row, Folk row, New Age row, four Jazz rows, and a row of Jazz box collections. In addition, some of the WICN DJs use music from their private collections on their shows. The WICN interim manager, Tom Lucci, said in an interview that the radio station acquires new music from artists that promote their album and/or songs via CD and Soundcloud. However, the station is still limited in their ability to integrate songs in digital form, therefore WICN requires physical CDs from artists.

Figure 2: WICN's CD Library

WICN uses two softwares, VAULT2 and Spinitron, to contain information about their music. Audiovault 2, or VAULT2, is a music database that is located on their station

server that currently holds the digitized music that they have. Spinitron is a playlist recorder that has all of WICN's music selection and publishes it for copyright and licensing purposes. WICN has also recently purchased Broadcast Electronics' (BE) newest radio database and automation software, AudioVAULT FleX.

2.2. Radio Station Composition

To analyze the inner workings of radio stations, we focused on the role of the radio disc jockeys (DJs), the equipment used in the radio station for broadcasting, and compared to the current WICN radio studio. This way we have background knowledge for how to best assist WICN

2.2.1. Role of The Radio DJ

Disc Jockeys, popularly known as DJs, are radio personalities that provide the public with a human connection to music. The traditional duties of a radio personality were broad at the advent of DJing in the 1930's, encompassing the release of news, reporting the weather, hosting political messages, and playing music. Furthermore, they were responsible for sharing the creativity and the excitement for music (Childs & Clay Hicks, 2005).

According to Bonini T. in *Doing radio in the age of Facebook,* from October 2014, the DJ's duties have changed since radio programs have started to incorporate social media sites such as Facebook into their operations. An example of how radio stations have adapted is the partnership they have created with artists and/or festivals in order to gain popularity. This change occurred in order to adapt a larger audience. In the United States, for example, these changes brought larger audiences to radio stations-- over 91% of Americans aged 12 and older tune in to the radio each week comparing to less than 50% of Americans aged 21 and older in the early

2000's years (Spangardt, Ruth, & Schramm, 2016). This practice attracts people who have a favorite artist and want to know more about the artist's daily life. This propels the radio in the public's sphere of consciousness because of DJs who build bridges between artists, and artists' fans who now become daily listeners of the radio station.

2.2.2. Equipment Used by the Radio Broadcaster

The heart of operations in a radio station is the production studio, where DJ's broadcast from. Although each radio station has a unique setup, the standard equipment that the DJ utilizes includes but is not limited to microphones, an audio console, computer workstations, a video monitor, CD machines, mini-disc machines, digital effects boxes, a patch panel, and a distribution amplifier. For ease of movement during operations, radio equipment is commonly set in a U-shape within which the radio personality is seated (Keith, 2012). Over time, some equipment has evolved or become obsolete, but most stations still save the most important functional equipment to keep the radio station operating. For example, the audio console has remained an essential piece of equipment, because it allows DJs to add or mix various dynamic audio sources to create their radio program that subsequently is sent off to listeners (Irwin, 2015; Keith, 2012). In recent years audio consoles have progressed from analog to digital, which feature more versatility and easier access to tracks.

2.2.3 The WICN Studio

WICN has two studios for broadcasting and one studio for live performances. The equipment in the radio studios for broadcasting and editing includes CD players, microphones, a DP DJ 151 Denon turntable, two computers, and an audio console. Some of

the equipment, such as the old WICN's soundboards, is being replaced to streamline and improve the clarity of live shows.

Figure 3: The mixing board and equipment available in WICN's broadcasting studio.

WICN uses a variety of software to support their operations, most notably Spinitron and VAULT 2 from AudioVault. Spinitron is online software for non-commercial radio stations used in playlist organization and publication. The DJs access WICN's account via the Spinitron website in order to generate playlists before, during, and/or after a show. It streamlines the DJ's work by recording all of their shows for legality purposes. This makes their use of songs legal by publishing their playlists in case the FCC wants to check their logs. Furthermore, these playlists are available online and could be used by another DJ

VAULT2, developed from AudioVAULT technology, is used for internal music storage and creation of playlists for broadcasting. It allows audio recording, editing functions,

storage and playback of audio music, news reports and segments, commercial announcements, themes, jingles, and sounds effects. Its main features are the audio cards Digigram VX222 family such as V1, V2, HR, and others which needed to be installed in the hard drive of the computer in order to store music. It can be a standalone system, where the audio library and the required tools are available from one computer, or it can consist of several workstations that access audio material from a central storage medium, which is what WICN currently uses it as.

2.3. Digitizing Music

In order to effectively digitize WICN's library, we will need to find methods that can handle more than 30,000 CDs and other media formats. To remedy this, we have done background research on conversion methods and equipment for different physical storage formats.

2.3.1 Audio File Formats

Audio can be digitally stored in a wide variety of file formats, each with its own benefits and drawbacks, and it is important to select the best format for a given need. If space is not a restriction, than uncompressed audio formats are best for retaining the highest sound quality, but often using a compressed audio format is necessary to accommodate available resources. Compressed audio files can be either lossy, where some audio data is permanently discarded in the compression process, or lossless, which sacrifices some space efficiency to retain all audio quality when decompressed. Some common file formats include MP3, Waveform Audio File Format (WAV), Apple Lossless Audio Codec (ALAC), and Free Lossless Audio Codec (FLAC).

MP3 is a compressed lossy format that reduces file size down to 1/11th of an uncompressed file by reducing or discarding parts of the audio that are less audible to the human ear, with some variation depending on the bit rate of recording. Because this lowers the quality of the audio less than some other forms of compression, MP3 is a common end-user format due to its efficient size to quality ratio, but it has low value as an audio preservation tool. MP3 has support for technical metadata, but lacks descriptive metadata innately (NDIIPP, 2014).

The WAV format was developed by Microsoft and IBM to support larger files that are used in multichannel sound applications, such as broadcasting or archiving. It features both high quality uncompressed audio and innate support for metadata, though not all applications utilize the latter. This allows it to function both as a production and end-user format (NDIIPP, 2013).

ALAC was developed by Apple for use with their various devices and services, such as iTunes. It features lossless compression, typically using around half the space of a corresponding WAV file, which gives it value as an archival format when limited space is available. However, it is an end-user targeted format specifically for Apple devices and software reducing its value outside of them (McElhearn, 2016).

FLAC is an open source lossless compression format developed by the Xiph.Org Foundation. It is like ALAC (actually predating it by several years) in that it provides efficient compression and retains audio quality, but FLAC has much wider support across Windows, Mac, Linux, and other operating systems and software. Additionally, it has integrated metadata support with the ability to retain metadata when performing compression (Coalson, 2014).

2.3.2. Digitization Techniques

An important part of maintaining a music collection is upgrading data storage formats to ensure that the collection will not be lost to time. There are a variety of digitization techniques depending on the type and amount of data being digitized. The three parameters that determine the amount of information stored in a file and the quality of the digital song are the sampling rate, which is the number of times the analog sound is sampled during each period (one second); bits per sample, which corresponds to how much information (number of amplitudes) is in each sample the computer is collecting; and the mono versus stereo problem which requires the decision of the sound technician because mono reduces the song file by half. Therefore, it is important to balance the sampling rate and the bits per sample to come up with an acceptable quality of sound, although it would come at the cost of a larger file size.

2.3.3. Digitizing Vinyl Records

The process of digitizing a vinyl record requires patience and care to avoid any deterioration of the long-playing (LP) vinyl. According to the website B&H, the equipment required to digitize LP includes a standard record player with phono level outputs, a phono preamp (stereo receiver), and a computer audio interface (USB, FireWire, PCI, or PCMCIA/ExpressCard audio interface).

2.3.4. Convert CDs records to computer files

To rip or digitize a single CD is a simple process and is not extremely time consuming. According to Microsoft on the “Burn and Rip CDs” tips, the giant of computer software gives the following steps: Open Windows Media Player, then insert the audio CD into the PC’s CD driver,

and finally press the Rip CD button to conclude. However, when it comes to ripping 20,000 CDs, it becomes an arduous task to do one by one. To remedy this situation, it requires the use of a huge electronic burner to do the job.

According to the article, *The rapid way to rip a CD collection*, from November 11, 2010, Honeyball J. revealed the Primera Disc Publisher Pro Xi2, a machine that was able to rip thousands of discs without the need of human presence during the ripping process.

Figure 4: Primera Disc Publisher Pro Xi2

Source: *The rapid way to rip a CD collection*, from November 11, 2010, Honeyball, J.

Honeyball explained that the first step consisted of loading approximately 50 CDs into one tray holder in the Primera box. The next step involved starting up dBpoweramp's Batch Ripper for Windows, and performing a calibration for the drives, which then became available for use. Next, the choice of the file format and the location to place the digitized music data was needed as

well as the folder structure. When all those settings are made, the Rip button was pressed and everyone could have walked away.

However, Primera Technology Inc, the company that produces Primera Disc Publisher Pro Xi2, has more accurate equipment, through the use of high quality disc drives, which can rip up to a hundred CDs at once at a higher speed with accurate file formats such as MP3 and FLAC.

Bravo 4202 XRP Discs Publishers & DVD Duplicato, from Primera Technology Inc are examples of accurate ripping equipment which can guarantee a ripping process of hundred discs at once with a time average depending on the speed of its belt drive no matter the output files. Although Bravo 4202 XRP Discs Publishers & DVD Duplicato has similar steps in the operation process as Primera Disc Publisher Pro Xi2, its ripping process would occur at a higher speed because they have two optical CD/DVD drives instead of the one offered by the Primera Disc Publisher Pro Xi2. Additionally, these hardware options would also allow the conversion of file formats such as FLAC and Blu Ray Disc Recordable (BD-R). It is also compatible with Windows 7, 8 and 10 versions and Mac OS X 10.7 version or higher (B&H, n.d).

2.4. Database Structure: Form and Function

Once converted we need a way to store the data that we have now acquired. For this a database is used to organize a collection of data, such as articles or music. The structure of a database must be properly implemented to meet the needs of its users, thus, designing a database must consider two perspectives: the user and the builder. The user perspective focuses on the functionality and user interface that is available user end of the database, while the builder perspective focuses on the technical aspects of setting up and maintaining the database. The user perspective describes aspects of a database that affect the person browsing the database.

Interface, accessibility, organization, and schema are all important components to consider for the convenience of the user.

The builder perspective describes aspects of a database that determine how it functions. Designing a database usually involves determining the data to be stored in the database, finding correlations between different data elements, and superimposing a logical structure on the data based on these correlations. The programming language used to code the database, the file system used for organization, and the format in which the data is stored are all examples of technical details relevant from the perspective of a builder.

In order to provide the best system for any group requiring a database, both of these perspectives must be taken into account. This way the users will be able to work with the system, and IT will be able to work on the system.

2.5. Metadata

Metadata is data/information about other data used to categorize the data and typically is split into structural, descriptive, and administrative metadata. Structural metadata indicates how files can be organized relative to other data, such as genre, BPM, style, and artist of a song, while descriptive metadata provides information on data for classification and identification, such as titles and keywords. Administrative metadata is used for management of data, such as time created and method of creation or file type (NISO, 1). Metadata is traditionally used in music software for tagging and sorting of different music files.

2.5.1. Format and Content of General Metadata

The format and content of metadata vary depending on the purpose of the data being described, and they should be selected to incorporate relevant information for the task at hand and ensure the longevity of the data. A wide variety of schema have been developed to standardize methods of creating metadata, such as the Dublin Core or MPEG Multimedia Metadata. Dublin Core is a simple, concise schema that allows authors to categorize Web resources. It has 15 core elements in title, creator, subject, description, publisher, contributor, date, type, format, identifier, source, language, relation, coverage, and rights. which defines the metadata elements, structure, and relationships that describe audiovisual objects such as pictures, graphics, 3D models, music, audio, speech, video, or multimedia collections (Brand, Daly & Meyers, 2003).

