Music Identification Software as a tool for precise monitoring of real music use in public spaces and fair distribution of music rights income

Working paper

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Abstract

The aim of this paper is to examine whether music identification software available on the market can be used for automatic, precise and cost-effective music usage monitoring and reporting. CRMOs in EU have to satisfy cultural needs by fair distribution of income to content creators, increasing efficiency of their operations by adapting to market demands. We argue that it is possible to meet both requirements using available technology. Our experiments proved that DJ Monitor technology can be used for monitoring of music consumption. We propose a generic model of music monitoring system.

Keywords: music collective rights management, viable system model, music identification software, music information retrieval, transaction cost theory, information behaviour

Introduction

Two important trends can be observed in today's music industry. One of these trends refers to the development of information technology that is used to process information according to the demands of the music industry. Hence, music recommendation algorithms (Celma, 2010), music identification software (Haitsma & Kalker, 2003) and web services (Knowles, 2007) all serve the emerging needs of the music industry in the information age. The second important trend refers to the diversification of incomes. Several authors warned about this trend (Frost, 2007, Myers & Howard, 2009, Thomson, 2013) that covers streaming services income, copyrights income and live performance income. The main objective of this research is to investigate the relationship between these trends and their mutual influence from the perspective of system thinking. Precisely speaking, the main research question is: can a music identification software be used to improve transparency of music copyrights income distribution?

Today we evidence the EU discussion on the role of the Collective Rights Management Organisations (CRMOs). The perspective of the cultural function of CRMOs was discussed questioning the likelihood of protection of cultural diversity through copyright law (Dietz, 2014). The important aspects of European copyright directives that relate to the development of creativity and culture are being assessed, pointing out the positive attitudes of European legislators towards the promotion of culture and creativity as well as cultural diversity via copyright law. According to EU legislators, copyright and related rights are crucial for intellectual creation. Therefore, authors or performers have to receive the appropriate reward for the use of their work to continue such work. Since collected and distributed resources safeguard the independence and dignity of artistic creators and performers, the rigorous and effective system for the protection of copyright and related rights is needed to ensure European cultural creativity and production.

The another perspective of EU CRMOs (Guibault & Gompel, 2012), points out that multi-territorial licensing of (online) music currently represents the most pressing issue at the European level. The authors emphasize the need for a coherent system of collective rights management as a whole. To improve the flow of cross-border licensing of copyright-protected works, the authors suggest the liberalization of market for collective management of rights for right owners and users. Hence, we evidence two different perspectives, one emphasizing the cultural function of CRMOs and another suggesting liberalisation of the CRMOs market. Both perspectives assume the existence of a system, which is rigorous, effective and coherent.

In this paper, we would like to define the complex system underlying EU CRMOs, content owners and users of copyrighted material, including promoters of music events and public space owners. This complex system is not deterministic, predictable nor mechanistic system, but rather a process-dependent organic one with feedbacks on multiple scales that allow this system to self-organize. Such a complex adoptive system consists of heterogeneous collections of individual agents that interact locally, and evolve in their genetics, behaviors, or spatial distributions based on the outcome of those interactions (Folke, 2006: 257). There are six properties of complex adaptive economic systems; dispersed interaction, the absence of a global controller, cross-cutting hierarchical organization, continual adaptation, perpetual novelty, and far-from-equilibrium dynamics (Arthur et al. 1997, recited from Folke, 2006: 257).

If we have 150,000 ([1]) electronic music events, we evidence dispersed interaction among public space owners, music event promoters, performers, DJs and content right owners, with no global

[1] the number was obtained from direct communication with Nick Sabine, founder and CEO of Residentadvisor.net, leading global online media covering electronic music and its based on the number of events published on their web site.

controller of such interaction or established hierarchy. Such system is in continuous adoption according to music performed by different performers/DJs and promoted by different promoters. The music novelty represents the competitive advantage and such system is far from equilibrium. Also, such properties are recursive on the town level, country level and continent level or globally.

The role of CRMOs (as proposed in two papers cited above) is to fulfil the cultural role in the society, distributing the collected money to creators of the cultural content, providing them with resources to maintain their cultural work. Their duty is also to be efficient on the EU level, providing the legal infrastructure for managing music rights.

Analysing such complex adoptive systems, two system behaviours can be identified: one relates to efficiency and the other to the resilience of the system. Discussing resilience and efficiency, there is *alert to exhibit caution when it comes to maximizing efficiencies (*Ulanowicz, 2009: 34). *Systems can become too efficient for their own good*. If CRMOs are being regulated by market efficiency, their cultural function could be threatened. Furthermore, resilience can be interpreted as a) the amount of disturbance a system can absorb and still remain within the same state or domain of attraction, b) the degree to which the system is capable of self- organization (versus lack of organization, or organization forced by external factors), and c) the degree to which the system can build and increase the capacity for learning and adaptation (Folke, 2006: 259). If we put it in context of CRMOs, the question is for how long the system will attract content owners to manage their music content if it is not aligned with possibilities of technology development. The self-organization of CRMOs according to such technological developments (and not by external factors) also represents an issue. The final question is how CRMOs will and how they could increase their capacity of processing information about music consumption measurement.

