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**DIGITAL RIGHTS MANAGEMENT - BLOCKCHAIN
AND DIGITAL MUSIC CONTENT MANAGEMENT**



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ABSTRACT

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The purpose of this thesis was to understand the influences of the Blockchain technology on digital music content management using digital rights management (DRM) as a framework for this study. The thesis included three research questions: studying what challenges Blockchain technology could solve, compared to previous DRM technologies in digital rights management issues, understanding how Blockchain technology relates to previous technological challenges in DRM and identifying the possible impacts provided by Blockchain technology on music content digital rights management. Research questions responses were based on the literature review and a research created on semi-structured theme based interviews. Based on the unanimous responses of the interviewees, the DRM's were originally created for the offline mode, the time before internet and peer-to-peer networks, and that the music industry needs a dedicated platform for digital rights management. When peer-to-peer technologies appeared in the late 1990s, this changed the whole setup of content sharing and caused an explosive amount of music content sharing, causing illegal sharing, also known as "piracy". Eventually when streaming services such as Spotify and YouTube arrived, DRM technologies disappeared to the background and changed the setup of content ownership, causing de-materialization and a market for online streaming services. Streaming services result in a lot of metadata issues and the collective management organizations are struggling with the correct allocation of compensation to the rights owners. The interview data also indicated the future roles of DRM and Blockchain technology, and that these technologies might not replace each other but complete each other for more efficient music content and rights management. Blockchain technology could provide the needed missing piece and support DRM technologies for a decentralized, traceable, tamper-proof, and transparent global platform for digital music content management. Blockchain technology could provide support to DRMs by assisting of monitoring the usage as a reporting entity. Blockchain technology could support in providing the rights owners and collective management organizations, a global decentralized platform, which seems to be needed in the music industry.

Keywords: Blockchain, Digital Rights Management, peer-to-peer, digital music, centralized, decentralized, digital asset, intellectual property, content management, smart contracts, Collective Management Organization.

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Tämän tutkielman tarkoituksena oli ymmärtää lohkoketjuteknologian vaikutuksia digitaalisen musiikin sisällönhallintaan hyödyntäen digitaalisten tekijänoikeuden hallintajärjestelmien (DRM) viitekehystä. Tutkielma sisälsi kolme tutkimuskysymystä: mitä digitaalisia tekijänoikeuden hallintajärjestelmien haasteita lohkoketjuteknologia voisi mahdollisesti ratkaista verrattuna edellisiin DRM-tekniologioihin, miten lohkoketjuteknologia liittyy DRM:n aiempiin teknologioihin haasteisiin ja mitkä ovat lohkoketjuteknologian mahdolliset vaikutukset digitaalisen musiikin tekijänoikeuden hallintajärjestelmiin. Vastaukset tutkimuskysymyksiin perustuivat kirjallisuuskatsaukseen sekä puolistrukturoituihin teemahaastatteluihin perustuvaan tutkimukseen. Haastateltavien yksimielisten vastausten perusteella DRM luotiin alun alkaen offline-ympäristöihin, aikaan ennen Internetiä. Vertaisverkkoteknologioiden kehittyttyä 1990-luvun lopulla, sisällön jakaminen koki rakenteellisen muutoksen ja sen myötä syntyi valtavasti musiikkisisältöä jaettavaksi verkossa ja aiheutti laitonta sisällönjakoa; verkkopiratismia. DRM-tekniologiat eivät pysyneet vertaisverkkojen kehityksen mukana, aiheuttaen vahinkoa musiikkialalle, koska käyttäjät kokivat DRM:n käyttöä rajoittavaksi ja monimutkaiseksi. Suoratoistopalvelut kuten Spotify ja Youtube muuttivat sisällön omistajuuden rakennetta, fyysisten levyjen myynti laski suoratoistopalveluiden sekä vertaisverkkojen tultua. Kuluttajat ostivat vähemmän fyysisiä levyjä ja olivat valmiita maksamaan tilauksia suoratoistopalveluihin tai pyrkivät lataamaan sisältöä ilmaiseksi verkosta. Suoratoistopalvelut ovat kuitenkin onnistuneet häivyttämään DRM-tekniologiat taustatoiminteesiinsa. Suoratoistopalvelut tuottavat suuria määriä metadatasia, jota tekijänoikeusorganisaatiot pyrkivät hallinnoimaan kohdistukseen tekijänoikeusmaksuja oikeuksien omistajille. Tutkielmassa ilmeni myös, että lohkoketjuteknologia voisi mahdollisesti tarjota täydennystä DRM-tekniologioihin, tuoden jäljitettävyyttä, läpinäkyvyyttä, salausta sekä lohkoketjun tarjoama hajautettu tietokantamalli saattaisi mahdollistaa globaalin alustan digitaalisen musiikin sisällönhallinnalle. Lohkoketjuteknologia tukisi DRM järjestelmiä tarjoamalla seurannan ja raportoinnin työkaluja. Lohkoketjuteknologiaan pohjautuva seurannan toiminnallisuus voisi tukea hallinnoimaan metatietoa, jota suoratoistopalvelut tuottavat suuria määriä. Musiikkiteollisuus tarvitsee kokonaisvaltaista uudistusta oikeuksien hallintaan sekä teosten raportointiin, jotta metadatan hallinnointi sekä korvausten käsittely olisi tehokasta, läpinäkyvää ja kompensatiot ohjattavissa oikeudenomistajille kohdennetusti.

Avainsanat: Lohkoketju, digitaalinen oikeuksien hallinta, vertaisverkko, digitaalinen musiikki, keskitetty, hajautettu, digitaalinen sisältö, sisällönhallinta, tekijänoikeusjärjestö, tekijänoikeus.

FIGURES

FIGURE 1 Music Sales in Finland 2000-2015 (Halttunen, 2016).....	8
FIGURE 2 Acquisition channels (Makkonen, Halttunen & Frank, 2011)	8
FIGURE 3 Different Steps of trading Content (Paskin, 2003)	12
FIGURE 4 DRM dilemma (Cartoon by Randall Munroe used in Bridy, 2008) ...	15
FIGURE 5 A distributed ledger (Norton, 2016)	20
FIGURE 6 Stack of Blockchain Technology (Mattila, 2016)	22
FIGURE 7 Proof of Existence (Swan, 2016)	22
FIGURE 8 Block information (Sikorski, Haughton & Kraft, 2016)	23
FIGURE 9 The platform (Consensys, 2016).....	29
FIGURE 10 The stems (Consensys, 2016)	30
FIGURE 11 The different licensing policies (Consensys, 2016).....	30
FIGURE 12 Modified from the trading content steps (Paskin, 2003)	55

TABLES

TABLE 1 ISO-identification system (Translation from Still, 2007)	13
TABLE 2 Interview numbers and organizations.....	38
TABLE 3 Table of saturation points	58

TABLE OF CONTENTS

ABSTRACT	2
FIGURES.....	4
TABLE OF CONTENTS	5
1 INTRODUCTION.....	7
1.1 Background.....	7
1.2 Motivation.....	9
1.3 Research questions.....	9
1.4 Research methods	9
2 DIGITAL RIGHTS MANAGEMENT	11
2.1 DRM's background.....	11
2.2 Peer-to-Peer networks and piracy	14
2.3 Music download stores	15
2.4 Subscription Based Music Services.....	16
2.5 DRM's challenges.....	16
3 BLOCKCHAIN	18
3.1 Introduction to Blockchain	18
3.1.1 Smart property	20
3.1.2 Smart contracts.....	20
3.1.3 Cryptocurrency	21
3.2 Blockchain technology.....	21
3.2.1 Deep dive into blockchain technology	23
3.2.2 Blockchain concerns	24
3.3 Digital music content management with Blockchain	24
3.4 Blockchain and Intellectual Property Rights.....	25
4 DIGITAL MUSIC CONTENT MANAGEMENT	27
4.1 Music industry.....	27
4.2 Future objectives	28
4.3 Blockchain in DRM	28
4.4 Literature review conclusions	31
5 RESEARCH METHODOLOGY.....	34
5.1 Research design.....	34
5.2 Data collection	35
5.3 Selecting the interviewees.....	36
5.3.1 Teosto	37
5.3.2 VTT and Aalto University	37

5.4	Data analysis.....	39
6	RESEARCH FINDINGS.....	41
6.1	DRM history.....	41
6.2	DRM currently	44
6.3	Blockchain	45
6.4	Case examples	46
	6.4.1 Pigeon.....	46
	6.4.2 Imogen Heap.....	46
6.5	Benefits of Blockchain.....	48
6.6	Challenges of Blockchain	49
6.7	Future objectives	51
7	DISCUSSION.....	54
7.1	Answering the research questions.....	54
7.2	Summary of the study	56
7.3	Implications.....	59
7.4	Reliability and validity	59
7.5	Limitations and suggestions for future research.....	60
	REFERENCES.....	61
	APPENDIX 1.....	64
	APPENDIX 2.....	65

1 INTRODUCTION

Digital music content production is growing rapidly and the digital content is available to the consumers through many different distribution channels, regardless of time and place. New media is produced and shared every minute, all around the world, digitally. Current technologies make it possible to produce music at a professional level, even with home equipment. This chapter introduced the research area of the study, describing the research motivation, questions, and used methods.