2.5.2. Metadata in Music

In music, metadata storage is reliant on the medium used as a delivery method. CDs, for example, can store metadata such as song title or artist name using CD-Text, which can then be read by CD players and CD-ROM drives. Digital applications such as rippers often cannot use CD-Text and are reliant on metadata embedded in the files or the use of online databases, like the Gracenote CDDB, when using files from a CD. Digital audio formats have file space dedicated to metadata that can be used to store metadata tags, both automatically, such as creation time, and manually at the user's discretion (Schlette, 2013).

2.6. Storage Formats

It is important to have an understanding of various data storage methods in order to determine the best system for storing the information needed and best storage apparatus to store the data. Storage formats can affect the amount of space taken up by data and can even effect the quality of data. For radio stations this can affect the quality of their broadcasting and how they organize their library due to size.

2.6.1. Brief History of the Evolution of Physical Data Storage

Over the past century, physical data storage has experienced extensive innovation. Introduced by radio corporation of America (RCA) victor in 1880, the long-playing records (LP) contributed largely to mass records from its first commercialization to present because some DJs still stick to this physical data storage for its direct manipulation (Record Collectors Guild, 2014). Due to its large radius and the heavy equipment required to play them, such as the phonograph, the introduction of cassette tape was welcomed. In 1950, IBM launched the first magnetic tape in America, expanding its presence in the electronic and computer devices market. The innovation became widespread and was later improved by the Dutch company Philips in 1963 as the compact cassette, which has had the longest market life of any electronic storage medium to date (Fosfor Gadgets, 2006). This is largely due to the variety of data it was capable of storing, including music, audio records for journalism, and computer data. This format also has the ability to overwrite old data on the same tape for reuse. During the same period, the laser disc was created, but it wasn't until 1978 that its capabilities and capacities became apparent. It could store videos and images using the best quality techniques at that time, and it had more storage capacity than its predecessors. However, laserdiscs are relatively fragile,

and even small amounts of damage can render a cassette and a disc unreadable. Therefore, engineers started to think about storage solutions to reduce the risk of data loss. Current physical storage options are compact discs (CD) which were introduced onto the market by Sony on October 1, 1982 (LEM staff, 2014). They were initially expensive, with each disc priced at $30 each, due to the manufacturing process being handled by 2 factories run and owned by Philips and Sony. Eventually with venture capitalism and high demand the price exponentially fell, leading to high production and use of the aluminum and polycarbonate storage device. Another current physical storage option is the hard disk drive. The hard disc drive was invented in 1953 by IBM as a faster way of random data access than the magnetic tape. The original hard disc drives were large and sensitive, making them expensive and difficult to handle. In time though, the hard disk drive grew exponentially from originally being commercially available at 5-megabyte capacity to 2-4 terabytes in current time.

2.6.2. Network Attached Storage

Network attached storage (NAS) is when a device is connected to a network that allows for storage and retrieval of data from a centralized location by authorized network users and heterogeneous clients (Seagate, n.d). During the early 1980's, Brian Randell and his colleagues demonstrated and developed remote file access across a set of UNIX machines at Newcastle University (Sowards, 2014). Inspired by this invention, several software companies, such as IBM and Sun, and electronic device firms, such as NETGEAR, dedicated resources to furthering Brian's invention. However, it was not until 2009 that NETGEAR and CTERA Networks launched NAS appliances with Backup Solution integrated for online disasters (Sowards, 2014).

NAS is advantageous for smaller businesses, like WICN, because it is straightforward to operate and a technician is often not needed for setup. Additionally, it is easy to backup data, cheaper than many other options, and good at centralizing data storage in a safe and reliable way. The downsides of NAS include the risk of data desynchronization, reliability issues, and accessibility issues if the storage machines are compromised (Seagate, n.d). For a radio station like WICN, accessibility issues could cause losses in listeners if broadcasts became unreliable.

2.6.3. Cloud storage

Cloud storage is "the storage of data in remote servers accessed from the Internet" (Beal, n.d). Introduced by John MacCarthy in 1961, cloud storage remained underutilized until 2006, when Amazon.com released Amazon Web Services (AWS), the first online data service during that period (Knoblauch, 2014). As they experienced increases in sales and notoriety, Amazon heralded the widespread use of online storage. Multinational companies quickly adopted cloud storage for its greater accessibility, reliability, rapid deployment, strong protection for archival and disaster recovery purposes, lower overall storage costs, and lower costs for purchase and maintenance (Beal, n.d). Capable of supporting more than an exabyte (one billion gigabytes) of data, cloud storage simplified enormous search tasks. Today, even smaller companies like WICN understand the benefits of using mass storage rather than dealing with large numbers of CDs. Although cloud storage reduces the risk of loss or degradation inherent to physical data storage, it is reliant on the speed of the internet and software used to connect to it (Alexander, 2006).

2.6.4. User's Point of View of Data Storage Choice

Over time, data storage solutions have become more efficient and gained greater capacity at lower cost. Peter Alexander suggested using the following ideas in his article *Choosing the Best Data Storage Solution* from December 20, 2006. Among ideas proposed, there were applications which generated the largest number of files. Also, he focused on the oldest of the data to make sure the data storage chosen would not destroy the original data stored. Other points were to know whether the data could be duplicated and saved in another location, and from which location the data needed to be access.

Physical storage could not actualize some of those ideas because according to Andrews J. in A+ Guide to Hardware, a CD can be rewritten many times but it cannot contain as much information as cloud storage. The other questions left the cloud and network attached storage as the potential best choice due to their high amount of storage, re-writability, and accessibility. To avoid any stress in the management of the data, it was necessary to consider a storage service which could provide on-demand storage capacity and essential storage management for any business (Alexander, 2006). Since a radio station needs to store more music than the average end user, network attached storage is the best storage option.

2.7. Other Institutions' Solutions

To select the proper method to digitize or preserve data moving from a physical storage medium to a digital database structure, we found it necessary to explore how other institutions went through the process

The Variations Digital Music Library, well known as VARIATIONS (Dunn and Mayer, 1999) is an online digital music library created and used by Indiana

University. Since its inception in 1996, Indiana University has incrementally added more capabilities to the online library, resulting in four versions of the project: VARIATIONS, Variations2, Variations3, and Variations on Video (The Indiana University Digital Library, 2011). To convert their collections of music, including long-playing phonograph (LP), digital audio tape (DAT), and compact disc (CD) in their first digital library (VARIATIONS), Indiana University used audio workstations and audio digitization hardware (Event's Echo Gina PCI card) and software (Sound Forge XP from Sonic Foundry and Disc-to-Disk from Microtest) to capture audio. In 1996, the process was as follows: Each track's start time for the recording was recorded in a text file by the technician, along with the track descriptions present on the original item's label, jacket, or accompanying booklet. This track file and the sound file were then transferred to a temporary holding area on an IBM RS/6000 AIX server. Each night, a batch rip job ran on this server which then compressed these CDs quality WAV files into MPEG-1 layer II format (MP3), at a compression ratio of approximately 3.6:1, using software provided by IBM. This compression step was performed mainly to reduce the need for storage space and network bandwidth while preserving most of the quality of the original song (Dunn and Mayer, 1999). By upgrading its library to Variations3, Indiana University used WaveLab (Notess, 2011). However, the usefulness of Indiana University online library, VARIATIONS from Variations3 version, is judged on the ability to navigate through it, because it becomes very difficult to search and to add content to it as the speed of data transfer drops. Additionally, VARIATIONS from Variations3 increases the demand for memory and disk space more than processor speed (Notess, 2011). Equipment to rip CD collections was not mentioned.

In order to save their archival manuscript documents, including audio and video CDs and tape records, the U.S. Library of Congress has developed an electronic storage database that uses audio metadata (audioMD) and video metadata (videoMD), by using XML schema. These schemas allow properties such as the file format name, the version, the speed adjustment for analog material, and the sampling frequency for digital recording (Library of Congress, 2011). Other properties include the formatting description for digital materials (commercial name, profile, version), and the format in terms of broadcast standards (NTSC, PAL, SECAM) for video metadata. However, the current U.S. Library of Congress's audioMD and videoMD 2.0 schema version does not have a search function within the database. Furthermore, the schema structure does not allow the records to be found in terms of their parameters, nor did they release information on the process used to digitize their discs

To overcome the preservation problem and to allow their audience to preserve their collection of physical LPs over the radio, Spain's premier radio network, Radio Alicante Cadena Ser, benefited from the help of the town's university, University of Alicante, which enabled more than 40,000 vinyl records to be digitized and hosted in the university library, Fonoteca. The process was carried out by cataloguing LP's using Universal Decimal Classification in Fonoteca, the Online Public Access Catalog (OPAC), and classified into subjects based on the National Library of Congress Subject Headings (Orio & al. 2011). The cataloging data consisted of the album's title, the name of the discographic company, the release year, its physical description, several entries classified manually by the cataloguers and notes about the content. With the use of fingerprint dataset, which is a specific identifier for individual tracks, the library succeeded in identifying different recordings of the same work whose tracks have been labeled using different languages. However, the equipment used to rip those vinyl records was not mentioned, and one of

the major drawbacks in this library was for the user to locate the music because the user had to query the library given metadata contained in the catalog like lyrics of the songs (Orio & al. 2011).

2.8. Summary/Conclusion

WICN has a vast collection of CDs in its library, and it provides a vibrant service to the community by preserving and providing programming using them. However, in order to remain relevant going into the future, it faces the issue of how to best modernize this compendium. Currently, WICN plans to address this problem by implementing a digital database to house its library. This database must be able to support the current collection with room for expansion and must be easily operable by the DJs and personnel. WICN also needs to be able to effectively organize and search its music once on the database; this will require a huge metadata overhaul for effective tagging their entire library. Our team will be working to find solutions to reach those goals.

3.Methodology

The purpose of this project is to help WICN convert its library of CDs and Vinyl records to a digital archive metadata library. The objectives that we set to fulfill this task were (1) to research options to transfer data from physical storage mediums to a digital music directory; (2) to determine a database system that will allow WICN to easily organize and access their music; and (3) to find ways that WICN can supplement their collection with music from additional sources. To achieve these goals, we organized our thoughts in a Must-Should-Could table, **Table 1**, to determine what the importance of ideas to investigate are.

Must	Should	Could
Determine a Database Suitable for WICN	Find ways for WICN expand their library	Link Spinitron and whatever database they use
Determine a method for WICN to convert their library	Provide tools for WICN to be able to make better programming	Auto updating metadata
Interview Radio stations for their method of transfer		

Table 1: Recommendations according of our Order of Importance

We addressed the Must column by preparing methods for interviews with radio stations to determine the different ways they used to transfer their library from physical medium to a digital database. From that information, we determined methods for WICN to upload their library. Then, we determined the needs and storage options of the database intended to find for WICN. We continued progressively with the ideas in the Should and Could columns for the recommendations that WICN want to see but are not the main parts of the project. We will make sure to work on each part, with these priorities in mind.

3.1. Interview Process

To gain knowledge about the transfer of music data, which has little documentation, we will need to conduct interviews with other radio stations which have already performed this process on their collections. We will conduct semi-structured phone interviews with the technical directors of radio stations. A list of questions will be provided to the interviewee prior to the interview to ensure that knowledge needed will be provided easily and efficiently. Phone interviews will be recorded with a tape recorder (interviewees will be notified that the call is being recorded) and by a note taker in the room during the interview.

During the interviews, we will gather information on the methods they utilized to transfer their data so that we have multiple methods to analyze. The questions that we will ask include Whether or not they have gone through a transition from a physical library of CDs and LPs to a digital database previously, the size of their library, their process of ripping, How they found supplementary sources of music, and what database they use.

3.2. Assessment of Data Transfer Options

In order to transfer music from WICN's physical library to a digital database, a system for ripping data from the CDs and LPs in their library must be developed. Two possible approaches to accomplish this task are (a) to do large scale CD data transfers or (b) to develop a process that the DJs can follow to upload the CDs they use most often. For large scale transfers, we can obtain equipment that can be used to rip the CDs, design and build the equipment ourselves, or do a hybrid solution by altering an existing machine to fit our requirements.