We argue that using available technology CRMOs could increase their efficiency and resilience at the same time. In order to regulate efficiency, they will not be left to external forces provided by the market, but will grow their capacity to respond to the new environment they operate in.

The motivation for this research came from our earlier research on Shazam technology where the small scale experiment tested if music could be measured with Shazam technology and if such technology could be used for measurement of music consumption. We also examined if the data collected by this technology can be used for the income distribution of music used in nightclubs. During that experiment we found another technology owned by company DJ Monitor, designed exactly for measuring music consumption in the public spaces.

Each year there are approximately 150,000 global musical events. If each event lasts for 8 hours and if DJ performs 10 songs per hour, we can conclude that around 12,000,000 songs are being performed annually in public. By copyright law, all these events are supposed to pay performance rights to CMROs, but it is not economical to manually record each song played on each event. The development of music identification software, on the other hand, allows for technology that supports the precise measurement of music consumption in public spaces.

The primary hypothesis of our research is that music identification software (MIS) could be used to recognise music in public spaces. The second hypothesis is that collected information could be used in the music system and bring benefit for most of the stakeholders. The following questions will be answered in this paper: Which MIS could be used? How do they work? How precise they are? What are the procedures of their successful implementation? How does information flow through the system and what are the effects of such new patterns of information flow?

The paper is organised as follows: in the next part we give the brief overview of music identification software, the theoretical background of market organisation and transaction cost theory. Then, the results of the experiment will be presented, comparing the Shazam and DJ Monitor technology. In the discussion part we present the generic model of the music information flow in CRMO stakeholders' ecosystem, concluding by listing implications of the implementation of such new technology into CRMOs operations.

Music Identification Software

The development of smart phones and wireless Internet in the last decade significantly increased the research interest in the field of Music Information Retrieval (MIR), since users started to frequently use available technology to discover, share and buy music. Also, along with the growing interest in MIR researcher, grew the number of music identification applications, which identify unknown songs users hear on the radio, link users to related services such as online music stores, concert ticket vendors and artist merchandise, offering users the possibility to interact with social networks sharing identified content (i.e. newly discovered music). Apart from showing the user related song metadata such as artist name, song title, album name, lyrics and artist biographies, such applications claim to engage users more deeply with what they are listening to.

To identify music, applications are using audio fingerprinting, which is defined as: *"The prime objective of multimedia fingerprinting is an efficient mechanism to establish the perceptual equality of two multimedia objects: not by comparing the (typically large) objects themselves, but by comparing the associated fingerprints (small by design)... the fingerprints of a large number of multimedia objects, along with their associated metadata (e.g. name of artist, title and album) are stored in a database. The fingerprints serve as an index to the metadata. The metadata of* *unidentified multimedia content are then retrieved by computing a fingerprint and using this as a query in the fingerprint/meta-data database.“(*Haitsma & Kalker, 2002: 107)

In system design, such an approach where actual music files in the database are being replaced by audio fingerprint files, reduces system memory and storage requirements, streamlines communication between the central database and devices (such as smartphones) and increases speed of the search process. As more and more music is created, there is a constant need to develop technology that will help us manage large music collections, which are also distributed to a number of markets in various media formats, from vinyl to digital audio streaming on mobile phones.

There are different strategies to approach this relatively new scientific field. There are two major possible ways to manage such a big amount of content: one is by using textual meta-data, while the other one implies content based search (Rhodes & Rauchas, 2009:51). The problem with the metadata is that its creation could be extremely time consuming and expensive and to enter metadata for one million songs could take approximately 50 person-years. The content-based MIR could be divided to: high-specificity systems that match instances of audio signal content, mid-specificity systems that match high-level music features, such as melody, but do not match audio content and low-specificity systems that match global (statistical) properties of the query (Casey et al., 2008: 670).

In the context of Music Information Retrieval, the concept of specificity denotes how discriminating a particular task is, or how clear is the dividing line between relevant and irrelevant retrieval results (Müller, 2007, Witten et al. 1999). In other words, specificity determines the amount of acoustic and musical material in a retrieved result that needs to be shared with a query for a result to be considered relevant and the number of documents in total that could be considered relevant retrieval results. Music identification, which is the topic of this paper, is defined as a highest possible specificity.