1.1 Background

The Internet has enormous musical resources and multiple streaming options with free or subscription based access with a low monthly fee. When examining the current music production trend, one might be interested about the music development in the future, and its sustainability. Even though there is a huge offering of music, it seems that the economic situation is not as successful as it could be, given that many consumers are not willing to pay for the digital content. The streaming services and music industries are not benefiting, not to mention the rights owners such as the professional musicians, composers and artists. The current situation needs a profound development in the whole system. Consumers have moved towards paying for subscriptions to online streaming services rather than actually owning physical CDs. Streaming services result in a lot of metadata issues and the collective management organizations are struggling with the correct allocation of compensation to the rights owners. Blockchain technology could provide support to DRMs by assisting of monitoring the usage as a reporting entity. The monitoring functionality could assist with managing the masses of metadata and provide the needed traceability and transparency. At the moment, the content is usually centralized with several service layers and multiple middlemen, and current digital rights management technologies cannot prevent piracy effectively. There is no control or trust in the technology of data and music content management.

Figure 1 shows Music Sales in Finland between the years of 2000-2015, showing the development of physical sales, digital sales and total sales, figures were originally applied from the Finnish National Group of IFPI report. Halttunen states (2016) that the main reason affecting these figures is digital piracy as a large study performed on consumer behavior using the context of legal digital music retailing. (Halttunen, 2016) Yet, there have been signs of “re-materialization” of products, which means that consumers might occasionally prefer to buy content in tangible products instead of intangible products. (Halttunen et al., 2010a; Makkonen et al., 2011 cited in Halttunen, 2016)

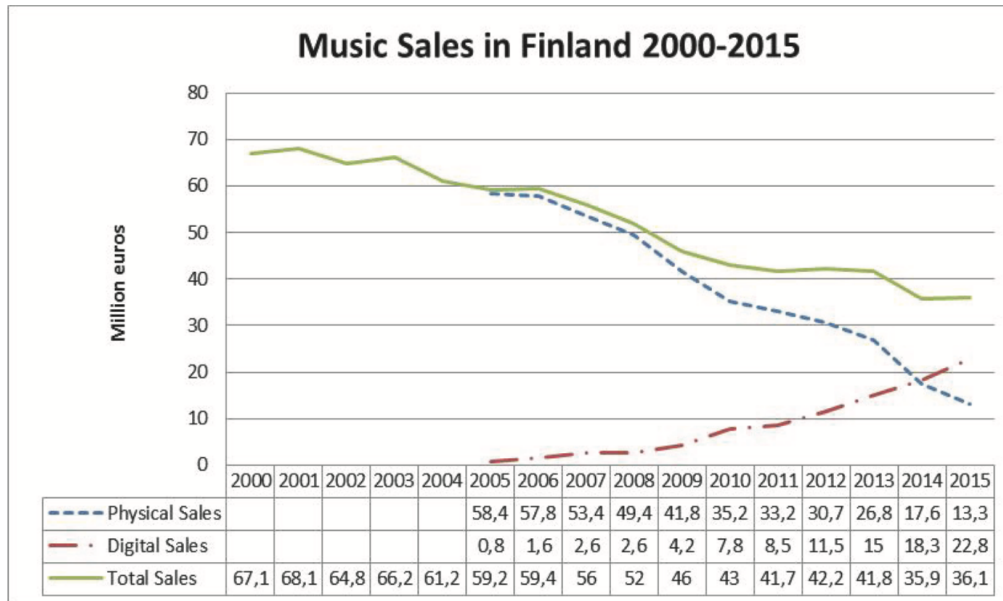


FIGURE 1 Music Sales in Finland 2000-2015 (Halttunen, 2016)

A framework for categorizing the acquisition channels of recorded music described by Makkonen, Halttunen & Frank (2011) in Figure 2 divides acquisition channels into four dedicated categories and using two classified dimensions: chargeability and tangibility. Chargeability represents consumers either having to pay a monetary charge for the content or not having to pay and the content is free. Tangibility describes the content being delivered in a physical form as CDs, cassettes or LPs, and intangibility includes digital content such as streaming content or streaming files. (Makkonen, Halttunen & Frank, 2011)

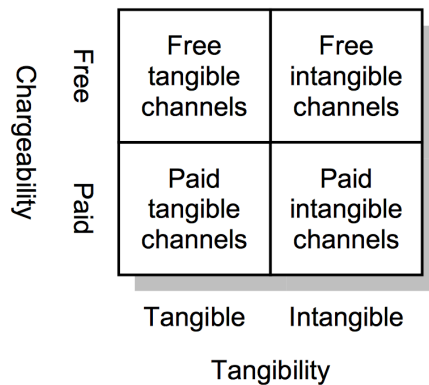


FIGURE 2 Acquisition channels (Makkonen, Halttunen & Frank, 2011)

1.2 Motivation

The motivation is to understand and introduce DRM technologies looking into Blockchain technology and evaluate its role related to DRM technologies. In addition, the idea is to examine if Blockchain is actually as revolutionary as it is stated in several studies, and if it can possibly fix the previous challenges and issues of the prior DRM technologies. The current music distribution is not benefiting the composers and music producers economically and there is a strong need for a new system backed by technological advances to solve this problem. This is why it was of interest to conduct interviews about Blockchain and determine if it can support in the digital rights management field. One of the aims of this study was to understand how Blockchain technology could provide a “fit”, namely, could it replace DRM at each stage or provide a partial solution. The literature review aimed to respond to the gained value of Blockchain technology. Blockchain is a new advance in technology and there are few empirical studies in this field, and only primarily pilots to examine.

1.3 Research questions

RQ1: What challenges can Blockchain technology possibly solve, compared to previous DRM technologies in digital rights management issues?

RQ2: How does Blockchain technology relate to previous technological challenges in DRM?

RQ3: What are the possible impacts provided by Blockchain technology on music content digital rights management?

1.4 Research methods

The first part of the thesis constituted a literature review looking into DRM generally, what has been done so far, and what the challenges in digital rights management were. The literature review also included an introduction of Blockchain technology and examined its possible potential to replace or solve previous DRM technologies' issues in digital rights management. The thesis also examined the possible options or benefits for music content digital rights management provided by Blockchain technology.

The framework for the thesis was DRM, which covered a very broad topic. DRM has been used for in different licensing models: the management of pay-

ments, and the usage rights. (Kwok, 2002). The research part in this thesis focused mainly on the management of payments and this involved interviewing the Finnish collective management society (CMO), Teosto.

The second part of the thesis included a study to examine the potential of Blockchain. The study consisted an intention-based interview of four employees from Teosto, two from VTT and one from Aalto University. Teosto is a non-profit organization, which protects and administrates music publishers' and composers' rights. The employees were interviewed to examine and understand digital rights management and its fundamental challenges, and to study the interviewees' attitudes towards Blockchain technologies as a means to resolve the DRM challenges of successfully fighting the piracy problem. VTT and Aalto University are conducting several research studies on Blockchain technology. The research part of this study included key personnel from VTT who were interviewed on the topic of Blockchain technology, and Aalto University representative were asked to describe the history of digital rights management and how Blockchain technology could be considered in future research and development.

Limitations in the research were identified as being due to the small number of previous studies, as research related to Blockchain is recent and there are not many similar studies or findings in the research field to review. This is the focus of the second part of the thesis, namely identifying key points from the existing literature. A conclusion was that existing DRM frameworks are not a perfect fit for Blockchain, but Blockchain provided the closest framework available for this topic.

2 DIGITAL RIGHTS MANAGEMENT

This chapter aimed to describe the background of Digital Rights Management (DRM). The role of DRM was explained and its evolution and role since the 1980's and how it was affected by the peer-to-peer networks at the beginning of the year of 2000, and in the late 1990s, bringing along piracy issues concerning digital content and sharing content in the network. Music download stores were also introduced and subscription/streaming based music services were also discussed in this chapter and how the streaming services affected and changed the role of traditional DRM systems.

2.1 DRM's background

DRM came into use in the mid-1990s and has had many ups and downs technology-wise. Some argue that DRMs have been around since the 1980's in software and computer programs, as used by licensing or simply typing in a system password obtained from a manual. It has been equally claimed that DRMs are either saving copyright industries, or are totally useless, but there is a difference of opinion as to what DRM covers. There seem to many misconceptions as to what DRM means. DRM is defined in many ways but Paskin (2003) provides the following description. Figure 3 describes what steps are usually involved when providing content, including those steps required for it to be traded. DRM has a role in each phase of the figure, which include: production, digitalization, distribution, identification, ascription of descriptions, the use by a consumer, monitoring, and payment collection. (Paskin, 2003)

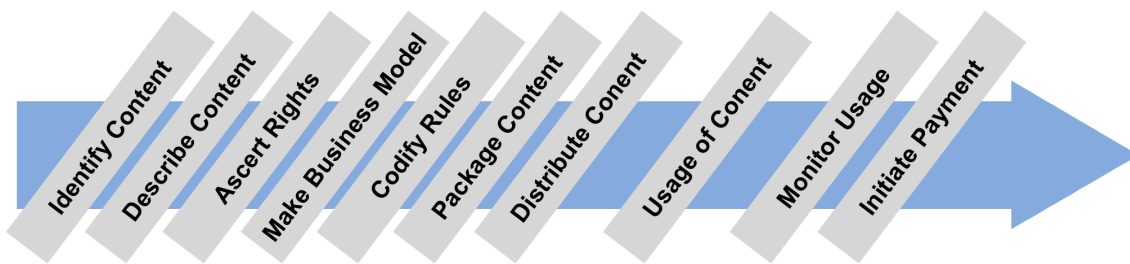


FIGURE 3 Different Steps of trading Content (Paskin, 2003)