In order to evaluate the commercial options that are currently available, we will record factors including price, speed, automation, and ability to be modified. We will compare their strengths and

weaknesses and present our recommendations to WICN so that they can choose the best option for their situation.

Another part of converting their library is to create a process for finding and ripping the most important CDs in their collection. We can (1) determine the songs that WICN DJs play the most and make a list of priority discs, or (2) utilize a download-by-play process where the DJs upload CDs as they use them in shows. In either case, a CD case will be marked after it is uploaded to indicate that it is now in the database. The process of developing a list of WICN's most played music can make use of Spinitron, which already stores their playlists in an archive. In order to do this, we must determine how the software archives past playlists and sort it accordingly.

To determine which process we used, we consulted the data that we collected from different radio stations and WICN personnel. If we would find correlations between radio stations of using one method, we will use that method. We will also take WICN's suggestions into account to make sure to tailor their system to their needs. Spinitron on hand for their technical director to download and have the DJs download any music that they are playing as well. Duplicates will be avoided as well because stickers will be on the discs that have been downloaded so either party won't download a stickered CD.

3.3. Evaluation of Music Database Needs and Storage Options

The best option to improve WICN's efficiency in organizing, accessing, and obtaining music is to rip their CDs and store them in a digital database. In order to accomplish this task, we will need to assess both database systems and DJ needs in order to determine the best software to store WICN's music collection. After this evaluation, we will present our results and make recommendations based on our research.

3.3.1. Determining DJ needs

To be able to provide the best database options to WICN, we must determine what the needs of the DJs are. To do this we will need to conduct a survey of WICN's DJs in order to measure their awareness of different modules and user interfaces of music software. We will conduct two surveys, one that will have them assess their own skills using music software and another showing different music database software UI and asking whether or not they would be able to use it. They will also be able to make suggestions at the end of the first survey, to give us an idea of what they would like to see in their database.

3.3.2. Database Investigation

We will need to gauge the benefits and drawbacks that each database software presents. The major criteria that we will need to look at to make comparisons will be: User Interface, metadata, and price. With the user interface (UI) criterion a scale of 1-5 will be applied in the table to determine how effective each software's areas of interest stack up with one another. Each point will be a feature that WICN would like to have in their software UI and will add up to a maximum of 5 total points. For metadata we will explore whether or not a software option will have metadata integration, as well as metadata creation. This will allow for WICN to be able to sort and effectively use their library.

Software	User Interface					Metadata		Price	Free Trial
	1	2	3	4	5	Integration	Creation		
Option 1									
Option 2									
Option 3									

Table 2: Table Evaluating Software Options

WICN is currently using VAULT2, a variation of Audiovault, which can be used as the main database system. However, if VAULT2 proves incapable of maintaining a database system sufficient for WICN's needs, we will investigate alternative sources. In looking for software, we will contact radio stations that have done or are currently doing a similar conversion for their library to inform our project on what system they are using for music storage. We will then determine if their solutions will benefit our own project, update our table, and put our findings from interviews in the results. We are not limited to this method, as we can find software options through research online and evaluate those options as well.

3.3.3. Additional Metadata Options

To provide WICN with integrated access to the information they use in their programs, we needed to ensure that extensive metadata can be included in their digital library. As metadata can be found both attached to the music file and stored in a directory within the database, we must find a way to alter the directory to include new tags and information. For this, we will determine the capabilities of the software that we find to be the best for our needs and integrate what WICN wants to store as metadata.

3.3.4. Spinitron Combination

For many database options, we have the option of combining Spinitron with the software. Adding this feature to WICN's new system could be done in order to streamline the process of DJing by automatically logging their playlists. To approach this, we would investigate the common requirements of each program and finding options such as scripts to automatically update Spinitron on what the library software is playing. Another way of doing this will be to determine if there is existing software which can manage both the library software and Spinitron in the same computer.

3.4. Supplementing WICN Digital Library

WICN currently receives music directly from artists in a variety of formats. Some via SoundCloud, other in direct file transfer while the rest are CDs. One of our goals is to provide a method for WICN to acquire new and missing tracks for its digital library once it is created. There are also titles that WICN wants to play, such as the Blue Note recordings, but do not have access to.

3.4.1 Additional Music Sources and Copyright

Some potential music sources to provide WICN with artists music and related performances to Jazz, Blues, Folk, etc. can be found over the internet. The Internet can be utilized because of the widespread use of genre-specific music websites and it could be a way to access artists' work via their direct channels. Before we find additional sources of music, we would explore the legality and copyright laws that govern these sources. An example, for iTunes, we would read Apple rights and permission terms, then, we would find and read articles of the universal and U.S laws and rights for public communication.

3.4.2. Internet Sources

In order to provide the best source of music, we will investigate a variety of online music sources. We will research the most important factors of internet music sources such as authorization, price, and ability to download songs for each option found. Then, we would attempt to answer questions related to how effective a source of music would be such as: What are the terms of use/disclosure in regard to access music? What is the most comprehensive in terms of new artists releases? Which internet sources have the most variety of artists and songs available? Which internet source has the best audio quality? To determine which internet sources would fit with WICN's needs and its available budget. We would finally rank the best internet sources for WICN.

3.4.3. Direct Communication

Direct contact with artists might be the only option if it is difficult to find artists' music through other means. To contact outside sources, we would ask them some prospective questions such as: Are they willing to allow WICN to promote their music and related performances? Do they have a music account with any music website (Bandcamp, SoundCloud, iTunes, Spotify, Deezer and etc...)? Would WICN need an agreement for each account? How long would the agreement run? What are the disclosures? These questions would help us determine potential protocol for relevant future music acquisition via direct contact with artists. With that can contact an artist's manager, if they have one, via information given on their social media pages to obtain CDs or download links and add them to WICN collection. We would recommend a method that would help WICN communicate with such artists thus allowing for smooth acquisition of music.

4.Results

To help WICN convert their CD library to a digital one, we interviewed other radio stations to gather information about how they had approached the task of conversion and communicated with the WICN staff and DJs to develop an understanding of their primary needs. We compared hardware options for CD rippers and software options for databases in order to provide the best systems for both transfer and storage. We make conclusions and recommendations for the best way WICN can go about this process.

4.1. Case Studies

We contacted other radio stations that have already digitized their library and asked them about the details of their process. We constructed an interview protocol for semi-structured phone interviews. Examples of questions that we asked were "What database do you use to sort and store your information?" and "What equipment did you use for the conversion?" (see Appendix B for a full list of the questions). The radio stations that we had contacted were KEXP, KBEM, KZMU, and WCJU; we decided not to include WCJU because they did not have a process that was applicable to this process.

4.1.1. KEXP

Our first case study was with KEXP, a public radio station based in Seattle, Washington, which specializes in alternative and indie rock programming. We spoke with Dylan Flesch, who is the Media Asset Librarian for KEXP. We spent about 30 minutes interviewing him on the details of the radio station and specifically how they handled their digital database.

KEXP has a larger library than WICN, which includes approximately 40,000 compact discs and 11,000 vinyl records. In August of 2016 they began transferring their library to a new system and by the time of the interview, Dylan estimated that they were about 25% of the way through the transfer process. Regarding the hardware, they have been using 2 Acronova Nimbie autoloaders. Regarding software, they are using dBPowerAmp to rip CD's, and a custom metadata tagging software created by a volunteer for the

station. Their goal is to convert their entire non-vinyl library and a few of the vinyl records that cannot be found on optical or digital formats.

KEXP has opted to use the media management system Dalet, a music database system, which has a studio module which populates metadata in the DJs playlists interface and is integrated into their DJ booth as their on-Air playout solution. This system covers their needs well, although there is some learning curve for DJs. Some of their DJs are comfortable with Dalet already, while most are still comfortable with their old system. Though this may be due to the fact that they are still only partway through their library, and they are waiting to see how their DJs interact with it when they are completely finished transferring their songs. One thing that Mr. Flesch says helps with the transition process for DJs are weekly tips or info to use the system. Mr. Flesch also recommends that the technical director is prudent with questions/feedback that any of the DJs have while they are still learning.

If there are problems with any of the digital files, such as glitching or skipping, the DJs will report it to Mr. Flesch and they will do a quality control check. Users can also notify their IT department if there are tracks missing from the database and they will make sure that they get put into the system that week. One interesting thing KEXP has in their system is the ability to access the system over the local network on any computer, and they are currently working on making it so that it can be accessed over the internet as well. Overall their management and system seems to be top notch and they look like they are on track for a smooth transition.

4.1.2. KBEM

KBEM or Jazz 88 is a program of the Minneapolis Public Schools System that approximately 150 students annually participate in. Their station is on air 24/7 and hosts 35 hours of student programming each week along with recorded programming for the rest of the schedule. We spoke with KBEM's program director Travis Ryder for about 10 minutes about their library conversion. Their Library has about

a 60-40 split physical to digital. When they originally had a physical library it included 10,000 CDs and a handful of LPs, although “regrettably” they have liquidated all of their LPs since.

For the process of ripping their discs they first had their music director identify a core group of important CDs. Than over a period of about a year proceeded to rip about 40% of their physical library. The equipment used to rip the discs were the disc drives on their automation system. The ripping process that they employed to rip the discs did not add metadata to the files however, and consequently KBEM had to manually add all metadata to their files.

KBEM uses two different softwares in conjunction with one another to handle storage, playout, and scheduling. For storage and playout they use Enco DAD which is a radio storage and automation software. The Enco system is equipped to feed information to Spinitron in order to automatically fill out playlists for documentation. For scheduling they use Music Master which is a music scheduling software that handles mixing for their automated shows. They now use these automated softwares instead of live DJ’s due to budget reductions.

For supplementing their library they use SoundCloud files sent to them by artists and record labels. For research into new music to play, they subscribe to two sources of jazz news: ‘DownBeat’ and ‘Jazz Times’, which provide them with news on jazz and various jazz artists around.

4.1.3. KZMU

KZMU is a community radio station that is located overlooking the beautiful Moab valley in Eastern Utah. Their station has a variety of programming from
jazz to rock to Latin American and Technohouse. We spoke with Christy Williams who is their program director at KZMU. Through our 20 minutes interview, we not only managed to get a good picture of their system and process but also their personality. They use an automated system for live radio with live DJs, called an "old school hybrid" as Ms. Williams calls it, which plays via a personal computer
(PC) using StationPlaylist software, custom made to be a search engine and run automatically for overnight programming/low message.

KZMU sports a large physical library that contains 75,000 CDs and 3,000 LPs. None of their LPs have been added to their digital system and they do not have any plans to do. Conversion of their CDs has been going on for 5 years, starting with the CDs that were deemed most at risk of breaking and most played. For conversion they ripped their files into a custom “Windows based system” that they have had made for them by volunteers. As for metadata, they use HTML code also custom made for their metadata that came along with their conversion and a program called MediaMonkey which works as a storage location and a search engine. After the tracks have been downloaded they are listened to check for obscenities. The ones that do have obscenities are deleted because they are trying to build a clean digital library. When asked to comment on the method of transferring disks into the new system Christy remarked, “Like an elephant, took it chunk by chunk” using an Acronova Nimbie and trusted community volunteers who would work through the transfer process about 50 or so CDs at a time. She also believes that they are going to be converting until the industry decides to stop using CDs.

Regarding DJ usage of the system, it was estimated that about 20% of their DJs have used it or use it regularly, though none use it primarily. KZMU does not want to force a transition to the new system, instead, they plan to let it happen gradually. The system is not available remotely, and only DJs and trusted community volunteers may use it. Altogether they are doing a great job with the system that they have, and should definitely be looked at as an example for WICN's library composition.

4.2. Data Transfer Options

For WICN to be able to transfer their music, they must have a method of taking the music data off of the discs. We have outlined options for WICN to transfer their data through equipment, software, and procedure options.