The aim of the research presented here is to evaluate the precision of the available technology to recognise music in the nightclubs. In our previous research we examined the Shazam technology. During that research, we discovered another technology owned by company called DJ Monitor from Amsterdam, Netherlands. DJ Monitor's technology is currently patent pending, so we are not able to present technical details in this paper. Though, the main difference between DJ Monitor and Shazam is in the way they communicate generated fingerprint with the central database. DJ Monitor processes audio signal directly to the system by audio cable, while Shazam uses mobile phone technology and sends fingerprint wirelessly to the system. The comparison of the result of both technologies shows that DJ Monitor proved to be the professional system designed to fulfil the task of music recognition for the purpose of the music rights payment, while Shazam aims toward end users and their basic needs. The first experiment with Shazam technology was maintained in two different environments: the first one being a nightclub and the other one being home studio environment. The second experiment with DJ Monitor was done in the DJ Monitor office, where the same set of songs was played to the system in the same way as previously (in the Shazam experiment) in the home studio environment. The only difference was that music in the Shazam experiment was played wirelessly, while in the experiment with DJ Monitor it was played through audio cable.

Shazam was founded in 1999 by Chris Barton, Philip Inghelbrecht, Avery Wang and Dhiraj Mukherjee [Wikipedia, Retrieved September 13, 2013). It became one of the top 10 downloaded applications for iPhone (Woodward, 2000). Shazam is a music identification application which gathers a brief sample of music being played (on a mobile phone or some other device), creates an acoustic fingerprint (a time-frequency graph called spectrogram) based on that sample and searches a central database of songs for a match. If the retrieval result is positive, Shazam provides the user with information such as artist, album, title, genre, music label, lyrics, a thumbnail image of the song/album artwork and links to download the song on iTunes or the Amazon store. Also, where relevant, Shazam shows the song's video on YouTube and gives the option of playing the specific song on Spotify. The application can identify pre-recorded music being broadcast from any source, such as a radio, television, cinema or club, provided that the background noise level is not high enough to prevent an acoustic fingerprint being taken, and that the song is present in its central database. Shazam has 70 million active users every month and in just one year (2012) it generated $300 million in digital sales, primarily through iTunes. It also has approximately 35 million of songs in its database (Dotted Music, 2013). Basic design of Shazam music identification system is presented in Figure 1.

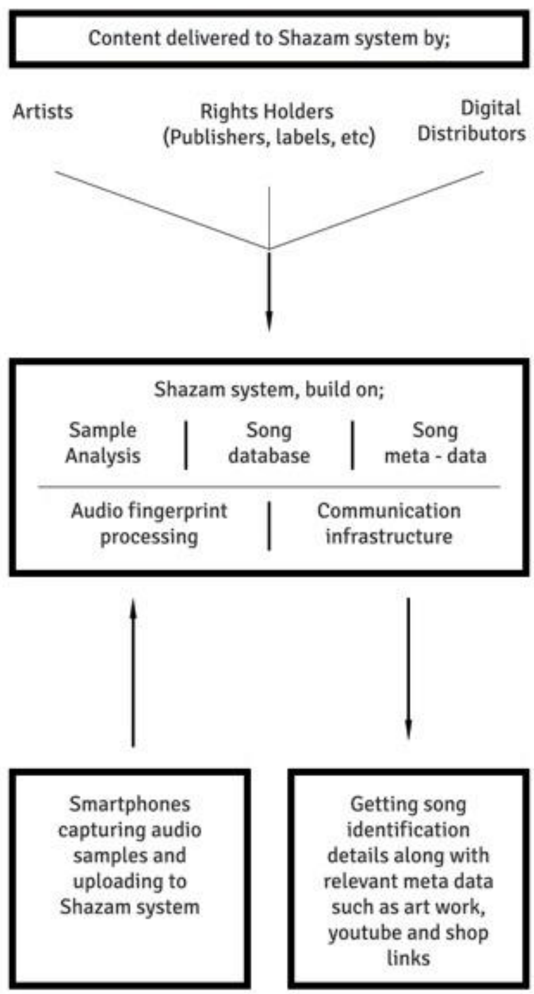

Figure 1. Shazam music identification system

Since 2005 DJ Monitor actively monitors music events and venues, having developed technology which records, streams and recognizes music using advanced audio fingerprinting software and extensive online music database. DJ Monitor has become a trusted source of reporting on music usage to music users and right owners: some CRMOs already base their remuneration on their playlist reports. To promote the total transparency, DJ Monitor has developed a Playlist

Management System (PMS) where right owners can listen the performed music, verify the results and make claims of no names. Only in 2013 they monitored more than 100 global music events. DJ Monitor takes the proactive role in promoting transparency of music consumption usage among content owners, CRMOs and event organisers ([2], djmonitor.com)