DRM has been used in two different licensing models, namely the management of payments, and the usage rights (Kwok, 2002). DRM was designed to prevent theft in the entertainment business, and although there are numerous access control technologies, they have still not been able to prevent piracy. The amount of digital music is increasing, but the music industry is struggling to adapt to the new technological era. The music industry is unable to prevent free copies of songs spreading online, through for example file-sharing networks such as LimeWire and BitTorrent. The industry has tried to use DRM to control digital media copying in several ways, such as controlling the method of usage, for example by preventing purchasers from converting or copying their purchase into formats, or restricting the purchaser's usage through regional codes. Some of the DRM technologies are considered controversial, and there are also debates surrounding legal issues and monopolies. (Hoffmann, 2009)

When transferring traditional products or business models to digital contents or goods, it is essential to most content providers and distributors that the online world has a functioning system for digital intellectual property protection. There are several ways for DRM technologies and to name a few as an example there is the typical DRM which involves four parties; the content provider, the clearinghouse, the distributor and the consumer, then there are plug-ins which are usually included in the physical CD's for digital content protection. The Microsoft WMRM is an end-to-end DRM system, which is for securing distribution of media files, InterTrust Rights | System supports rentals pay-per-use, sales and try-before-buy business models. IBM EMMS supports pay-per-time, pay-per-use, controlled printing, subscription, protected transfer to portable media and devices. RealNetworks RMCS is utilized by MusicNet and supports a subscription service for record labels on music formats. Then there are the DRM trust model, cryptographic mechanisms, symmetric and asymmetric encryption, digital signatures and one-way hash functions, digital certificates, device individualization and digital watermarking. (Liu, Safavi-Naini & Shepard, 2003)

"Entertainment businesses say digital rights management prevents the theft of their products, but access control technologies have been a uniform failure when it comes to preventing piracy." (Hoffmann, 2009).

There is a great amount of digital media available, which is growing all the time due to the explosive growth of the Internet, as it offers new ways of

disseminating, marketing, monetizing creative works, interacting and expanding the markets. DRM's role in the media marketplace, usually depends on the forms of DRM in mind. (Sohn, 2007)

The ISRC-code is an international identification code for recordings and music videos. It aims to support the rights management in identifying the rights owners to allow for allocating compensation and claim management (IFPI, 2017). Table 1 summarizes the different ISO-identification system standards that are relevant to the copyright industry, which are used to support and identify the rights owner and allocate compensation (Still, 2007). However, there still seem to be several issues in matching and allocating compensations to rights owners, as there are mismatches between identifications, and collective management organizations (CMOs) are facing enormous amounts of data due to the streaming services. This is causing them administrative issues related to the quantity of data, and current DRM systems cannot support this. Streaming services have generally about 30 million music tracks and the number is constantly increasing. There are new demands for music licensing, reporting and claiming because of the enormous amount of music metadata, which needs be managed. As an example, the British CMO PRS handled in 2016 about 4,3 billion separate rows of data; the amount of data has increased 80%, when compared to the amount of data to the previous year. (Muikku, 2017)

TABLE 1 ISO-identification system (Translation from Still, 2007)

Acronym	Name	ISO-number	Content	Administrator
ISAN, V-ISAN	International Standard Audiovisual Number ISAN - Version identifier	ISO 15706:2002	Audiovisual work	ISAN International Agency
ISBN	International Standard Book Number	ISO 2108:2005	Books, separately available sections of books (chapters, separate articles) also on computer programs and	The International ISBN Agency
ISMN	International Standard Music Number	ISO 10957:1993	Notes in paper form	The International ISMN Agency
ISRC	International Standard Recording Code	ISO 3901:2001	Recorded music	International Federation of the Phonographic Industry (IFPI)
ISRN	ISO Standard Report Number	ISO 10 444:1994	Unpublished scientific reports, which are not produced and delivered commercially.	Fachinformationszentrum
ISSN	ISO Standard Serial Number	ISO 3297:1998	Periodicals	ISSN International Center
ISWC	International Standard Work Code	ISO 15707:2001	Literary and musical works	International Confederation of Societies of Authors and Composers (CISAC)

EC directive (2001/29/EC), a directive related to copyright and similar rights in the information society, consists of three new elements in national copyright law:

“a new right of communication to the public intended to accommodate internet use, restrictions on the copyright exemptions available (the so-called à la carte list of exemptions which may not be exceeded) and the legal protection of digital rights management systems (consisting of technological measures and rights management information).” (Still, 2010).

2.2 Peer-to-Peer networks and piracy

At the beginning of the year of 2000, and in the late 1990s, digital music started to be distributed via peer-to-peer (P2P) networks. This was different to the previous client-server architecture, since in peer-to-peer networks nodes serve both as a client and a server. For sharing digital content such as music, the peer-to-peer architecture is economical and efficient but difficult to manage. Peer-to-peer networks were used widely for illegal purposes and accused of harming the music industry. (Halttunen et al. 2010b.)

Since music content sharing was henceforth no longer limited to sharing physical copies, but instead constituted digital files, which can be shared through a peer-to-peer network to users virtually, illegal downloading of digital has continued to spread and harm the music industry. (Borja et al., 2015) Napster was a pioneer in sharing audio files through peer-to-peer networks, such as music in MP3 formats, and was created at the end of 1999. After only a few years it was shut down due to legal issues, but after this several peer-to-peer files sharing online services emerged, such as LimeWire, Madster, Piratebay and BitTorrent. (Hoffmann, 2009)

The consumers used the online service Napster to download unauthorized copies of copyrighted digital music content without payment, even though these users would have not bought pirated CD's in the real world This rejected the traditional ethics, laws and principles of commerce based on copyrights (Garnett, N. ,2001). Services like these and content sharing in general started spreading explosively. These were the first steps of harming the music industry and losing control of licensing, and in particular the handling of rights management for the music creators. (Hoffmann, 2009)

Even though DRM is perceived as important, it is still a controversial issue, because DRM enforces many restrictions, even for legal users, and so many practitioners in the music industry believe that it is doing harm than good for the music industry. The music industry also assumes that download piracy will decrease if the industry allows DRM-free content. Since music became available for downloading from the Internet, the music industry has been concerned about the long-term impacts affected by online piracy. DRM was only providing a part of the solution, and on the flipside imposed too many restrictions on users. It has been claimed that in some cases DRM decreases and in other cases,

increases profits for the music industry, depending on the conditions and restrictions set by DRM system used. (Vernik, Purohit, & Desai, 2011)

2.3 Music download stores

Between the years of 2000 and 2006 several music download stores such as iTunes came on to the market. The music download stores used DRM technology to protect content and prevent piracy and illegal use. Eventually DRM systems turned out to be inefficient for protection and caused many issues for users, and so in 2009 a decision made by Apple for iTunes, followed by many other stores was to abandon DRM protection. (Halttunen et al., 2010a; Halttunen et al., 2010b cited in Halttunen, 2016)

Figure 4 shows the DRM dilemma, DRMs have not solved the issues of piracy, even though there are many DRM technologies in the field. Consumers are frustrated, since they feel digitally restricted and it can be complicated or even impossible to use the content on other media players or operating systems. DRM technologies do not serve the intentions they are designed for, even ordinary users can feel that piracy is an easier way to get hold of the desired digital content. (Bridy, 2008)

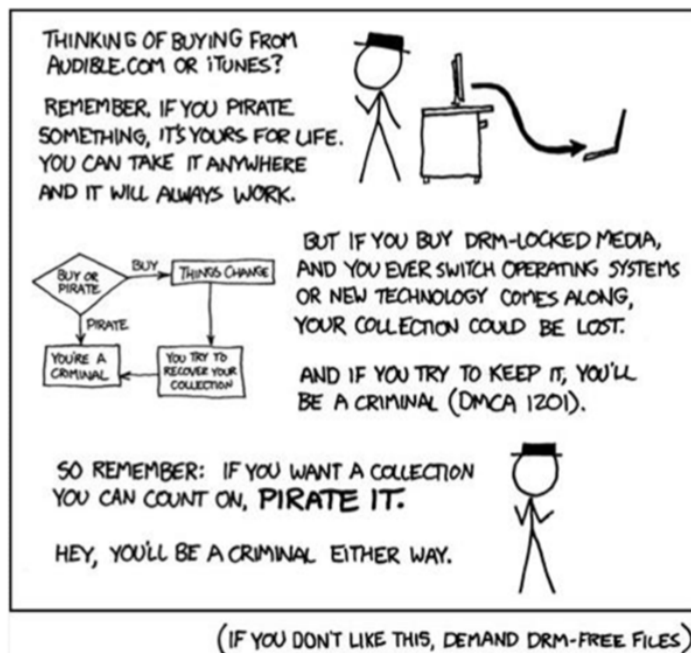


FIGURE 4 DRM dilemma (Cartoon by Randall Munroe used in Bridy, 2008)