4.2.1. Discerning Core group of Discs

In order to begin the process of ripping we need to discern what the most important discs needed in the system are. To accomplish this, we did research on the Spinitron web service, looking to see if there was a way to compile the music used by the station to get the most played discs. We were able to obtain WICN's playlist in an excel spreadsheet with help from Tom Lucci who downloaded the excel file from their personal page on Spinitron. We reorganized the list based on album, then made a separate column with only one instance of each album. With that column, we used a countif function that took the original column and counted every instance of the album in the new column. This way we got a playcount of every album, with which we organized the columns by playcount, while still having the rows attached to the number, to have the top albums ranked at the top. The list was then scanned for inconsistencies and outliers, such as junk table formatting, to be deleted. This list is available in Appendix G.

The second way that we determined a core list of CDs was through our WICN DJ survey. We asked 12 of WICNs DJs what their top 15 most played discs were. These responses will be given the highest priority for download, even before the Spinitron list due to the fact that the DJs have requested these specific CDs.

4.2.2. Physical Transition

For the transfer of data from their compact disc library, WICN has the option of purchasing equipment that will aid in the process of transfer. In order to recommend the best hardware options, we put together a table (Table 3) outlining the elements, abilities, and functions of different equipment options. Each of these options are originally meant for publishing discs, but with the right software they can be used in the opposite direction. The equipment options range from disc rippers meant for large scale disc data transfer to your basic disc drive that is not automated.

Equipment	Price		Speed	Automated	Modifiable
	Used	New			
Primera Disk Publisher Bravo 4200	$400	$3225	30-60 Discs/h	Yes	No
Acronova DupliQ	$250	$500	15-30 Discs/h	Yes	Yes
Acronova Nimbie USB Plus	$300	$600	15-30 Discs/h	Yes	Yes
Disc Drive	$5	$50	Dependent on the Operator and speed of the computer	No	Yes

Table 3: Table of Equipment Options Explored

Our options for hardware made for this task are the Primera Disk Publishers, the Acronova DupliQ, and the Acronova Nimbie. The Primera can hold up to 50 disks at a time and has a printing time of "30-60 CDs per hour" (Primera Customer service). It's important to understand that the Disc Publisher isn't a ripping engine, but is designed for duplication of CDs and DVDs; however, dBpoweramp can run the process in reverse turning it into a ripping machine (John Honeyball, 2010). They are the top disk publishers available and they tote their robotics prowess as much faster than any competitor, due to faster arm movement and drive boot up, and are considered one of the most reliable

disc publishers out there. The main drawback to using such a system is that the hardware is expensive and would not have much use after the transition process, unless WICN wanted to print CDs.
The Acronova DupliQ is another option that is less expensive. It holds 25 discs and has a robotic arm that automatically transfers disks from its CD storage container to the drive and back out into its completed disc container. The Acronova Nimbie is a great alternative that offers a small, more reliable disc publisher than the DupliQ. This option does not have a robotic arm and therefore it has less of a chance of malfunction, causing damage to discs. The price is a small amount more (See Table) than the DupliQ but many of the features are better, such as its ability to continuously accept discs and a safer disc eject system. Both of these options are reliable in general, because Acronova has the highest rated economical disc rippers on the market. These options are all able to be used with any operating system because they are essentially removable disc drives.

Another option that is not automated but would make the transfer process much easier is using multiple individual optical disc drives. Using removable drives would be a completely manual process, using humans to individually insert discs. Depending on WICN's resources and the amount of time that they would like to spend they can buy more or less drives. The benefit is that the price is low in terms of hardware. The downside is that it would require a person watching the drives and making sure that they are continually downloading the discs. We estimate that it would take about 1-4 years depending on the amount of drives and individual help.

The automated options are able to work quite efficiently, but still require some level of human interaction. In order to maximize the automation it is possible to alter disk publishers/rippers by adding slides or other modifications that can move the disks through the machine's storage before and after ripping in order to keep the drives from running out of disks to rip. With this in mind the Acronova drives are more modifiable due to their open-air design and easily accessible parts. Even optical disc drives can be altered to maximize automation, though this would take a large amount of time and planning to do so. This can be taken into consideration for WICN when choosing the most effective system to use.

4.2.3. Ripping Software

Regarding ripping software, we found two services that seem to fit the criteria that we are using to help WICN with their transition. The first is dBpoweramp, which is a lossless ripping software that will rip to .flac with faster ripping by using a multi-encoder (developed by the company) to download everything off of the disc twice as fast by taking music data from the internet to aid the process. This software will also provide additional metadata such as cover art, album title, and year produced. DBpoweramp can be downloaded as a free trial for 21 days and then can be purchased for $38.

The second ripping software is Exact Audio Copy (EAC), which has the ability to use multi encoding as well, through a different codec than the one that dBpoweramp uses, and can even read scratched CDs through the use of verify and AccurateRip according to EAC's website. The files can be converted to MP3, WMA, flac, and OggVorbis after extraction. The software also is able to read the metadata off of the disc, such as title, artist, and album, but does not add any metadata to the files. EAC is also able to run at a faster speed than normal, called burst extraction, but is only recommended to be used in conjunction with drives that have jitter correction in order to get the most exact rip. This option is free which makes it a great choice because it is both of high quality and great price.

4.3. Database Needs

We sent a survey to WICN DJs in order gauge their abilities with various databases. From the survey results, we determined specific criteria that we used to determine possible database options. In case one option does not have metadata integration we researched various music metadata acquisition choices. We determined ways to integrate Spinitron with our various database options, through the use of scripts and 3rd party applications.

4.3.1 DJ Ability

During an interview with WICN's current General Manager, Tom Lucci, we acquired a handful of recommendations that their DJs would like to see in the new system. We took those suggestions and found software that we thought would provide the best database for WICN. We also sent a survey to WICN's DJs to gauge their abilities with various music software. For the survey we asked DJs how comfortable they were with our suggested software options which were Dalet, AudioVault Flex, Sam Broadcaster Pro, PlayoutONE and Virtual DJ (**Appendix E**). Due to timing issues we could not send another survey with the last software we found, MediaMonkey, but we introduced it later in the report because we found it relevant. We gathered answers from twelve out of the twenty-five DJs who host shows in WICN's studio. Prior to the user interface (UI) section of the survey questions, we asked to DJs to rate how they would feel using each of the suggested software's interface by showing images of the UI and asking them to rate their comfort on a scale from 0-100. We compiled a series of pie charts presenting the ability of DJs with suggested software. We sorted all the answers by breaking into these following ranges:

Capacity	**Percent range**
Strongly Comfortable	80%-100%
Comfortable	60%-80%
Fairly Comfortable	40%-60%
Below Average Comfort	20%-40%
Not Comfortable	0%-20%