The process of song database update and monitoring is presented in Figure 2

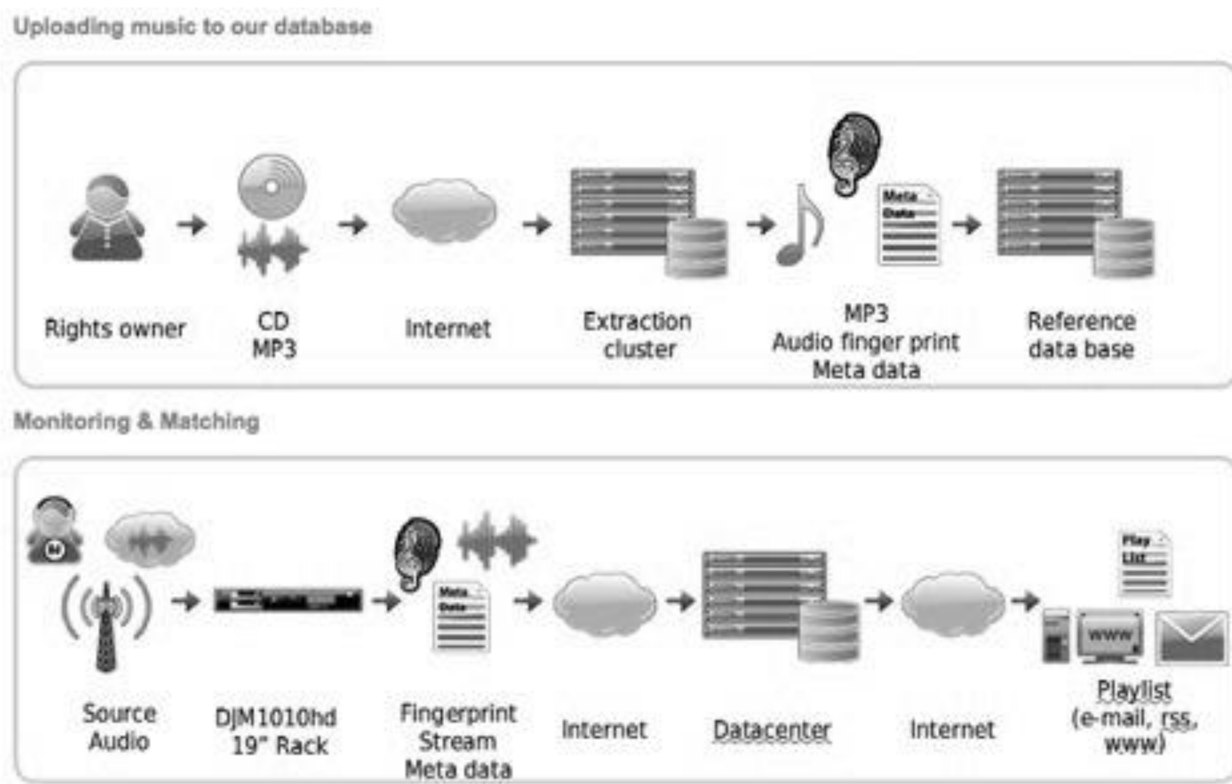

Figure 2. DJ Monitor music identification system

Transaction cost Theory and Music Industry

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[2] http://www.djmonitor.com , retrived 28.08.2014.

*"As an owner of an information good, you should ask yourself: is it cheaper for me to distribute my products directly to the end user or is it cheaper for the organization to distribute my product to the end user" (*Shapiro & Varian, 1998*:*101). These authors suggest that an organization and an owner who share gains of system's effectiveness might be able to reach a bargain. Such gains and advantages are based on the Transaction Cost theory, probably one of the most significant theories related to the information age. The cost of the transaction regulates the size of companies: if outsourcing a service represents a cheaper alternative, then there is no reason to do the transaction in the company (Coase, 1937). In terms of collecting music rights royalties, it would be expensive if every copyright owner tries to issue an invoice for use of its copyrighted property to every party using it. This is the basic economic reason why music authors' collecting societies emerged in the last century and are active on the music market. But this is still far from perfect, as sometimes transaction cost related to royalties tend to be significant. One example evidencing high transaction cost in music industry is Beatles Capitol/EMI case. *"An audit revealed more than 20 separate areas where Capitol/EMI had "wrongfully accounted" for costs or revenue concerning promotion, manufacture and sales, resulting in $19 million of unpaid royalties due the Beatles from 1969-1979*" (Connolly & Krueger, 2006 :705). But, as Ronald Coase proposed in his lecture, scientists aren't receptive to proposals for change in their subject unless they are dissatisfied with the old views (Coase, 2002). Reflecting on that statement, we recognize an emerging need to make information sciences (i.e. music information retrieval) and economy working closely together, as both fields deal with a system and ways information is communicated through that system creating the fundaments for money distribution. Before we distribute the money we have to distribute information through the system, and more precise information will generate the more fair

distribution of income. We could assume that information technology was not well developed at the end of the 20th century, but today we should ask ourselves if technology can actually help businesses to become better organised by providing infrastructure for the information flow.

If we take a closer look to the income of the top-ranked rock performer in 2002 (Paul McCartney), we can discover that he received $64.9 million from live concerts, $2.2 million from recording sales and $2.2 million from copyright royalties (La Franco, 2003). The figures reveal that he received the same amount of money from copyright royalties as from record sales. Furthermore, according to the ratio extracted from International Survey of Music Publishing Revenues in 2001, 23.6 % of the revenues from performance based music publishing income in the U.S. came from live performance (published in Connolly and Krueger, 2006). The sum of the publishing income in top 10 countries of the world reached 2,619.05 million of US dollars in 2001 only. Based on the proposed ratio, if we calculate the amount of the revenues that were collected from live performances (e.g. concert venues or other public spaces), we come up to 618.09 million of US dollars in top ten countries in the world (published in Connolly and Krueger, 2006: table 8.3).