2.4 Subscription Based Music Services

New commercial alternatives came under development and emerged onto the market around 2010. Since the beginning the music download stores were not successful, and there was a threat of digital piracy spreading even more. The new services were mainly streaming-based, instead of downloading. One of the most popular music streaming services in the market currently is a Swedish streaming service called Spotify. (Halttunen, 2016)

The content streamed on Spotify is DRM protected, but it is applied in the background so it does not affect the usage, which satisfies the users. Since Spotify has several business models for music content and pricing, it is challenging to predict how users will accept the different alternatives in the long run (Halttunen, 2016). A study from 2015 states that piracy problems have not been resolved by streaming-based music services and subscription based music services (SBMS) despite high user acceptance. (Borja et al., 2015)

The Digital Era highlights the digital piracy issues - the current trend is moving towards a de-materialization or licensing of commodities, which means that the consumer does not own the music itself anymore, since consumption is through streaming videos or music. (Magaudda, 2011; Halttunen, 2016)

“De-materialization of musical goods do not mean less materiality and do not imply a less relevant social role for material objects within consumption processes. In fact, we will see that digitalization of music reveals itself, quite paradoxically, as a process in which the reconfiguration of the relationship between materiality and culture leads to a renewed role played by material objects in people’s life and activities.” (Magaudda, 2011)

SBMS, also known as Musical Digital Service Providers (DSP), such as Spotify, AOL or Pandora, acquire licenses for digital content they provide by relying on a patchwork of databases. This setup may cause unfair advantages for term negotiations and cause inefficiency. There is a need for a central licensing database. The Internet has caused many changes to information processing, which reflects on the efficiency of music licensing. Current systems for royalty payments create a high level of disenchantment among musical artists, and are inefficient and patchy. There needs to be a solution that takes into consideration the high complexity of the industry. Blockchain technology might offer the needed framework for achieving a higher efficiency in the music industry. (Dunham, 2016)

2.5 DRM’s challenges

Traditional DRM systems were originally designed for the offline mode, in the time before the Internet. Peer-to-peer technologies in the late 1990s, changed the whole setup of content sharing and caused an explosive amount of music content sharing and caused illegal sharing. DRM technologies could not keep up with these developments, and resulted in more harm than benefits for the

industry, as using them was extremely complex and restrictive. Eventually when streaming services such as Spotify and YouTube arrived, DRM technologies disappeared to the background and changed the setup of content ownership, causing de-materialization. Streaming services result in a lot of metadata issues and the collective management organizations are struggling with the correct allocation of compensation to the rights owners. Since DRMs provide identification, id codes, monitoring the usage and limiting the usage, they can still be very restrictive and make systems complicated for the users. DRM technologies need a supportive technology for music content and metadata to be traceable and for providing reliable and transparent systems for monitoring and reporting data. Rights owners and collective management organizations need a profound renewal of their current management and reporting systems to manage metadata handling. Compensation allocation is needed to the rights owners efficiently and transparently and this cannot be provided alone by DRM technologies.

3 BLOCKCHAIN

This chapter provides an introduction to the Blockchain technology and explains its architecture. Some of the most familiar Blockchain features were introduced, such as smart property, smart contracts and cryptocurrencies. Some of the features might be applicable for music content management and for some features were aimed for overall comprehension. A deep dive to Blockchain technology was introduced and some of key concerns were also described. Finally, Blockchain's role in the music content management was explained and insights added into the matters of Blockchain and Intellectual Property Rights.

3.1 Introduction to Blockchain

Swan describes that digital asset protection could be applied automatically, standardized through Blockchain technology. The evolution of Blockchain technology has been compared to the revolution of the World Wide Web in the late 90's. It is a distributed, decentralized database that contains records, called blocks. Each block contains a timestamp and a link to the preceding block. The main idea is to protect intellectual property by controlling ownership and access by registering and treating the content as a digital asset on the Blockchain, and providing access through a private key. (Swan, 2015)

Blockchain can be described as a distributed ledger, which has chronological "blocks" in a chain. Each block includes a record of information related to network activity since the last block. Blockchain technology operates on a decentralized network, which means that there is no entity that governs or controls the system (Nakamoto, 2008). Each block may be described as containing encrypted pieces of information. In theory, anyone can add data to a Blockchain and review it at any time, but no one can change the data without authorization. Blockchain technology can build trust between entities that do not trust each other, and transactions can be performed securely over the Internet without middlemen or third parties. (Mainelli & Milne, 2016).

It has been presented by Swan (2015) that in many studies Blockchain technology could help to regain trust and control of data traffic and transaction and digital content management since it is based on peer-to-peer transactions with decentralized data. Swan states that Blockchain provides more privacy, better control, security, trust, automated tracking, ease of use, inexpensive and supports, for example, crowdfunding, micro-payments and auto-payments. The cryptocurrency Bitcoin is one of the most familiar systems using Blockchain technology at the moment (Swan, 2015). Bitcoin's underlying technology is Blockchain, and was presented in a white paper 2008 by a someone using the pseudonym Satoshi Nakamoto. (Nakamoto, 2008)

It has been stated by Swan (2015) that this technology cannot only be used for economical purposes, but also has applications to, for example, political, humanitarian, legal, scientific, art and entertainment. There are many bold claims about Blockchain revolutionizing every market field in the industry, offering transparency, traceability and tamper-proof systems. Almost all industries are discussing and investigating Blockchain technologies, and there is technological hype in, for example, finance, banking, logistics, supply chain, energy industry and intellectual property management. (Swan, 2015)

Swan (2015) describes Blockchain as follows: *"experience of a continuously connected, seamless, physical-world, multidevice computing layer, with a Blockchain technology overlay for payments – not just basic payments, but micropayments, decentralized exchange, token earning and spending, digital asset invocation and transfer, and smart contract issuance and execution – as the economic layer the Web never had."* (Swan, 2015)

Mattila explained that Blockchain technology's technical capabilities are superior when comparing to traditional platform solutions. The challenge is that to develop the technology for future needs requires know-how, competition and demand. According to Mattila's observations, there are about a thousand companies globally focusing on innovations related on Blockchain. (Mattila, 2016)

Blockchain as a term usually describes a version of a distributed ledger structure and a consensus protocol ensures data consistency between peers. Different consensus mechanisms are used in Blockchain configurations depending on the size and on the type of a network and the particular company's case. For example, the cryptocurrency Bitcoin is "permissionless" and public, which means anyone can contribute to the ledger and participate. Figure 5 illustrates on the left how a traditional payment transaction is handled and how it always requires middle men/ a clearing house for safe transactions. The illustration on the right in figure 5 shows how Bitcoin transactions are made in a distributed ledger setup. (Norton, 2016)

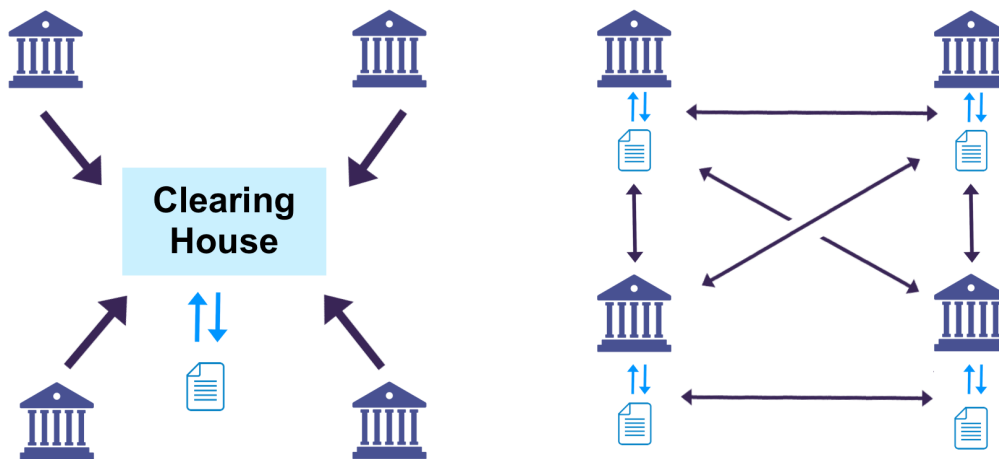


FIGURE 5 A distributed ledger (Norton, 2016)

3.1.1 Smart property

Smart property management is possible with the Blockchain technology and it can include any form of asset registry, exchange, inventory and any area of finance, money and economics. Intangible assets such as information, data, copyrights, reservations, stock shares, intentions, reputations, ideas and votes can be applied and tangible/hard assets meaning physical property such as a car, home, computer or a bicycle can be linked to a matching virtual asset. Property encoded on a Blockchain, converts to smart property and can be applied to several functionalities and it can also be included in smart contract transactions. Any asset and property can be registered and encoded to a Blockchain, on which its registered as a digital asset and this also supports transacting with smart property. Ownership of a Blockchain-encoded asset or a property can be controlled with a private key. The owner of a private key can determine when to transfer the asset associated with the private key to another party for example in a business transaction, or a pre-established smart contract may release ownership automatically after an installment or a loan payment completion. (Swan, 2015)

3.1.2 Smart contracts

Smart contracts are designed for more complex transactions for Blockchain-based digital assets, which are not about basic “buy and sell” transactions. They are autonomous, decentralized and self-sufficient. Autonomous meaning that after a smart contract is launched it will run for the contract’s life cycle automatically and the involved parties in the contract do not need to be in contact with each other anymore. Decentralized means that the contract is not on a single server, which is centralized, and instead that it is decentralized across the network. Self-sufficient means that the smart contracts are able to organize resources such as: providing services, raising funds, or issuing equities. A smart

contract is about an agreement between two or more parties with agreed actions, obligations or payments via Blockchain. When comparing a smart contract to a traditional contract the need of trust between parties is reduced, since the smart contract's content is defined and executed by the code automatically. (Swan, 2015). Smart contracts could contain many features, depending on the setup, such as auto-payments, micropayments and crowdfunding (Swan, 2015; Huckle et al., 2016). There are a few Blockchain ledgers, which support smart contract functionality, for example Ethereum and HyperLedger, but Bitcoin is only focused on cryptocurrency transactions and does not support smart contracts other than in a very limited fashion.