Table 4: Comfortably Range with Target Percentage Range

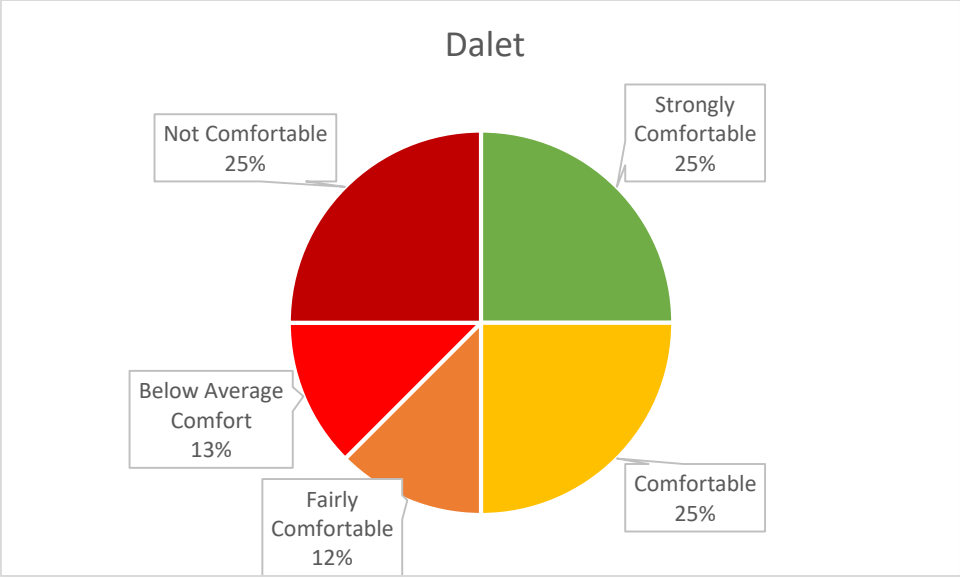

Figure 5: Dalet Ability Pie Chart

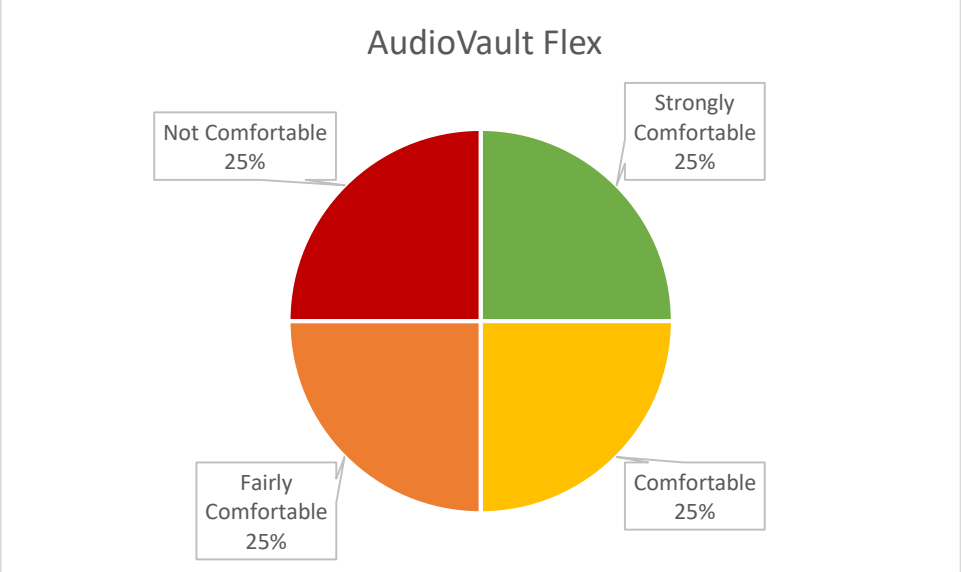

Figure 6: AudioVAULT FleX Ability Pie Chart

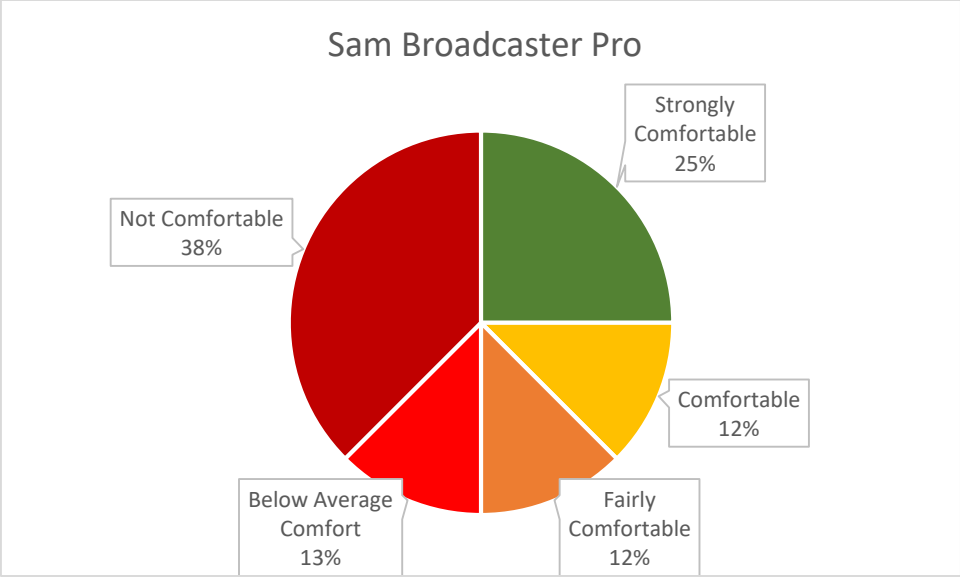

Figure 7: Sam Broadcaster Pro Ability Pie Chart

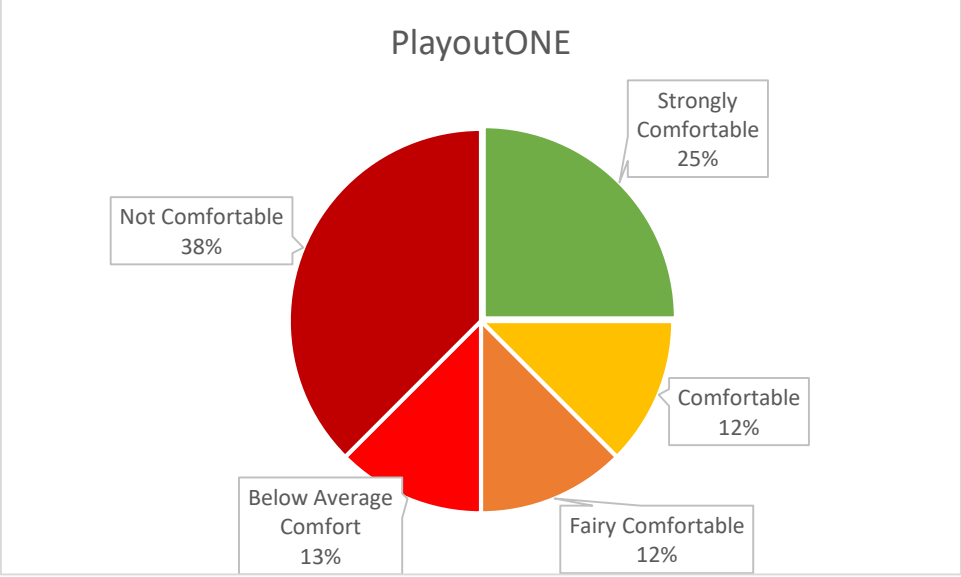

Figure 8: PlayoutONE Ability Pie Chart

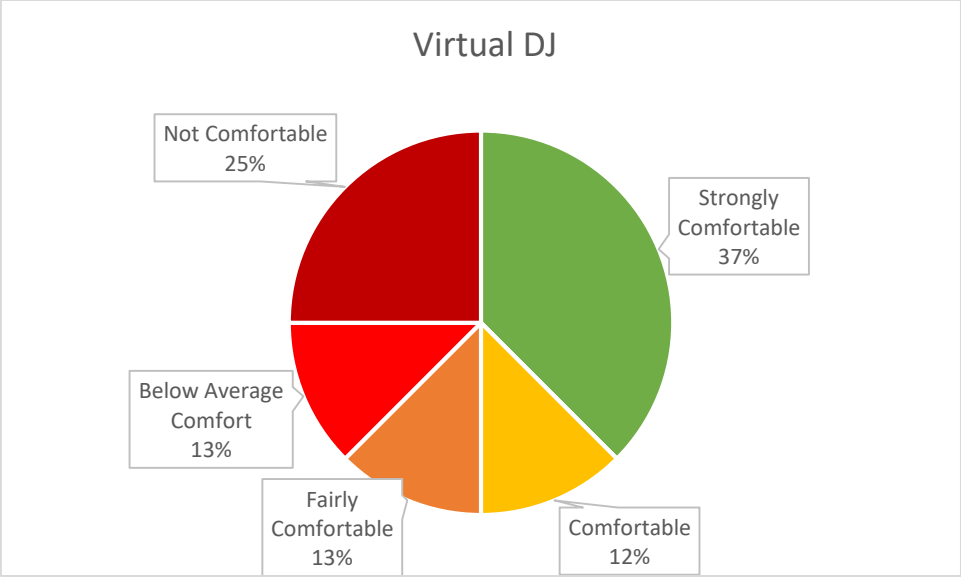

Figure 9: Virtual DJ Ability Pie Chart

It appeared that WICN's DJs would be the most comfortable with Dalet, AudioVault Flex, and Virtual DJ because only 25% of DJs felt that they would not be comfortable using them while Sam Broadcaster Pro and PlayoutONE had 38% rated not comfortable using them. The number of DJs stayed consistent in the utilization of each software with 12% for poorly comfortable and another 12% for fairly comfortable. The only exception was AudioVault Flex, for which there were 25% of DJs who felt fairly comfortable with no one rating it poorly comfortable with this radio software. Furthermore, in our statistical analysis we found that Virtual DJ had 37% of DJs rated having strong confidence in their ability using it, while the rest of the suggested softwares showing that only 25% of WICN's DJs were strongly comfortable.

Besides this, we also studied suggestions gathered from WICN's DJs on what they would like to see in the new software database, as well as album suggestions to put into the new system. We found that most of the answers were focused on the following criteria: a rotation of songs from one field to another field in the computer during and after show sessions, a library of songs containing song information in the database, custom tags to personalize the documents or fields of a DJ, and a software which could be understandable and clean.

4.3.2. Suitable Database options

We explored the features of the following suggested software list: Dalet, AudioVault Flex, Sam Broadcaster Pro, PlayoutONE, Virtual DJ, and MediaMonkey. We spent time on each software's web page between the frequently asked questions and the features page to determine features of the user interface (UI), the metadata integration, the price and trial extension questions. Sam broadcaster pro, PlayoutONE and virtual DJ took the least amount of time to find information about while Dalet and AudioVault Flex were the most difficult to find information because we needed to contact their support teams directly to answer our questions.

4.3.3. UI Guide

According to Rouse M. in *What is User Interface?* from November 2016, the user interface is everything designed into an information device in which a person may interact. In other words, it is everything on screen that makes the user experience smooth and wonderful. In order to determine the most important UI features from the suggested radio software, we gathered up all the possible user interface features that were available from the researched DJ software choices. Once we had gathered all of the options available, we rated UI features based on how applicable they are to WICN's needs and separated out the 5 most important UI features that would be the most important. (1) The ability to view their music library on screen was the most important UI feature due to DJs expressing their need to see the music on the screen. This will also give them more flexibility when picking songs while on the air because they can change their queue whenever they like. (2) The ability to create tags was second most important due to WICN's expressing interest in the ability to create tags themselves. (3) The third most important UI feature was multiple channels because it would allow for preparation for the next song in the queue and give the DJs time to do any editing if necessary. The fourth most important is the (4) ability to shift screen presets. This is especially important because WICN's DJs are very unique individuals who like their workspaces specific ways and if the preset system does not work for them they will be less likely to use it. The fifth

most important UI feature is (5) listener statistics; this will help DJs know if their listeners like their show and will help them with programming for future shows. **Table 5** illustrates how we organized UI features with Metadata integration, price and free trial for each software.

Software	UI					Metadata		Price (US Dollars)	Free Trial
	1	2	3	4	5	Integration	Creation		
Dalet	✓	✓	✓	✓	x	Yes	No	Starting at $190,660 (Meant for large radio stations)	No
AudioVault Flex	✓	✓	✓	✓	✓	No	No	Currently Owned by WICN	No
Sam Broadcaster Pro	✓	✓	✓	✓	✓	Yes	Yes	$699	14 days
PlayoutONE	✓	x	✓	✓	x	Yes	Yes	$123.46 (at the time of conversion)	No
Virtual DJ	✓	✓	✓	✓	x	Yes	No	$299 one-time payment / $19 per month subscription	30 days (if you have an account)*
MediaMonkey	✓	✓	x	x	x	Yes	Yes	$24.95	Yes

Table 5: Suggested Softwares with Considered Features

In **Table 5**, on the column of UI, we checked whenever the UI has one of the considered UI features previously outlined, and we marked an "x" whenever a software did not have the UI feature considered.

4.3.4. Metadata Integration

Metadata integration or data profiling is when music software has information about each music file that is in its database. This data is a library of information that works in parallel with the music library. The factors of metadata that we were looking for in the software were if they had the main criteria of

metadata such as genre, artist, album, and song name. It was also discerned whether or not the different suggested softwares were able to create their own metadata. So, in the following part, we focused on the pros and cons of the metadata integration of the considered softwares. For Dalet Radio suite, the system is connected to Dalet Galaxy, which is basically a giant database that holds all information linked across systems from Dalet's servers. This includes metadata for a prodigious amount of music, but will not allow for additional metadata unless you request it from Dalet. Another software we considered is Audiovault flex which does not have metadata integrated in the software due to the system being mainly used for commercial and set broadcasting that is meant for automation. The only metadata that it has stored are the song title, artist, and song length. Users can obtain metadata through other programs working in sync with it at the cost of processing power. For the next software considered, Sam Broadcaster Pro, we found that it has its own metadata database that is built into the program. The metadata can be built on by editing the media files themselves within the program, which is found by right clicking on the song and selecting edit. Virtual DJ, stores the metadata in the software's database. It also allows for tagging of the downloaded music files and stores those tags along with the metadata with the VDJFlacTags tool. PlayoutONE, has easily one of the best metadata systems that we have found. It has metadata integration as well as an easy metadata creation option that allows for adding of tags and a description to different songs. Their metadata creation allows for descriptions as well as a whole media page that allows users to fill out specific tags, such as genre and playlist identifiers. This is the software that would best fulfill the requests that WICN had for information addition to songs for their software. The last software is MediaMonkey, which has a window linking to Allmusic, which is a music information website that provides facts and information on the song(s) that have been selected. The Software also sports easy metadata creation that is on par with PlayoutONE.

4.3.5. API Metadata Sources

For additional sources of music metadata, in the case that metadata is not already integrated into the database software that is chosen, we can use and Application Programming Interface (API). An API is a tool that can be used to place an application within a server that can send and receive information from another server. An example of this is if there is a google search bar on a website, it is sending a search to google and receiving information back and displaying the search without leaving the page. Metadata API will only give information on the music and WICN would add the metadata themselves. We can use an API integrated into options that metadata is not available in and it would allow for easier metadata configuration.

The options that we researched for API options are Acoustid and Last.fm. Acoustid is a complete audio identification service, based entirely on open source software. The software identifies the audio fingerprint of each song and connects to MusicBrainz metadata database and using the unique identifiers on the fingerprint it will identify the song and produce all facets of the music. This is a free option but WICN must register a key in order to use it. The second option is Last.fm which is also a free option that has various API methods for the various parts of music options. Some areas that Last.fm goes into are album, artist, and chart. Within these areas there are subdivisions that can include adding tags, find similar, and get info. All that WICN would have to do is request a key from last.fm for the individual API's that they want.

In order to use the API WICN would have to pull an executable HTML or some form of window within the database software or in a window. That way the API would have a place to run from on WICN's server. This is entirely dependent on the software chosen though.

4.3.6. Spinitron

Spinitron is an online software which can be combined with any software as long as the software to interact with is compatible. The compatibility of a software is it's ability for operations to

run congruently with another software on the same computer or different computers linked by a computer network. We studied the possible interaction of Spinitron with the current software used by WICN, VAULT2 from AudioVault, before carrying out further research of Spinitron interaction with the suggested software: Dalet, AudioVault Flex, Sam Broadcaster Pro, PlayoutONE and Virtual DJ in order to provide both insight and an option for if they decide to stick with their current software.

4.3.6.1. Interaction Between Spinitron and VAULT2: Approach

Due to the fact that WICN uses Spinitron and VAULT2 in two separate computers, It was important to search ways for them to interact automatically to simplify DJs lives by exporting the metadata to Spinitron. Although it is advantageous to have them interact, it is costly as it would required WICN to buy additional equipment.