The musicians (in the research sample) earned 12% of revenue from sources directly related to copyright, 10% from sources with a mixed relationship to copyright, and 78% from sources indirectly related or unrelated to copyright. Looking at the subgroup of composers in the top income bracket, 68% of their revenue directly relates to copyright, 17% has a mixed relationship, and 15% is indirectly related or unrelated (DiCola, 2013:305) to copyright. Similar findings are presented in (Kretschmer, 2005) showing that in UK in 1994 only 1.96% of copyright owners made more than 20,000 GBP annually, while in the same time in Germany 3% of copyright owners made more than 25,000 GBP annually. Both researches indicate that only small number of the musicians make significant income from the copyright. We argue that such weak distribution of income to the small number of top performing artist is due to the ineffectiveness of information technology systems used by CRMOs. As we already mentioned, currently there is no economic feasibility in manual recording of each song performed in each of 150,000 global electronic music events each year. Also, money collected in that events is (in most cases) not distributed according to performance but rather according to distribution models that are not transparent and standardised across different CRMOs. This research does not aim to offer a detailed economic analysis or guidelines for the development of the methodology for income distribution. It rather aims to question MIR technology, music recognition in particular and the potential to improve transparency and decrease the collection costs of data on music usage.

The results presented here are only a small scale preliminary findings, trying to answer the following question: could the technology that is available today (more precisely: Shazam or DJ Monitor) improve monitoring of the songs used in the night club environment?

In other words, the aim of our research was to discover whether the technology can help to reduce transaction costs and improve efficiency and transparency of CRMOs. For any organisation, including the CRMOs, it is necessary to continuously develop its information systems, with the basic aim to drive down the transaction cost. Apart from the decrease of the transaction cost, an organisation should satisfy information needs of all its stakeholders. Such process is sustainable only if it satisfies all actors involved (Mota et al., 2006:49), including ones who control the process (CRMOs), users of music in public spaces who pay for the use, and artists for whom the money is being collected. Each stakeholder is able to observe the process and would like to maximize the value from the different perspective. CRMOs would like to have more cost effective reporting, end users would like to pay less for the music they use and artists would like to get more money and information where and when their music was used.

This is possible if transaction costs are decreased and more money is left for distribution in the system. In order to obtain a holistic view on the business process, it is necessary to develop the evaluation matrix that includes perspectives of different stakeholders matched by perspectives of relevant performance indicators. With the development of the new state-of-the-art technologies, such as music information retrieval and identification, outsourcing became an option that should be considered.

The advantages of outsourcing are: production efficiency (focus on "what" instead of "how") and market mechanism that helps to get most of the value for money so that the organisation using it can focus on the core business and efficiency. Disadvantages are related to cost of describing and enforcing performance and changes, to exposition to the opportunistic bidding and losing expertise that could be useful in the future (Culik & Popesko, 2012). At the same time, better and more transparent information circulating in the system will increase resilience of the system, enabling it to self organise and adopt to changes in environment, to become attractive as a service to copyright owners. If the organisation decides to outsource its operations, it should focus on contracting.
According to the analysis, organisations claim that the hardest parts in contract management are related to the alignment of the project with timeline and scope, price negotiation and dynamics of payments, penalty calculation, service level definition, meeting legal advisor requirements and actually implementing what is written in the contract (Syaripah Ruzaini et al., 2009).

We are considering outsourcing as a better option, since music identification systems available on the market could provide CRMOs with instant access to technology that captures data in real time and distributes it through the whole system providing users with an integrated and relevant information view.

Experiment

The initial idea behind our first experiment was quite simple: we aimed to analyse how precise Shazam application is in recognising the songs played in nightclubs (Lugović & Mikelić Preradović, 2014). During that research we discovered new technology available on the market – DJ Monitor and decided to compare results with Shazam technology.

In our first (Shazam) experiment, each song was tagged in two different environments. Shazam created two different audio fingerprints for each song based on some of the anchors of the simplified spectrogram and the target area between them. While we were trying to perform the experiment in the night club environment (the first experiment), one examiner was standing next to DJ, taking notes of the songs he played, while the other examiner was on the dance floor holding two different smart phones: Galaxy1, and iPhone5 (both having Shazam installed) clicking the Shazam “listening button“ and recording tags in "My Tags" list. Galaxy1 used Blue version of Shazam application, while the version installed on the iPhone was Red Version. After nightclub part of experiment, the playlist was transferred to the spread sheet and links to music were found on the internet for the comparison in the home studio environment. Examiners have also taken notes on all different songs that Shazam retrieved as a result of a query. It is important to point out that DJ in the club was asked to play music that is already available on the market. He was specifically asked not to play new music, some demos or promotional copies of songs that are not yet published. Sound system that was used in the club was: Electro Voice 2 x MTL2 Subs, 4 x

Funktion one res 4 flying from truss, 2 x Funktion F18 monitors. The experiment was performed on a 5 meter distance from the sound system. In the home studio, the experiment involved MacBook (MacBook 7.1, Intel Core 2 Duo, 2.4 GHz) and speakers that were installed on that computer. The songs were played and analysed from MacBook.