3.1.3 Cryptocurrency

Cryptocurrency is one of the most familiarized concepts using Blockchain technology. The traditional idea of currency becomes relevant for reassessing and rethinking forced by the cryptoeconomy. The cryptocurrency Bitcoin is used and accepted by a number of people. According to a study done by Hileman & Rauchs (2017) and produced by Cambridge University the number of users of bitcoin users had grown substantially since 2013 from a starting point of 300,00 to 1.3 million users. The number of users in 2017 was estimated to be between 2.9 million to 5.8 million of unique users using a cryptocurrency wallet and most of these containing bitcoins. (Hileman & Rauchs, 2017)

Even though there is nothing concrete like a gold standard backing the cryptocurrency, it can be argued that the fiat currencies are not backed either to anything tangible, but backed by the issuing government. The measurement of the value and what "backs" the currencies is the acceptance and adoption rate; this creates the illusion of the "stability" of money. Cryptocurrencies can also become as liquid as fiat currencies if people accept and use cryptocurrencies more widely. (Swan, 2015)

3.2 Blockchain technology

Traditionally data is transferred through digital networks by copying the data from one location to another, which raises issues of tracking that is the data up-to-date and rises questions of its authenticity. Solving this issue usually requires trust between the parties participating in the transaction. Blockchain technology is stated to solve the issues of trust and authentication, not needing middlemen or intermediaries for reliable transaction by providing reliable digital platform of distributed trust open to all users. (Mattila, 2016)

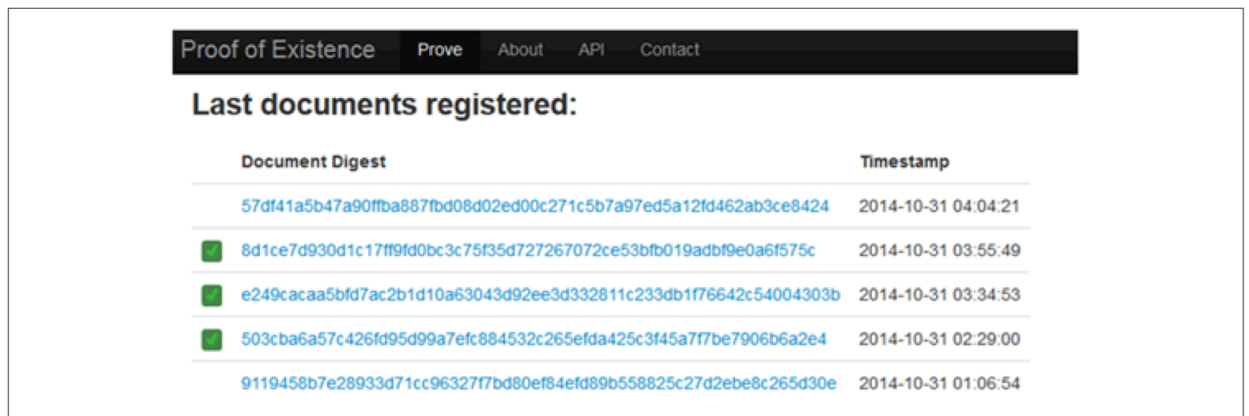
Blockchain is described as a series of blocks, which are chained together; it is a data structure with distributed control. When Blockchain was first introduced there was only one application in existence: the cryptocurrency Bitcoin. Bitcoin constituted Blockchain's entire technology stack of the distributed architecture. Entities such as Eris, Ethereum and Filament focused on separate layers

of the Blockchain technology stack to find applications beyond Bitcoin. As a result, the technology stack became fragmented and the term Blockchain included different structures and different levels of stack as shown in figure 6 as an example of a Blockchain-related product or service situated in the layer. (Mattila, 2016)

Layer	Example of a Blockchain-related product or service situated in the layer
Application layer	Ujo Music
Platform layer	Eris Industries' smart contract application platform
Processing layer	Ethereum virtual machine
Data/Protocol layer	The bitcoin Blockchain
Network layer	Filament Tap
Hardware layer	BitFury mining chips

FIGURE 6 Stack of Blockchain Technology (Mattila, 2016)

Figure 7 is a screenshot of digital assets with proof of existence information. This information is available for to public online (Blockchain Info, 2017) and the information is updated constantly in real time. This tool provides proof that a digital asset, file or document exists and describes the exact content, and also provides time stamped data (Swan, 2016). Figure 8 shows what kind of block details are found behind the document digest link. This is an example of a Bitcoin transaction and it includes detailed information. (Sikorski, Haughton & Kraft, 2016)



Document Digest	Timestamp
57df41a5b47a90ffa887fbd08d02ed00c271c5b7a97ed5a12fd462ab3ce8424	2014-10-31 04:04:21
8d1ce7d930d1c17ff9fd0bc3c75f35d727267072ce53bfb019adb19e0a6f575c	2014-10-31 03:55:49
e249caca5bfd7ac2b1d10a63043d92ee3d332811c233db1f76642c54004303b	2014-10-31 03:34:53
503cba6a57c426fd95d99a7efc884532c265efda425c3f45a7f7be7906b6a2e4	2014-10-31 02:29:00
9119458b7e28933d71cc96327f7bd80ef84efd89b558825c27d2ebe8c265d30e	2014-10-31 01:06:54

FIGURE 7 Proof of Existence (Swan, 2016)

Block #438995


Summary		Hashes	
Number Of Transactions	1527	Hash	0000000000000000042b6b0a7bfa7f43b648167a5c0547d6b3a67e23d4c226
Output Total	12,726.25791485 BTC	Previous Block	0000000000000000023522e6372109dd28f97a86eef46a54cf15199c005e6a85
Estimated Transaction Volume	965.70420589 BTC	Next Block(s)	00000000000000000257616ab8ed39e0e7bca056d13faf1652075a34e335e7ed
Transaction Fees	0.41251118 BTC	Merkle Root	4a6be460a67526fd576788cf737713ae614003989706a0675e9d946ec58ca030
Height	438995 (Main Chain)	Network Propagation (Click To View)	
Timestamp	2016-11-15 08:26:59		
Received Time	2016-11-15 08:26:59		
Relayed By	GBMiners		
Difficulty	254,620,187,304.06		
Bits	402936180		
Size	749.146 KB		
Version	536870912		
Nonce	173727158		
Block Reward	12.5 BTC		

FIGURE 8 Block information (Sikorski, Haughton & Kraft, 2016)

Mattila (2016) explains that Blockchain's technical capabilities are superior compared to traditional platform solutions. The challenge is that to develop the technology for future needs, it needs know-how, competition and demand. According to Mattila's observations, there are about a thousand companies globally focusing on innovations related on Blockchain technologies. (Mattila, 2016)

3.2.1 Deep dive into blockchain technology

Blockchain technology is surprisingly not a new invention when its different elements are examined closely. Satoshi Nakamoto, in 2008, combined four different elements. From the combination of these traditional elements, a new technology emerged: (Nakamoto, 2008)

1. **Tamper-proof:** linked lists were invented in 1955 by Allen Newell, Cliff Shaw and Herbert Simon. (Ülker & Turanboy, 2009)
2. **Asymmetric key cryptography:** the mathematics of cryptography was invented in 1970 by James Ellis, but kept secret by the British government, and independently re-invented by Diffie and Hellman. (Diffie & Hellman, 1976)
3. **The set of rules:** Byzantine fault tolerance was first described in 1982. (Lamport et al., 1982).
4. **The peer-to-peer network.** (Ripeanu, 2001)

3.2.2 Blockchain concerns

The following concerns are related to Bitcoin and may not apply to other ledgers as such. There are several Blockchain ledgers available on the Internet, and Bitcoin is only one of them. Each ledger has its own consensus protocol; namely the set of rules used to agree on what data to append to the ledger at any given time. It is also essential to consider that Bitcoin is a totally open ledger where anyone can join and follow or submit transactions. Ledgers can be private, semi-open or semi-private, with each having their own consensus system.

Bitcoin has no physical existence and is only a digital currency, which might cause security issues. The transactions and the mining processes on bitcoin are not fully secure. Some services provide digital wallets and cryptocurrency exchange services and both of these can be targets for hackers. (Vyas & Lunagaria, 2014)

1. Wallet Software attacks: the online wallets are vulnerable to attacks and need to be protected and encrypted.
2. Timejacking attacks: an attacker might announce an inaccurate timestamp in a block. The networks time counter can then be altered and an alternate Blockchain is approved.
3. 51% attack: a user or a group may be able to exclude, modify or reverse transactions if more than 50% of the computing power applied to securing the Blockchain is acquired.
4. Double-spending: an attacker makes more than one transaction using a single coin, which results to invalidating the "honest" transaction. This is linked to the 51% attack, where a transaction is honored and subsequently reversed through the attack.
5. Selfish Mining: allowing the miner to obtain revenue larger than its ratio of mining power.