The first thing needed for interaction is (i) a software called The Radio Experience (TRE) which is only available from Broadcast Electronics (BE). TRE has support for Spinitron and for VAULT2 built in; so, it would be able to directly connect VAULT2 to Spinitron. When purchasing it, BE requires details about internet protocol (IP) address of the computer to install it, automation system details, and general hardware information of the computer. All these informations would be used by BE to preconfigure the TRE before sending it to the radio station. To make the process happen, the computer where the TRE would be installed has to be cleaned completely from any other program before installing the TRE software. An ethernet connection needs to be installed from the computer which has the TRE software to the high definition (HD) exporter for main programs services and to the HD importer for secondary programs services by using an internet box protocol. The following figure is an illustration of the configuration.

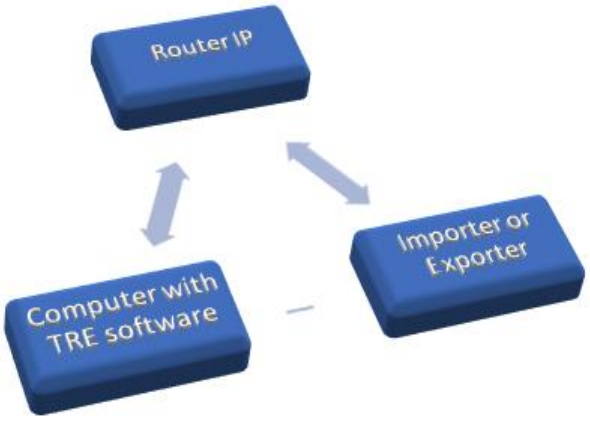

Figure 10: Ethernet Connection between the TRE Computer Software and the Importer/Exporter via the Router IP

To send information directly from the TRE to the WICN radio station website, WICN would need to allow the TRE computer file transfer protocol (FTP) to access the station web server. In case of limitations of connectivity between the TRE and the importer and/or the exporter, an ePad available from BE could be used as an alternative solution to the internet box protocol.

The second equipment required is (ii) the RDi 20 accelerated radio data system (RDS) generator encoder to support the data transmission capability. Once Spinitron and VAULT2 would interact, the flux of information between the two would be slow that is why an RDi 20 is needed to speed up the data flow.

Figure 11: RDi 20 Front Panel

According to Broadcast Electronics, its front panel eliminates the needs to drag the computer to the transmitter to adjust the settings. After connecting to the RDi 20 for the first time, it would set the rest of the configuration parameters automatically. By using TRE and an RDi 20 and following all the details it would be guaranteed for WICN to get more from its current software VAULT2, and the online software, Spinitron.

4.3.6.2. Interaction Between Spinitron and Suggested Software

From the suggested software list (see above Suitable Database Options), we researched protocol in order for Spinitron to interact with each of them. For our first suggested software, Dalet, we could not find online information which could allow interaction between Dalet radio software and Spinitron. Also, we did not get answers from Dalet support team after sending multiple emails. For our second suggested software, AudioVault Flex, we found out that there is still the need of the TRE previously mentioned above, though it would not require the hardware previously mentioned due to it being more advanced than VAULT2. Through personal communications with Mr. Backus, Eastern Regional Sales Manager at Broadcast Electronics, the Spinitron plug-in would allow the use of Spinitron to access and display the correct ’playing now’ information. For the next software, Sam Broadcaster Pro, we found in our research that it could interact with Spinitron through the use of a script because it doesn't have any built in features

specifically for sending song metadata to remote machines, according to Spacial LLC's website. The proposed solution is a playlist automation language (PAL) script that we have found on Bitbucket, which was written by Spinitron (**Appendix F**). MediaMonkey is not able to connect to Spinitron on it's own, but according to Mediamonkey's help page, it is possible to create one's own script for entering in the values for a spinitron file. In our research, we have determined that for the remaining softwares, PlayoutONE and Virtual DJ, interaction with Spinitron is not possible.

4.4. Additional Sources of Music

To provide WICN effective ways to expand its digital library, we followed three steps. First, we researched copyright laws for music use to determine if we would be able to use internet sources without running into legal implications. Second, we found individual internet sources and determined if WICN would be able to download the music files, if their individual terms of service would allow WICN to use them, and the associated costs with using their services. Third, we created a method using direct communication with artists on how to find and obtain music.

4.4.1. Legality and Copyright Laws

According to U.S. copyright law, authors own the exclusive rights to their compositions. Therefore it is subject to section 1101 of Title 17 of the United States Code, which states that anyone who without the consent of the performer or performers involved: "Fixes the sounds or sounds and images of a live musical performance in a copy or phonorecord, or reproduces copies or phonorecords of such a performance from an unauthorized fixation […] transmits or otherwise communicates to the public the sounds or sounds and images of a live musical performance […] distributes or offers to distribute, sells or offers to sell, rents or offers to rent, or traffics in any copy or phonorecord fixed as described in paragraph (1), regardless of whether the fixations occurred in the United States" shall be subject to the remedies to the same extent as an infringer of copyright. Based on article 10, WICN would have to distinguish between

broadcast artists' works and available artists' works over internet. WICN uses Spinitron which can be used by any radio station to display the list of songs which have been broadcasted by the radio station over a period of two weeks. It should be good to ask if artists are willing to accept their work to be displayed on Spinitron's website, and whether they are willing to consider another agreement for this purpose.

4.4.2. Internet Sources

For WICN to be able to find and obtain new digital music sources, we researched various internet sources. We made sure to take into account each one's ability to download music, legal status, and associated costs. For legal status "TOS" stands for Terms of Service, and means that they do not allow non-personal use.

Internet Sources Names	Download	Legal status	Associated Costs
ITunes	Yes	Term of service (TOS)	$1 - 1.25 (pay per song)
Spotify	No (locally to the service)	TOS	$10/Month
BandCamp	Yes	Artist basis	Varies (per song)
SoundCloud	Yes	User basis	$63/Year
Tidal	Yes	TOS	$10/Month for Premium, $20/Month for HiFi
Allmusic	No	Individual Basis	Free

Table 6: Internet Sources with Tagged Criteria

4.4.2.1 AllMusic

Allmusic is a music discovery service that allows users to rate albums, create album lists and find new music. The service also recommends albums based on your taste and helps users find new music through "discover" which allows users to find new music based on genre. The service is free but it also has

a paid subscriber option that takes away ads. The service only shows new music to the user and does not allow for downloads. It could be used as a good music discovery alternative for WICN. However, their terms of service allow for only individual use. As long as you are not downloading and do not using the music for commercial use, the information that you get is free to use.

4.4.2.2. BandCamp

BandCamp is an online music retailer that allows artists to directly market their music through their service. Artists are granted a microsite and allowed to set the prices on their own music, with BandCamp taking a percent seller's fee. Using music from their service is dependent on the individual artists, who can be directly contacted through their microsites. Bandcamp's service is an extremely good new source of music because it can not only be used as a way to find new sources of music but can also be used to get in contact with the artists. The biggest benefit is that the audio files can be downloaded and immediately put into the system.

4.4.2.3. ITunes

ITunes is a music service developed by Apple, and it functions as a music retailer, library, and player. Songs from their store are typically priced at around $1 and can be downloaded and transferred across devices using the same account. Their TOS currently forbids the use of iTunes beyond personal playing. ITunes has the benefit of a large collection but because of their strict terms of service they are not a great option for finding new sources of music.

4.4.2.4. Spotify

Spotify is music streaming service with over 30 million songs available. It offers both a free service subsidized by ads and a premium service for a monthly fee (standard $10/month) that features higher streaming quality. Songs from their library can be downloaded to local storage but are only playable through their software. Their TOS currently only allows for personal use of their service. Their

service excels in high quality streaming as well as their more recent recommendation service that they have implemented. This would be a great way for individual DJs to find new music to use for their radio show but would not be a good way for the station station to add to its digital library.

4.4.2.5. SoundCloud

Soundcloud is a platform for artists to stream free music for the public. This service also allows for downloads with permission from the artist. WICN already has experience with getting songs through Soundcloud in the past and this source can definitely be used in the future for finding more. Their "Go" service is an upgraded version of their service that takes away ads and allows for offline listening as well. Although this would not be necessary for WICN because they would download the file from the artists.

4.4.2.6. Tidal

Tidal is a service that is like both Spotify and Itunes, as it is both a streaming music source and a retailer of music. Their service only allows downloads after purchasing the subscription and then subsequently purchasing the song. Due to their terms of service though they do not allow for any party to use the music for anything but personal use.

4.4.3. Direct Communication

For direct communication, we have found that communication will mostly be necessary when asking for permission to use songs on the air after purchase. The main uses for this will be using Bandcamp and will rely on the built-in email system that they have on each artist's page. When using direct communication, we have determined that it is best to introduce yourself and the group that you are representing. Then proceeding to ask for permission to use the artist's song on the radio station. Along with the message, WICN should ask for them to ask any questions or concerns that they have to make sure that they are comfortable with their music being used.

5. Conclusion/Recommendations

For this chapter, we detailed the conclusions and recommendations drawn from the findings of our research. We begin by outlining the options for hardware and software related to the process of ripping CDs. For Software recommendations, we provided our recommendations for high and low cost software as well as for AudioVAULT FleX due to WICN already owning the software and hardware for the program. After that, we provided our conclusions on how metadata management should be looked at and how it should affect WICN's choices. Lastly, we shared which options we believe would be the best sources to supplement WICN's library. We provided the core list of CDs that we compiled from the DJ survey and Spinitron files in the Appendix.

For WICN to make their decision on the system that they will go with, we recommend that they pick their top choices from sections 1, 2, and 3. Any of the combinations of those options will work, WICN just needs to take into account what they are looking for in regards to their system. For supplementary sources of music we recommend using all of the services that we have provided in the 4th section.

5.1. Hardware Options

In order to expedite the process of data transfer we will recommend the best options based on the data taken from case studies and WICN's needs. The first option we recommend the Acronova Nimbie.

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Figure 12: Acronova Nimbie

This piece of hardware has been used by two of the three case studies that we have explored and is recommended by both of those case studies' radio stations. The design allows for easy disc autoloading and allows for disc refills at any time without interrupting ongoing processes (Acronova, 2014). This option can also be modified by adding a larger disc holder on top of the machine in order to allow for a larger clip of discs per reload, making it even easier to have discs constantly ripping. The Nimbie is also supported by most 3rd party applications and will work with many burning or ripping softwares, which makes it able to handle the ripping software that we would suggest. The price for one Acronova Nimbie new from a manufacturer is ~$600 but will significantly increase the rate at which discs will be ripped. Another option is buying it used for ~$300 from either Ebay or any electronics resale vendor.

Figure 13: USB Optical Disc Drive

Our second option that we recommend is buying extra USB optical disc drives, because it is the most inexpensive option that will expedite the process of ripping. Having multiple optical disc drives has been done by one of our case studies and although it is much slower it has been proven that it can be done. The disc drive will work with any 3rd party ripping or burning software. The price of new usb optical disc drives are ~$50 and for used usb disc drives you can find for as low as $5. For a low cost yet faster than having no extra hardware option ripping process this would be the best option, although someone would have to be constantly monitoring the drives to make sure that the process is continuously moving.

5.2. Ripping Software

Through our research of different ripping softwares we looked for the best at both acquiring the music data in flac format as well as metadata acquisition. The ripping software that we found to be the best is dBpoweramp.

dBpoweramp is a lossless ripping software that will rip to .flac as well as other popular file forms by using a codec which they came up with. Their codec is a multi-encoder that downloads everything off of the disc twice as fast by taking information from over the internet to aid the process. dBpoweramp will

also aid in finding Metadata by searching for the metadata over the internet and including it with the downloaded music files. This alone is an amazing feature which will aide in organizing and tagging the files once they are in the system. There is a free trial for 21 days and after the trial is over a perpetual license can be purchased for $38.

5.3. Software Recommendations

WICN needs a database that can contain their digital library and handle playout for the station. Based on our research that we have done based on WICN's DJ needs we have compiled the best softwares that we believe will suite their needs. For recommendations, we have decided to write options for both a high and low-cost option as well as a section for AudioVault Flex because WICN already owns the hardware and software required for AudioVault.