The second experiment, in which DJ Monitor technology was tested, used the same data set from the first experiment and links were played to the DJ Monitor system. The experiment was conducted in the DJ Monitor office where laptop was connected to the DJ Monitor system, playing the songs from same data set used in the Shazam experiment, and time needed to recognise each song was measured. The difference was in the design of the technology, as DJ Monitor technology needs to have cable connection to the system. In this way, noise is reduced to almost zero, neutralising difference in nightclub environment, home studio or office. As we stated before, this is one of the major difference between these two technologies, as they are designed for different purposes (Shazam for the end user, DJ Monitor for the professional recognition).

Below are results of the comparison of two experiments.

Percentage of songs recognised by Shazam on Galaxy in the club environment	5.00%
Percentage of songs recognised by Shazam on iPhone in the club environment	45.00%
Percentage of songs recognised by DJ Monitor system in the club environment	NA

Table 1. Music recognition results for iPhone5 and Galaxy1 in the public place

Percentage of songs recognised by Shazam on Galaxy in the home studio environment	70.00%
Percentage of songs recognised by Shazam on iPhone in the home studio environment	75.00%
Percentage of songs recognised by DJ Monitor system in the office environment	90.47%

Table 2. Music recognition results for Shazam (iPhone5 and Galaxy1) and DJ Monitor in the home studio/office

The above listed tables (Table 1 and Table 2) present the result of our experiments with Shazam and DJ Monitor technology. These tables show the percentage of songs from the same playlist recognized in two different environments (night club and home studio) by two different mobile devices (smartphone Galaxy1 and iPhone5) and by DJ Monitor technology in the office environment. In the second experiment, DJ Monitor used the same data set in the office environment. We did not obtain the differences between results in the nightclub environment and the office since it was not possible to re-create the same DJ set in real environment and since DJ Monitor uses direct audio in signal connection to the music recognition system. We assume that such experiment would show no difference, as there is no signal to noise ratio. Although Shazam managed to recognize more than 70% of songs in the home studio environment, as a result of some queries it firstly offered one or more songs that weren't on the playlist, before recognizing the right one. DJ Monitor recognised all songs instantly, providing the evidence for the more accurate technology.

Galaxy in Home Studio Environment (accuracy)	28,57%
iPhone in Home Studio Environment (accuracy)	57.14%
DJ Monitor office environment (accuracy)	91.5%

Table 3. The accuracy of song recognition

	Total time	Average per song
Galaxy in Home Studio Environment (14 songs in total recognised)	18:22:00	1:18:00
iPhone in Home Studio Environment (15 songs in total recognised)	7:43:00	0:30:00
DJ Monitor office environment (19 songs in total recognised)	1:59:00	0:6:00

Table 4. The total time Shazam and DJ Monitor needed to accurately recognise all songs and average time per song recognised

Table 3 reveals the percentage of songs that were accurately recognized in the first run. Table 4 shows the total time needed to recognize the song for songs the applications managed to recognize. Furthermore, a detailed playlist and the summary of the research results of our experiment are given in the Table 5. Table 5 provides the information on Artist, Song and whether the song was recognized by Galaxy smartphone (G) or iPhone (I) in the night club or at the home studio environment (0= not recognized; 1 = recognized) for Shazam technology and whether it is recognised by DJ Monitor technology (as well as time needed for the recognition).

		Night club		Home		Home studio recognition time - Shazam		Recognition (Y for recognised, N for not recognised)	Recognition time DJ Monitor
Artists	Track	G	I	G	I	G	I		
Fresh and Low	No Going Back	0	0	1	1	1:30	1:20	Y	0:09
Ivano Tetelepta	Smokin G	0	0	1	1	4:24	1:41	N	NA
Kelvin K	Ancestral Moon	0	0	1	1	0:24	0:18	Y	0:08
Ark	Nuark	0	0	0	0	NA	NA	Y	0:01
Terrry Lee Brown Jr	Our Rhythm	0	0	0	0	NA	NA	Y	0:29
Highland Brothers Inc.	This One's A Keeper	1	1	1	1	0:48	0:14	Y	0:02
MP	The Domm	0	0	0	0			Y	0:02
Timewriter	Love Trap	0	1	1	1	3:37	0:13	Y	0:05
Kelvin K	G'groove	0	1	1	1	1:13	0:34	Y	0:17
Basement Jaxx	Fly Life	0	1	1	1	1:29	0:12	Y	0:06
Point G	Braka	0	0	0	0	NA	NA	Y	0:06
J.C.	Differential	0	0	0	0	NA	NA	N	NA
Cevin Fisher	The Way We Used To	0	1	1	1	0:35	0:28	Y	0:18
E.B.E.	Werked	0	1	1	1	1:43	0:27	Y	0:01
Van Basten	Blood wars	0	0	0	0	NA	NA	Y	0:02
Sasse	Soulsounds	0	1	1	1	0:44	0:30	Y	0:03
DJ Vasile	Nu vrei sa mergi?	0	0	0	0	NA	NA	Y	0:05
Atom	Love To Heart (Too Hot)	0	0	1	1	0:20	0:24	Y	0:05
Scoper And Bubba	I’m Satisfied	0	1	1	1	2:39	0:15	Y	0:04