(Vyas & Lunagaria, 2014)

3.3 Digital music content management with Blockchain

The music industry is even more challenging when compared to modern day banking and considering its efficiency. In the banking industry is it considered excessively slow when a transaction takes several banking days to clear, however in the music industry it could take years for an artist to receive royalties. It has been proposed by Mattila (2016) that with Blockchain technology, music licensing and digital rights management could be brought into the 21st century. Blockchain technology provides the music industry a decentralized music platform through Ethereum, which allows artists to record their music into a smart contract and specify the shares that the contributors are entitled to; and when a customer buys a song, the payment is generated for each contributor in real time through the smart contract (Mattila, 2016). As presented before in this thesis, Blockchain enables micropayments and the transaction fees are more economical when compared to traditional methods, which are expensive and slow.

A decentralized music platform provides new capabilities, which the traditional archaic licensing framework cannot provide, such as buying and paying for single music tracks of a song, for example an isolated singing track without the music instruments to be used for a remix. The terms of the track can be agreed directly with the artist and specified with a smart contract. This kind of a contract could for example include an arrangement that the singer offers the vocals for non-commercial use for 50 euros and commercial use would cost 25% of the remixed song's revenue; any kind of arrangement could potentially be defined through a smart contract, which could serve all parties involved. Smart contracts can be adjusted to include predefined terms and anyone who agrees to the terms immediately acquires the tracks to use for remixing, without involving middlemen, such as studios and record labels or even artist themselves. When accepting the smart contract terms, the revenues will be generated to the rights owners in real time, as with the original song revenue model. (Mattila, 2016)

Blockchain could provide several ways to implement and innovate new services, but they seem to be overlooked at the moment. There could be potential for example to be integrated with the Internet of Things (IoT). Another implementation example is a streaming platform called Resonate, which would use Blockchain technology to provide for instance visible proof of the service's membership and voting records anonymously. Blockchain could provide support in asset transaction, such as intellectual property. A company developing intellectual property management is called Colu and it claims that their offering would benefit the music markets significantly. (O'Dair, Beaven, Neilson, Osborne & Pacifico, 2016)

Several studies discuss that Blockchain technology could provide a solution to the music industry and that it could "revolutionize" the whole industry. (Wallach, 2014; Perez, 2015 cited in Mattila, 2016) For future objectives of Blockchain it is not yet confirmed, which platform or technology implementation will achieve the strongest position to provide recorded music, since it needs further exploration. Ujo Music is one of the most familiar decentralized music platforms. In addition, there are Peertracks, Bittunes, Aurovine, and Dot Blockchain Music. All use different cryptocurrencies and this may limit adoption and innovation. (O'Dair, Beaven, Neilson, Osborne & Pacifico, 2016)

3.4 Blockchain and Intellectual Property Rights

There have been discussions in the Intellectual Property Rights (IPR) field around Blockchain and what the technology they could offer for protecting immaterial rights. Using a Blockchain ledger could be cost efficient for IP-rights management and with smart contracts, licensing could be processed immediately. Some organizations have already started implementing the technology, for example Ujo Music is applying Blockchain technology in their music and has co-operated with the singer-songwriter Imogen Heap, whose song "Tiny Human" was published on the Blockchain. The users were able to obtain the

song via a smart contract and without the involvement of any middlemen. (IPR, 2017)

It has been proposed by IPR (2017) that there might be benefits in rights management with Blockchain technology. With information that is written onto the Blockchain, the original rights owner or the authenticity of a product can be verified. An example is the clothing brand Babyghost and the start-up company Vechain who cooperated with a 2017 clothes collection that included fabric with embedded microchips that were connected to the Blockchain with a mobile app, each microchip gave the customer information on the product's origin and other relevant details related to the clothing item. (IPR, 2017)

Even though Blockchain technology seems promising, for it to work efficiently with rights management it requires the consumers to use the services. For example, the music industry's piracy issues are hardly related to the fact that copyrights are not familiar. Blockchain could provide an alternative to centralized services for purchasing content legally. There could even be the possibility that the consumer's willingness to pay for music increases if the payments are allocated directly to the rights owner, namely the artist/composer. (IPR, 2017)

Commercial interest towards Blockchain technology is growing. When corporations focus on research and development projects, it could provide big leaps forward for Blockchain technology to develop. At the moment companies are concentrating mainly on private Blockchain ledgers, where participation and anonymity is restricted. The future will show how the Blockchain will be adapted in different areas. (IPR, 2017)

4 DIGITAL MUSIC CONTENT MANAGEMENT

This chapter introduced the role of Blockchain in the music industry and explaining pilots done in the music field related to the Blockchain technology. There were five areas suggested, where Blockchain technology could affect the music industry. Future objectives and DRM's role were discussed in this chapter and the findings of the literature review were also explained. Almost all of the references supported the aspect that Blockchain technology might be able to replace many functions in various industries. There might be many possibilities with Blockchain technology, but it all comes down to being easy to use and having supporting communities and entities using it. Deeper discussions of Blockchain's role in the in the music content management area were done in the research findings, which was performed after the literature review.

4.1 Music industry

Almost all industries have been presented in the Blockchain hype from finance, banking, logistics, supply chain, energy industry and intellectual property management. It is boldly claimed by Swan (2015) and other researchers that Blockchain will revolutionize every market field in the industry, offering transparency, traceability and tamper-proof systems. (Swan, 2015)

The many challenges that the music industry is facing have been claimed by Mattila (2016) to be solved by Blockchain technology disrupting the whole industry. A British producer/singer/songwriter, Imogen Heap, is acting as a spokesperson for Blockchain technology taking back control of the music industry's rights management with her Mycelia concept. (Mattila, 2016)

“One of the biggest problems in the industry right now is that there's no verified global registry of music creatives and their works. Attempts to build one have failed to the tune of millions of dollars over the years, largely at the expense of some of the collective management organizations (CMOs) – the agencies (such as ASCAP, PRS, PPL and SOCAN) who ensure that songwriters, publishers, performers, and labels are paid for the use of their music by collecting royalties on

behalf of the rights owners. This has become a real issue, as evidenced by the \$150 million class action law suit that Spotify is currently wrestling with.” (Heap, 2017)

Since Blockchain is providing inter-organizational co-operation for the fintech sector, and Heap (2017) states in an article that the collecting societies should be inspired to create a partially open global registry to maintain their position in the rights management, as it would support managing the infinite amounts of new music, which are added and uploaded daily. Metadata could be created through Blockchain-verified profiles for music creatives when new music is updated - a registry would build up in the Blockchain. (Heap, 2017)

4.2 Future objectives

It is said that some claims have inflated the potential impact on recorded music provided by Blockchain technology, claimed to be a hype around the topic. Still it seems that some potential use cases have been overlooked. For example, smart ticketing for concerts and gigs is one possibility. A company called Ascribe is exploring creating limited editions of digital visual images - This means revenues could be made with limited editions, collector’s editions, fans’ editions and box-sets of recorded music. A streaming platform Resonate suggests using Blockchain technology to provide proof of membership and anonymous voting records. Blockchain technology could be used for managing asset transferring, such as intellectual property. A company called Colu, which is developing a service for transferring intellectual property claims that it will support the rights management. In addition, there seems to be significant benefit in licensing with smart contracts, which support syncing licenses automatically peer-to-peer for example a rights owner and a mixer. (O’Dair, Beaven, Neilson, Osborne & Pacifico, 2016)

4.3 Blockchain in DRM

The first part of this thesis introduced the DRM technology and the Blockchain technology. As the research questions state, there was a need to find out what aspects the Blockchain technology could solve, and how Blockchain technology responds to previous challenges in DRM. At this point it seemed that Blockchain has many functionalities, which are missing from the traditional DRM technologies. There might be a possibility that Blockchain technology is seen as a part of DRM technologies, but there are certain characteristics that do not fulfill the DRM framework. It was claimed by Swan (2016) that Blockchain will revolutionize all of the industries including the music industry. There is a lot of around the topic but the actual implementations will be seen in the future. (Swan, 2016)

Ujo Music worked on the Alpha project in 2016, which was built on the Ethereum Blockchain ledger, for providing an open platform for all artists. The project was done with the artist Imogen Heap, and her song “Tiny Human” was used and included all the relevant metadata of the song. The aim of the project was to achieve an open and fair music industry. “Tiny Human” was the first song implemented on the Blockchain for demonstrating transparency and benefits of smart contracts on Ethereum. The smart contracts generated automated royalty payments. (Consensys, 2016)

Figure 9 shows the platform and behind each selection more details and metadata are found. Figure 10 show the stems. When buying these stems for the indicated price, which is set by the smart contract in this example, the user gets all the stems/tracks of the song separately. The user can then use these stems/tracks in a music recording project since the purchase through a smart contract provides a license. Figure 11 shows the different licensing policies, including several different variations of licensing. (Consensys, 2016)