5.3.1. Sam Broadcaster Pro

Sam Broadcaster Pro is our first option which we would like to recommend. According to our research the software has 5/5 of our most important user interface (UI) features which are the ability to view their music library on screen, ability to create tags, multiple channels, ability to shift screen presets, and ability to see listener statistics. The software has a metadata library of its own that will display tags and information as well as cover art for each song. Sam Broadcaster Pro also allows for metadata alteration by editing the music file itself. One of the best features that Sam Broadcaster has is support via the parent company, Spacial. Spacial is constantly updating Sam Broadcaster to make it better, one example of this is that the program can support flac files while at the early stages of the program it did not support the file type. This option is our high cost option which sits at a price of about $699 for the studio. This software option has many features as well as an easy to use UI that will make it easy for the DJ's to transition to the new system.

5.3.1.1. Spinitron Integration

In order to streamline the system of playout we have researched ways to integrate spinitron into the various music database softwares that we have chosen. We found that there is a way for Sam Broadcaster to interact with Spinitron through the use of a script. It is a playlist automation language (PAL) script which can be found on BitBucket. Spinitron was the creator of the script so it is a legitimate and safe option.

5.3.2. MediaMonkey

MediaMonkey is our second option that we recommend for WICN's database. Due to our research we have found that it has 2/5 of the most important UI features which are ability to view music library on screen and the ability to create tags. Although it has this score it still has a whole host of other features, such as play reports and statistics, that make it a solid option. The UI is simple yet accomplishes everything that WICN would absolutely need in order to have good and consistent radio shows. MediaMonkey also has metadata integration through an on board app that allows for music identification from the internet. MediaMonkey also has an extremely good metadata/tag creation method that allows you to set ratings, mood, comments, and descriptions to the usual metadata that will allow for WICN to have more information on their live shows. The Software can handle the playout of any type of music file including flac which is the file format that WICN will be using. This is the low cost software starting at $24.95 but it is recommended that WICN contact MediaMonkey before doing so because they will be using it for broadcasting. The simplicity of the software will make it easy to learn for the DJ's at WICN but it will take a small amount more time to gain proficiency at it.

5.3.2.1. Spinitron Integration

Spinitron integration for Mediamonkey is possible through the use of scripts. The main problem with integration for Mediamonkey is that there is no solution currently available. Mediamonkey supports most script file types and is able to handle 3rd party applications that are able to move data between applications due to it is simple nature. What we recommend for WICN is that they write their own script to handle the data transferal.

5.3.3. AudioVAULT FleX Option

AudioVAULT FleX is the option that WICN currently has in their servers and has the hardware for. AudioVAULT FleX has 5/5 on our most important UI features including the ability to view their music library on screen, ability to create tags, multiple channels,ability to shift screen presets, and ability to see listener statistics. FleX is able to shift screen presets in order to optimize for music intensive use by moving different tools around the screen. The Software also sports an option called Quick Starts which allows for quick use of ad and contest clips that can be added into a show. There is not a metadata library or tagging of music files within AudioVAULT FleX, instead it relies solely on artist and song title. AudioVAULT FleX is able to rip audio files into its system by using its own codec to rip. FleX also offers radio automation that can compile and create shows ahead of time. Overall WICN's DJ's would be able to easily adjust to the software and with its adjustable interface they would be able to make it their own. The only concern that we have is that without tags it would not be as easy to make playlists based on genre and other factors. Otherwise it is an amazing piece of software.

5.3.3.1. Spinitron Integration

For integration with Spinitron, AudioVAULT FleX would require The Radio Experience (TRE) plugin. FleX would communicate with Spinitron by having TRE display 'playing now' information and transfer it to the Spinitron file.

5.3.4. Metadata Conclusions

Metadata is an important piece for choosing the best database option because it changes how users will interact with the database. While user interface affects what users see, metadata is the tags and information associated with each music file that allows for users to navigate through all of the information in the system.

Through contact with both Tom Lucci and Brian Barlow we have found that WICN would like to have information about the song viewable on screen as well as easy tagging of music in order to make personalized tags for easy show creation. We recommend that WICN takes metadata into account when making their decision for a database.

5.4. Additional Sources of Music

In order for WICN to expand their music library and find new sources of music we did research in order to find services that could aid them in that search. We are recommending 3 services, 2 for acquiring music and 1 for finding new music. For acquiring music, we are recommending Soundcloud and Bandcamp. Soundcloud is already used by WICN for acquiring music and should definitely continue to be used to do so. Their service will allow WICN to download music with the permission of artists to their library. BandCamp is an online music retailer that allows artists to directly market their music through their service. Artists are granted a microsite and allowed to set the prices on their own music, with BandCamp taking a percent seller's fee. Using music from their service is dependent on the individual artists, who can be directly contacted through their microsites. Bandcamp's service is an extremely good new source of music because it can not only be used as a way to find new sources of music but can also be used to get in contact with the artists. Another benefit is that WICN will be able to purchase and download the files immediately to their library.

For finding new music we are recommending Allmusic which is a music discovery service. To use the service, the user adds their music library/specific albums to the webpage and based on your taste it will recommend new music. The service also has a "discover" option which allows users to find new music

based on genre. The service is free but it also has a paid subscriber option that takes away ads. The service only shows new music to the user and does not allow for downloads. Allmusic would be a great way for WICN to find new music to supplement their library by having their DJs use it as a supplement for their personal libraries to therefore forward data to WICN archive digital library.

5.5. Future Directions

After this project WICN could go multiple ways for future projects. If they choose a method that does not use metadata, there is possibility for a project involving an app that can show information about the song currently playing. Another project could be creation of an automatic ripper that will run indefinitely, making other disc rippers obsolete and streamlining the process for future radio stations. At the earliest stages of the Modern Music Library Project team we discussed creating our own database software for WICN, but that would require its own IQP team to do so. Building from the information in this paper is also possible, with enough time it would be possible to write a paper outlining library conversion processes for not only WICN's music library but for any radio station's conversion from a physical library to a digital one. This information could even be added to a larger paper based on physical library conversion as well, due to the scarcity of papers outlining library conversion. Otherwise, WICN has all the information needed to make an informed decision regarding their own situation, and we wish them luck with their process.

Appendix

Appendix A: Emails

Appendix A.1: WICN DJs Survey Email

Dear WICN DJs,

We will be conducting a survey for you to evaluate your own abilities with music software. There will be two surveys, one now and one a month from now. This survey will only take 10 minutes and will allow for you to give us suggestions on what you would like to see in your new system.

Prior to the survey, we are a team of students from Worcester Polytechnic Institute who is currently working to (1) find better ways to digitize the radio physical discs library, and we plan also to (2) find a database that will give you more flexibility in your work.

Thank you and please make sure to get back as soon as possible!

Sincerely,

The Modern Music Library

Appendix A.2: Email Sent to Radio Stations - KEXP and KZMU

To whom it may concern,

We are a group of students from Worcester Polytechnic Institute (WPI). We are working on a project to research how radio stations manage the transition of their library from a physical medium to a database. Our project focuses on transitioning compact disks (CDs) to a computer database.

If you have gone through this process recently, we would appreciate it tremendously if you would be able to schedule some time for a phone interview with you regarding our project.

Sincerely,

The Modern Music Library Team

Appendix A.3: Email Sent to Radio Software Companies - Dalet and Broadcast Electronics

Dear _____,

We are a group of students who are doing consultation for our local radio station, WICN, to find the best fit for their software needs.

We have been researching software for a while now and ----------(software name) looks like it would be a great fit. We are just wondering how much it would cost. If you need more information please feel free to contact us at modernmusiclibrary@wpi.edu.

Thank you very much for your help!

Sincerely,

The Modern Music Library

Appendix B: Interview Protocol

Before an interview is conducted, a document is prepared which includes the name(s) of the person(s) being interviewed, the date and time of the interview, the place where the interview is to be held, and the method of communication (in person, over phone, Skype, etc.). A list of important questions and topics to be covered is to be formed and verified with the professor.

When conducting an interview, the interviewers start by introducing themselves and giving a brief overview of the project. They then request permission to use the contents of the interview in the paper and

to record the interview (when necessary). The interviews may be recorded via digital recorder and a secretary, this will be made known to the interviewee prior if it is decided to be necessary. Interviews are to be flexible, allowing the interviewee to present information they think are relevant and allowing the interviewers to use the premade topics to gather the information they were looking for going into the interview.

Here is the format interview applied:

Interviewee: [Name]

Date: [MM/DD/YY]

Time: [HH:MM]

Location: [Place]

Type: [Method]

<u>Questions and Topics:</u>

Questions for other Radio Stations

1. Have you updated your library from physical to digital?
    a. What was your physical library made up of?
        i. How large was your physical library?
    b. What process did you go through to convert?
1. Did you convert your entire library?
    a. What equipment did you use for the conversion?
    b. Does the process used only apply to your station?
    c. How long did it take to convert the first set of physical data into the new library?
    d. How did you handle storing metadata from the CDs

e. How much memory space does the digital library take up?

2. What database do you use to sort and store your information?
    a. Does your database interact with other programs?
3. How did your DJs handle the transition?
    a. Do they primarily use
        i. Digital Library
        ii. Physical CDs
        iii. Private Collection
        iv. Do they have any advice?
4. What do you use to supplement your collection?
    a. Did you look for missing tracks?
    b. Did you make your database available over the the internet?
5. Does it use a login system?
    a. Is it available publicly or just to your employees?

Notes/Minutes:

Appendix C: Interview Format Questions with WICN Staff

Appendix C1: Interview with the General Manager, Mr. Tom Lucci

WICN Preliminary Interview Questions

Time: 12-2 pm January 24

Location: WICN

Interview with: Tom Lucci

WICN:

1. Current workings
    1. How do they currently play music
    2. What's the process of saving data
2. Library
    1. How is the library currently organized?

Usage:

1. What should the DJ/Personnel be able to do with the library?
    1. How do the DJ's choose music (Tags)
2. What permissions do they have for the music they own? Distribution, etc.?

    I. license or copy of song they will need for their library
3. Do you want others to have access to your collection? Download songs?

Conversion Process:

4. Do they have a co-storage organization (local or out-state)
4. What equipment do they currently use?

    a) Do you have LP/Vinyl records? Tape records?

Set Up:

6. What functionality should the digital library have? (specify)
    1. What kind of information/schema do you want to store with a given song?
    2. What kind of file format do you want to use? (.wav, .mp3, .flac, no preference?)

Language Accommodations:

7. What language does WICN want the library to be wrote? (English, Spanish, English & Spanish)?

Appendix C2: Interview with Mr. Brian Barlow

Interviewee: Brian Barlow, Former General Manager, Current Host

Date: 02/21/17

Time: 12pm to 1:30 pm

Location: WICN

Type: Face to face

1. Describe Project as you see it and current progress

2. What is your goal for the project?

3. What would you like to see as a result?

3. How do you believe the process should be carried out?

4. As a host how would you like to see this project turn out?

5. What Ideas do you have for the future of WICN with this project?

6. Does WICN have other projects currently ongoing?

    1. What do you see as a potential follow up to this project?
    2. What will be useful in the future?

7. Could we have the contact information of the WICN technician/technical director?

Appendix D: Interview Format Questions with Radio Station - KEXP and KZMU

Interviewee:

Date:

Time:

Location:

Type: Phone / Face to face Interview

Recorded Permission: Yes / No

1. Have you updated your library from physical to digital?
    1. What was your physical library made up of?
        1. How large was your physical library?
    2. What process did you go through to convert?
        1. Did you convert your entire library?
        2. What equipment did you use for the conversion?
        3. Does the process used only apply to your station?
        4. How long did it take to convert the first set of physical data into the new library?
        5. How did you handle storing metadata from the CDs
    2. How much memory space does the digital library take up?
2. What database do you use to sort and store your information?
    1. Does your database interact with other programs?
2. How did your DJs handle the transition?
    1. Do they primarily use
        1. Digital Library
        2. Physical CDs

3. Private Collection

2. Do they have any advice?

2. What do you use to find missing tracks from your collection?

3. Did you make your database available over the the internet?

    1. Does it use a login system?

    2. Is it available publicly or just to your employees?

Appendix E : WICN DJs Questions Survey

Q1 What is your name?