Birdsmaking machine	Black Pearl	0	1	1	1	1:12	0:19	Y	0:05
Caucasian Boy	Northern Lighst	0	0	1	1	1:04	0:24	Y	0:05

Table 5. The playlist and the results for each song ([3])

Discussion

The result from experiments presented in the previous parts of the paper represent evidence for our first hypothesis that MIS could be used to recognise music in public spaces. While Shazam technology was not designed for the purpose of music consumption reporting to CRMOs, DJ Monitor technology was and it is used for that purpose. Based on the interview with Yuri Dokter, founder and CEO of DJ Monitor, some EU CRMOs, in particular BUMA/STERMA ([4]), already support the use of MIS technologies and are proactive in promoting its usage. According to Yuri, there is an EU-wide ongoing discussion with CRMOs and EU commission, including Vice President Neelie Kroes ([5]), and there is awareness of the importance of transparency in music consumption reporting. To achieve better impact and represent wider stakeholders, Yuri and his colleagues (Featured Artists Coalition from UK, Technopol from France and C3S from Germany) act through the Younison, (*Platform of Music Artists who demands European legislation to create proper governance and representation while enforcing precise, regular and transparent redistribution of all revenues collected on their behalf by European authors' societies).([6])*

[3] I = iPhone5, G= Galaxy1, 1=recognised, 0=not recognised

[4] DJ Monitor and BUMA/STERMA are aleready working together ensuring transparency in music cunsumption reporting, while with some another EU agencies there is already collaboration established or negotiations are in the process. As those are business critical information at this stage we mention only BUMA/STERMA

[5] http://www.djmonitor.com/dj-monitor-meets-in-eu-parliament/

[6] http://www.younison.eu

Currently there is awareness of difficulties in data exchange between different CRMOs in EU, but there exist motivation to improve both, data exchange and transparency, while the dialogue between CRMOs and stakeholders has already started (see [7] or [8]).

Yuri stated that the more high-income artists speak openly about transparency and exact reporting on music consumption, the more CRMOs get interested.

To make economy of scale work, Yuri and his colleagues are putting extreme effort to decrease the cost of the monitoring system and equipment. It demands additional R&D, but cost are (or could) be reduced by better algorithms, making systems perform faster on cheaper hardware on the user side (as a black box for monitoring) and on the back end side (lighter HW to process data collected). The optimal business model is not yet defined, but according to Yuri, the aim of his company is to make their system feasible for every possible user, from small bar to big festivals (currently, the price of the system is between 200-400 euros, depending on the applications, but DJ Monitor also does the measurement activities as a service). At this stage, clubs are still questioning what is there for them, as they are operating legally paying flat fees. Also, there are some explorations of cost shares between CRMOs, DJ Monitor and event organisers, since the end result of increased transparency (the reduced cost) ultimately benefits all stakeholders. As Yuri pointed out, the more right holders speak up, the more interest in transparency of reporting will be in the whole eco system, leading to increased economy of scale.

[7] http://www.exberliner.com/features/lifestyle/gema-over/

[8] http://www.musikmarkt.de/Aktuell/News/LiveKomm-ueber-GEMA-Tarife-Es-wird-teurer

Apart from being used by CRMOs for the reporting purpose, we evidence the use of SHAZAM (see [9]) and DJ Monitor (see [10]) popularity playlists by industry's stakeholders. In order to answer the last two of our research questions, which are related to the information flow through the copyright eco-system and how new information patterns could be generated, we used applied system modelling technique to construct generic model of information behaviour in such system, addressing different stakeholders (Figure 3).