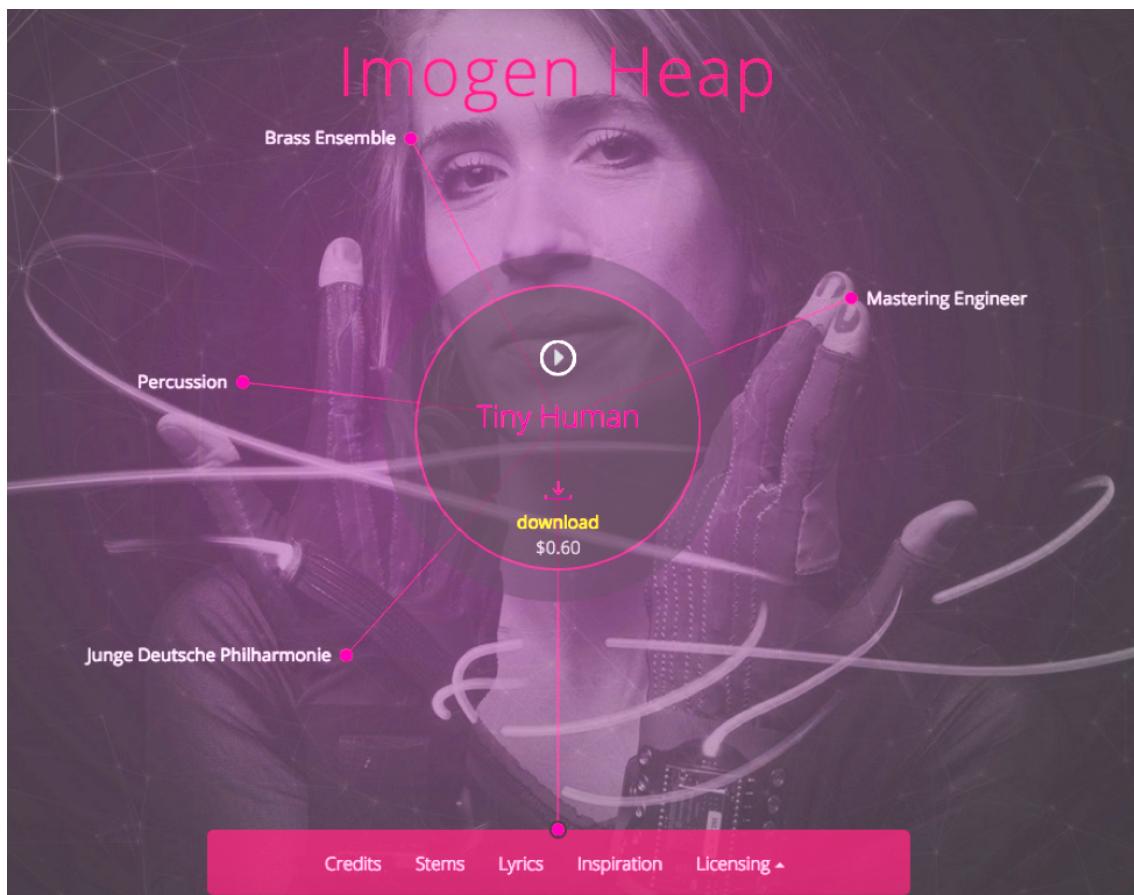


FIGURE 9 The platform (Consensys, 2016)

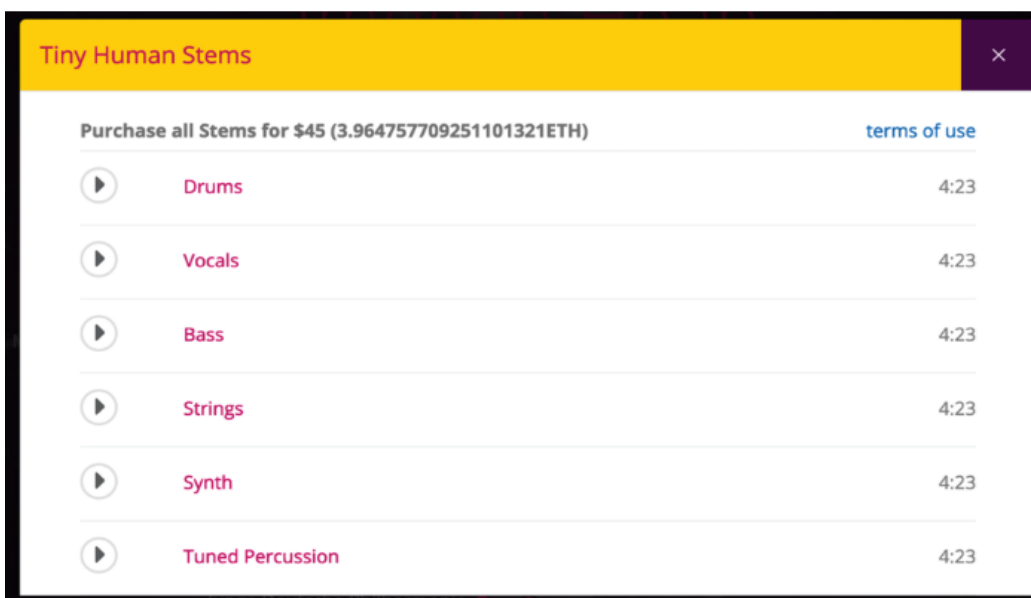


FIGURE 10 The stems (Consensys, 2016)

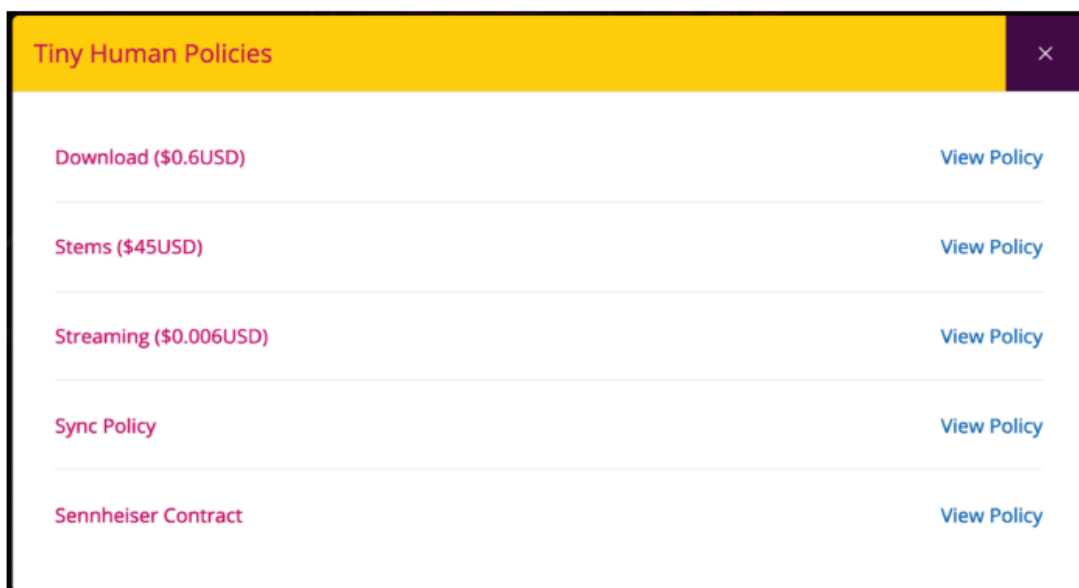


FIGURE 11 The different licensing policies (Consensys, 2016)

There are five areas identified where Blockchain technology affects the record industry: (Heap, 2017)

1. The database is distributed
2. Peer-to-peer transmission
3. Transparency with pseudonymity
4. Irreversibility of records
5. Computer logic

(Heap, 2017)

Teosto has developed a pilot project called Pigeon, based on Blockchain technology, which was designed to report live performance of rights owners globally. The Pigeon pilot is a reporting tool for the Collective Management Organizations (CMOs) to manage and handle performance related data and is ideal case example of using Blockchain technology. (Teosto, 2017b).

4.4 Literature review conclusions

Digital content production is growing rapidly and the content is available to the consumers in many various ways, regardless of time and most places. Streaming services and music industries are not benefiting, not to mention the professional musicians, composers and artists. The current situation needs a profound development in the whole system. At the moment, the content is usually centralized with several service layers and multiple middlemen, and current digital rights management technologies cannot prevent piracy effectively.

DRM has been used for two different licensing models, which are the management of payments and the usage rights (Kwok, 2002). The literature review introduced both areas generally and gradually introduced Blockchain technology. Since there are not many empirical studies on implementing Blockchain technology, there is an emphasis on the second part of the thesis with related interviews.