Q2 Have you used any of these music services before?

Spotify (1)

Itunes (2)

Deezer (3)

SoundCloud (4)

Other... (5) _____

Q3 Have you used any of these DJ softwares before?

Audacy (1)

Zulu (2)

AudioVault (3)

Serato DJ (4)

Tracktor Pro (5)

Virtual DJ (6)

Dalet (7)

PlayoutONE (8)

SAM Broadcaster Pro (9)

Other... (10) _____

Q4 If you have used DJ software before, list the one that you feel the most confident using.

Q5 On a scale from 1- 10 how capable do you feel with music software?

m 1 (1)

m 2 (2)

m 3 (3)

m 4 (4)

m 5 (5)

m 6 (6)

m 7 (7)

m 8 (8)

m 9 (9)

m 10 (10)

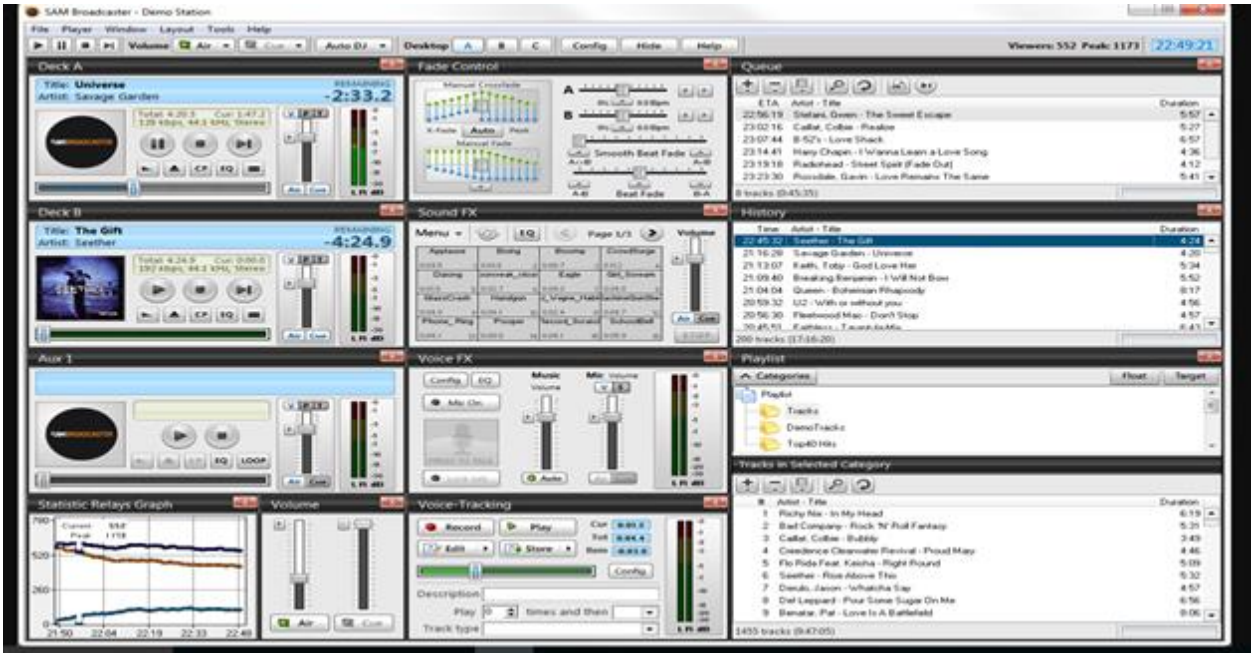
Q6 What are features that you would like to see in the new system? (examples: list of music stored by the last DJ in the interface page, a shortcut to an element you like the most to use,etc..)

Q8 What are your top 15 CDs currently in the WICN library (this is only a minimum, please list as many CDs as you like)

Q8-1


PlayoutONE
REQUEST SONG NOW 2
SWEEPER
Requiem
London Boys
Life in a Northern Town
Dream Academy

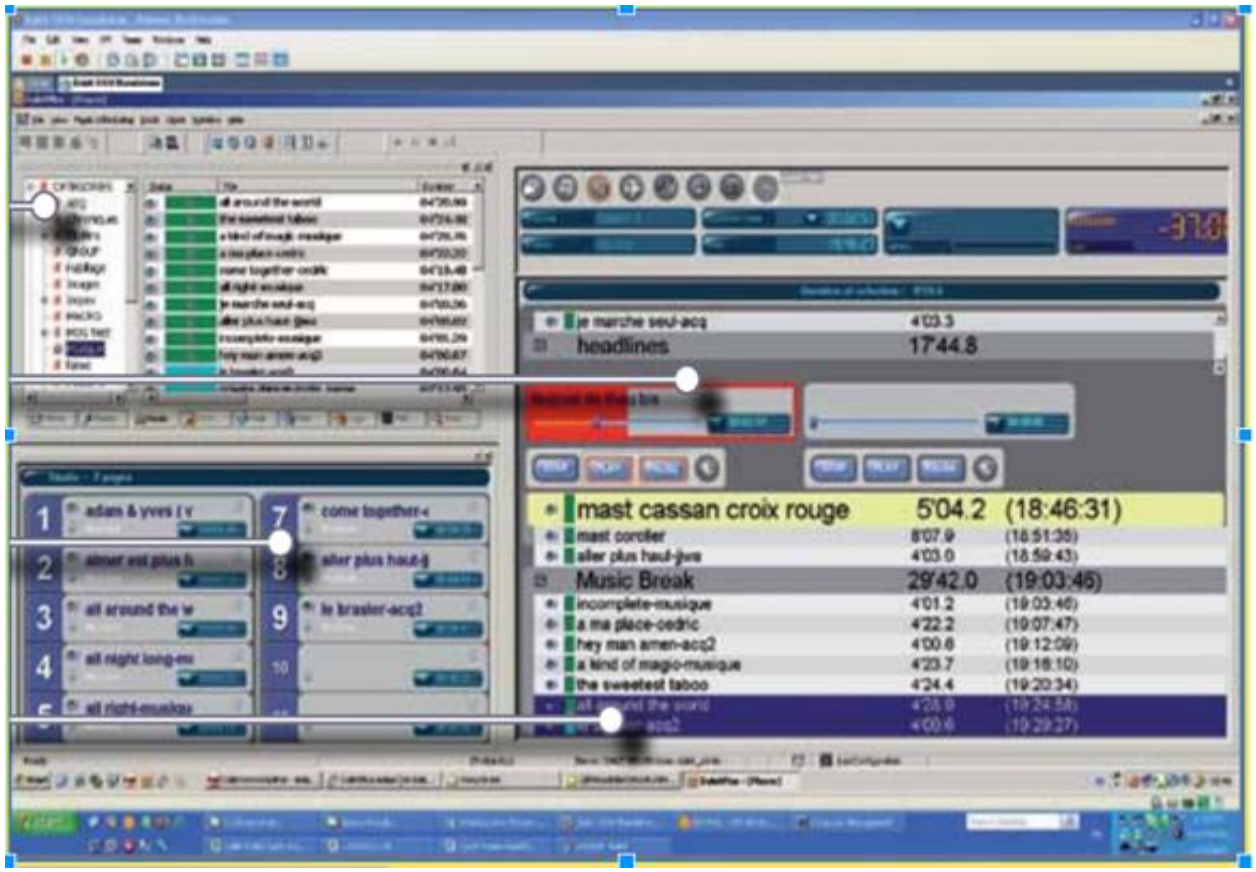
Q8-2



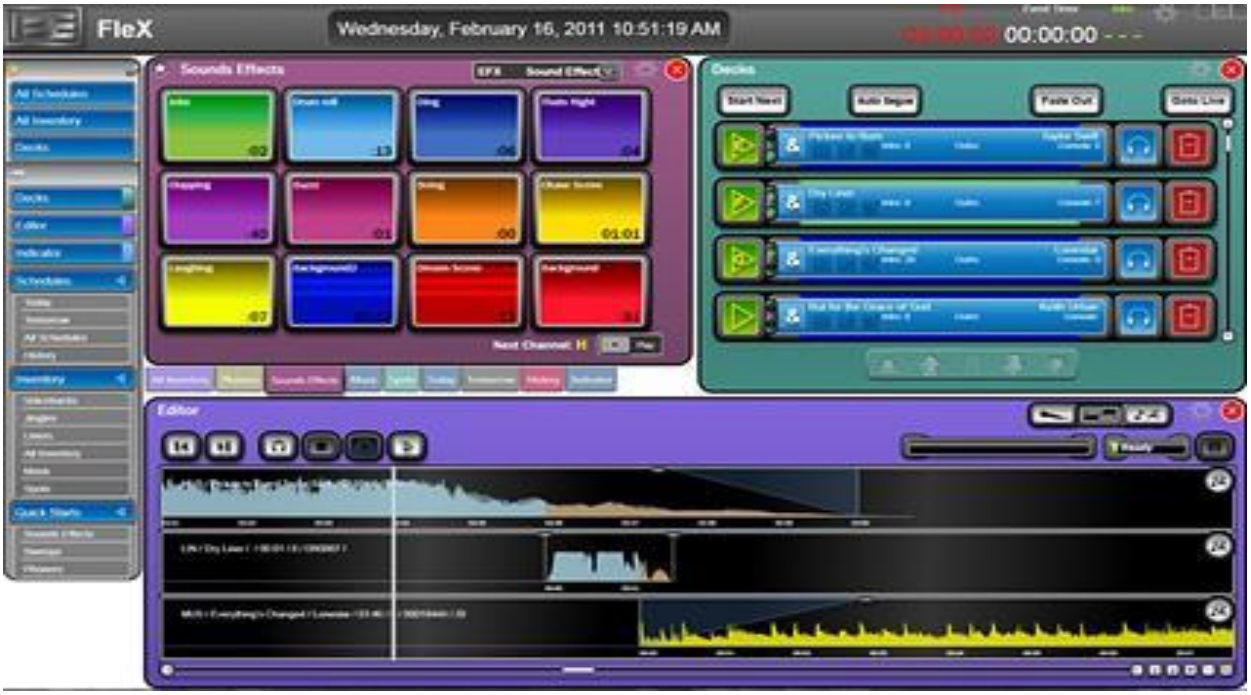
Q8-3


VIRTUAL DJ
Ain't A Party Without Nirvana
Used to know Metropolis

Q8-4


headlines
mast cassan croix rouge
Music Break

Q8-5



Q9 How comfortable would you feel using each of these user interfaces?

0_____ 100 Playout One (1)

0_____ 100 SAM Broadcaster (2)

0_____ 100 Virtual DJ Version 8 (3)

0_____ 100 Dalet (4)

0_____ 100 AudioVault Flex (5)

Appendix F: PAL Script Screenshot Instructions written by Spinitron to Interact with Sam Broadcaster Pro

Instructions

Configure the script so that it works for your station (follow the instructions in the script's comments) and save the file somewhere on the SAM computer as Spinitron.pal.

Feel free to adapt this to your situation and needs but, to maintain compatibility with Spinitron, please observe the comments indicating what not to modify.

Then, in SAM, locate the PAL Scripts window and click the **+** button in its tool bar. SAM asks you to locate the script file—do that and press OK.

To start/stop the script: click to select it and use the triangle/square buttons in the tool bar. The fourth icon from the left in the tool bar opens the built-in script editor and debugger.

You can configure the script to work in either full automation or live assist mode (see Section 3.2) with the pm constant. If you need to switch between modes on one computer you can, at the very least, have two PAL scripts, one that logs songs with pm=0 and the other with pm=2. Be careful to only run one at a time. But, with more sophisticated PAL programming, you may be able t find a much nicer solution.

License

Retrieved from: https://bitbucket.org/spinitron/sam-broadcaster/src

Appendix G: Core Group of Discs

See External Document

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