[9] http://www.mixmag.net/music/the-blog/top-ten-most-shazamed-tracks-in-ibiza
[10] http://www.djmonitor.com/dj-monitor-launches-live-chart-hard-chart/

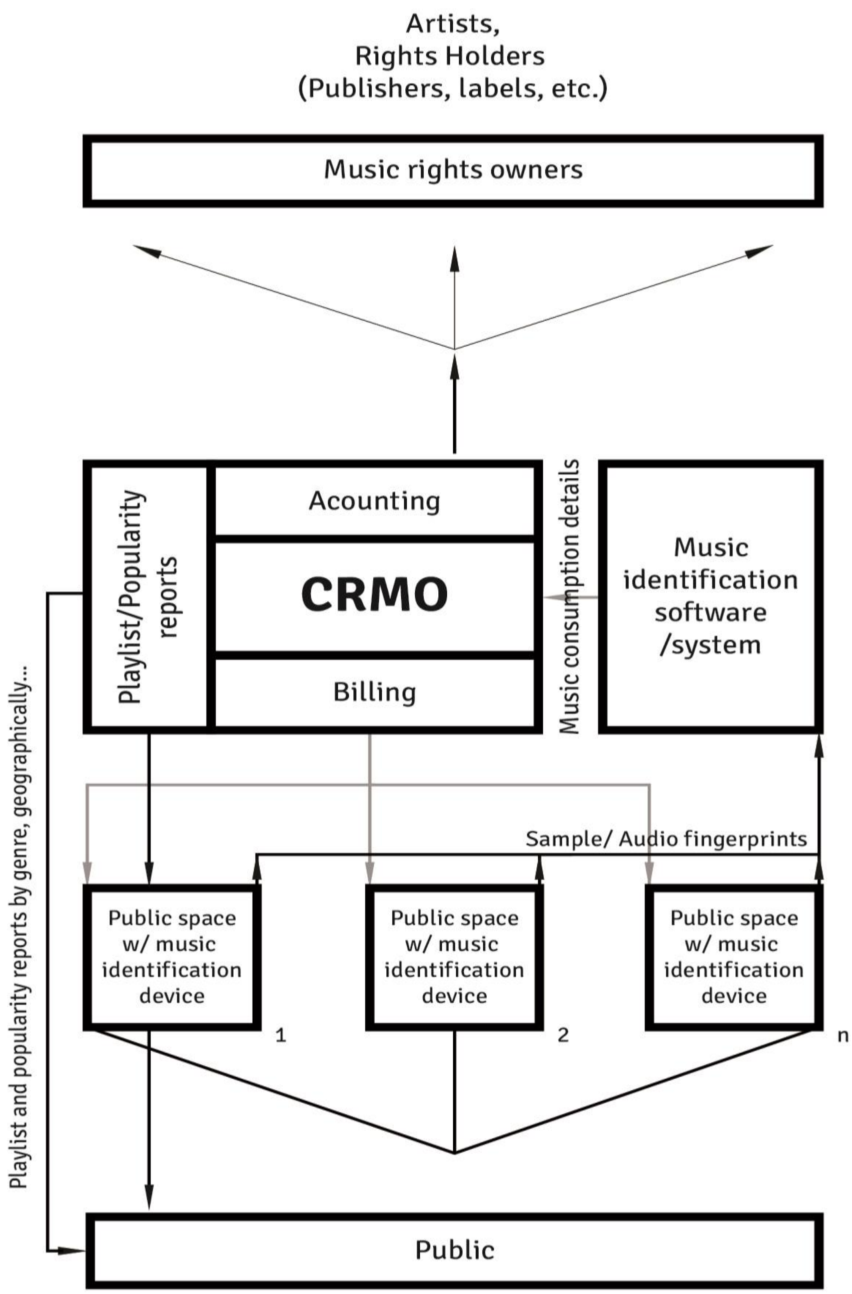

Figure 3. Generic Model of music monitoring, income and information distribution

CRMOs could precisely monitor the music consumption in public spaces using recent development in music identification algorithms and technologies which are, according to our research findings, quite precise. Such monitoring systems could be developed in house or obtained on the market. CRMOs could benefit from the process of digital, precise and transparent collection of data from the public spaces. This process would lower the administration cost of the collected data, billing towards public spaces and reporting toward content owners. Also, such process could be transparent and fast, with low transaction cost of data processing, making data easily accessible from multiply locations at the same time in almost real time. If implemented, the system would be efficient and resilient at the same time, easily handling any changes in the music consumption patterns. The more it is used, the more robust and more valuable it will become. In parallel of fulfilling the main function of transparent music consumption reporting, collected data will generate popularity playlists which could be used by other stakeholders, such as public spaces (for example, when a guest chooses a vacation venue, it could check the most played songs at that venue), record labels (they could analyse genre or artist popularity geographically) and media (having instant information about music popularity).

The proposed generic model opens up a new research question: who will enable such change of the information flow in the system using available technologies for real time and transparent data collection.

Conclusion and future research

The development of technology researched in this paper opens up the whole new area of research. New technology increases the information capacity of the system, and more information flowing through the system changes its properties and behaviour, enabling extension of its goals (such as real time music consumption reporting). Such change depends on the definition of the system which could be perceived as a closed simple unit with strong established hierarchical structures and non-dynamic relationships or an open complex and adaptive system with dynamic relationships enabling emerging properties. Also, the coherence of the system could be based on the hierarchical power of few or it could be based on the interest of all stakeholders including the smallest copyright owners and biggest with the same rights. Choosing the one of these two perspectives will define the future development of the system and whether the future copyright system will fulfil local cultural functions satisfying the global market need for efficiency.

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