DRM came into use in the mid 1990s and has had many ups and downs technology-wise, (Paskin, 2003). At the beginning of the year of 2000, in the late 1990s digital music got distributed via peer-to-peer (P2P) networks. It differed from the previous client-server architecture, since in P2P networks, nodes serve both as a client and a server. P2P networks were used widely for illegal purposes and accused of harming the music industry. (Halttunen et al. 2010b.) Several music download stores such as iTunes came to the market during the first five to ten years of the year of 2000. The music download stores used the digital rights management technology to protect the content and prevent piracy and illegal use. Eventually DRM systems turned out to be inefficient for protection and caused many issues for users, and in 2009 a decision of the iTunes store, followed by many other stores was to abandon DRM protection. (Halttunen et al., 2010a; Halttunen et al., 2010b cited in Halttunen, 2016)

SBMS or also known as Musical Digital Service Providers (DSP), such as Spotify, AOL or Pandora acquire licenses for digital content they provide by relying on a patchwork of databases, this setup might cause unfair advantages for term negotiations and cause inefficiency. There is a need for a central licensing database. Internet caused so many changed to information processing, which reflects on in efficiency in music licensing, current systems for royalty payments creates high level of disenchantment among musical artists, is inefficient and patchy. (Dunham, 2016)

There was an aim to understand figure 3 on chapter two, of how Blockchain technology could fit in this figure: could it replace DRM in each phase or

provide a partial solution. Almost all of the references supported the aspect that Blockchain technology would replace many functions in various industries. The literature presented functionalities, such as smart contracts, micropayments, autopayments, crowdfunding and even an Alpha project done as a collaboration between Imogen Heap and Ujo Music. There was also a reference to the Finnish Collective Management Society (CMO) Teosto, discussing their Blockchain pilot project for live performance reporting. The literature review did not thoroughly respond on the gained value on these features - it was only reported that they were a success. Blockchain technology is a new technology and does not yet show the gained value over time.

DRM's role has been mainly to restrict and control usage and prevent piracy of digital content. In the music industry DRM technologies are mainly used by record labels. DRM technologies have not been directly connected with collective management organizations (CMO), which operate globally and are responsible for collecting and allocating the rights owners' compensations. The Finnish CMO, Teosto, is a pioneer in the Blockchain technology field.

It has been stated by Swan (2015) that this technology cannot only be used for economical purposes alone, but also for example: political, humanitarian, legal, scientific, art and entertainment. Swan claims also that Blockchain will revolutionize every market field in the industry, offering transparency, traceability and tamper-proof systems. Almost all industries are discussing and investigating Blockchain technologies, there is a technology hype for example in finance, banking, logistics, supply chain, energy industry and intellectual property management. (Swan, 2015)

For future objectives of Blockchain it is not yet confirmed, which platform or technology implementation will achieve the strongest position to provide recorded music since it needs further exploration. Ujo Music is one of the most familiar decentralized music platforms, in addition there are Peertracks, Bit-tunes, Aurovine, Dot Blockchain Music and they all use different cryptocurrencies and this might limit adaption and innovations. (O'Dair, Beaven, Neilson, Osborne & Pacifico, 2016).

There are also concerns with Blockchain technology issues and possible capacity issues. These questions were asked in the second part of the thesis in the interviews. It seemed that the future will reveal how the Blockchain will be adapted in the market, but there is a substantial need for a change in the music industry since the current trend cannot go on economically and is causing challenges for the rights owners.

Obviously, there are going to be several challenges with the Blockchain technology implementation and adjusting the adaptable services for the users in the digital rights management market. When comparing the introduced possibilities and future objectives and comparing these to the traditional DRM-technologies, it becomes apparent that these kinds of possibilities have not been provided before. Music tracks and individual tracks from a song can generate revenues in real time to the original owners with integrated smart contract and micropayments. There are many remarkable possibilities with Blockchain technology, but it all comes down to the final implementation; it should be easy to use, approachable, effortless, customizable and innovative. The future will re-

veal how the Blockchain will be adapted in the market, but there is a substantial need for a change in the music industry, since the current trend cannot economically continue.

5 RESEARCH METHODOLOGY

The chosen research method was a qualitative study approach, since it was a suitable method for this field. Suitability was determined by having very specific areas to examine and the interviewees needed to have the expertise in the related fields. The method combined a literature review, conducted interviews, and gathering background information from commercial websites, aiming to understand the involvement of Blockchain technology and digital rights management. There is no well-formed hypothesis for this research since the field of study is new, and not that well examined. The research findings relied on the information gathered from the interviews, extracted perspectives and the insights. A sufficient dataset was achieved when reaching a saturation point after performing the interviews and examining emerging themes. (MeasuringU, 2017)

Interview questions were based on the following research questions:

RQ1: What challenges can Blockchain technology possibly solve, compared to previous DRM technologies in digital rights management issues?

RQ2: How does Blockchain technology relate to previous technological challenges in DRM?

RQ3: What are the possible impacts provided by Blockchain technology on music content digital rights management?

5.1 Research design

As stated, the first part of this thesis was a literature review and the second part included comprehensive interviews including a total of 7 interviewees from different organizations such as Teosto, VTT and Aalto University. There were four interview areas and three research questions and respond-

ing to these depended on the findings of the literature review and the interviews.

The study followed an inductive approach, with related interviews, which were semi-structured and with only the main areas of questioning determined and sent in advance for the interviewees. (Hirsjärvi & Hurme, 2009)

Interview topics comprised:

1. History of DRM
2. DRM challenges
3. DRM abandoned
4. DRM resurrection including Blockchain technology.

Appendix 1 included the frame of the interview, the headers and the article link, which were sent to the interviewees in advance. Appendix 2 includes the English translation. Interviews were performed in Finnish. The questions for each area were based on the literature review findings and room was left for improvisation as the Blockchain technology is new and requires discussions to get a deeper and better understanding of the area involved. For Teosto emphasis depended on the interviewee and their experience of the field in each area, whereas for VTT emphasis was on Blockchain technology. For Aalto University interview emphasis was on DRM technologies. The overall aim was to gather a consistent representation of the described interviewees, since the topic was new, especially within the challenging framework of DRM; there was no single organization that could cover all the questions, so it needed to be a combination of different entities to cover the area in study.

The case unit in the thesis were the participants in the interview in a one-to-one interview. The interview responses were organized and classified by paragraphs and sentences related to a list of topics emerging from the interview, and then written up and organized in the findings section. Interviewees' background information was taken into consideration when conducting the interview and the focus was on each relevant area. The thesis also included quotes from the interviewees and described different outcomes as they emerged. A saturation table of the key topics discussed in the interviews was also constructed to provide an overall picture. In addition, Blockchain technology's role was identified and suggested in the DRM context and described in an adapted illustration in figure 12, chapter 7.

5.2 Data collection

Data was collected by performing one-to-one interviews with representatives from the Finnish Collective Management Organization(CMO) Teosto, from VTT, the Technical Research Centre of Finland, and from Aalto University. The interviews were done through one-to-one interviews, since the information varied from individual to individual. Each interview duration time varied between 1 to 2 hours. The risk of gathering information from small group interviews was

that it might not have provided authentic valid responses from the respondents, other participants in the group may have influenced the responses and each other. Each interview was digitally reordered and notes with keywords and links were taken for ensuring active listening.

The interviews were designed as semi-structured theme interviews, as this ensured the consistency for each interview. Themes were determined in advance and sent to the interviewees before the interview, and for each different theme there were more specific questions and conversations based on each theme focus and the responses obtained. With only partially determined questions the interview gave room for conversation to illuminate tacit knowledge, which might have been difficult to spot with purely structured questions. The study was performed in a conductive manner since there were no theories or hypotheses determined in advance. (Hirsjärvi & Hurme, 2009)

5.3 Selecting the interviewees

Interviewees selected needed to represent the thesis topic from the perspective of different organizations, since this area of study is fairly new and one organization cannot cover this area and respond to the questions. The interviews included four employees working for Teosto, who represent the area of handling rights management. Teosto has been also involved in research collaboration projects with Jyväskylä University. Two of the interviewees work for VTT and have deep Blockchain expertise, and one interviewee is a researcher at Aalto University and has extensive expertise on DRM technologies.

It was important that the research area was relevant to the organizations and that the organizations need or wish to answer the research questions. To ensure motivation, research benefits should be provided to the organizations and expressing to them *“What is in it for them”* (Darke et al., 1998). For motivating interviewees from these three organizations it is beneficial to offer to share the gained knowledge and results from the interviews and the thesis findings.

Teosto is a non-profit organization, that protects and administrates music publishers' and composers' rights. VTT, Technical Research Centre of Finland Ltd is the leading research and technology company in Finland, and provides a technical view for the research questions. The study group of the interviews were determined through the actual interviews when finding the possible saturations points from the studies.

The representatives were interviewed to examine and understand digital rights management and its fundamental challenges and to study the interviewees' attitudes towards Blockchain technologies as a means to resolve the DRM challenges and to more successfully fight the piracy problem.

The possibility of performing a quantitative study, which would have been directly targeted to artists and music composers, was evaluated. However, the required information for this study would have been challenging to gain since musicians, digital right owners, composers and artists are unlikely to have experience of digital rights managed and the management might be outsourced

to a third party. Teosto provided the needed source to answer the research questions, since it had the knowledge of DRM history and was able to provide the insights and information of future objectives, since intellectual property is their main specialty and they have the latest information on DRM and its future direction. VTT Technical Research Centre of Finland Ltd is the leading research and technology organization in the country, and the aim is to gain responses to technological questions, possibilities and challenges about Blockchain. A representative from Aalto University was interviewed to describe the history of digital rights management in more depth and how Blockchain technology could be considered in the future with DRM.

5.3.1 Teosto

Teosto, founded in 1928, is a non-profit organization initiated by composers and music publishers to protect and administer their rights. The decision-making power lies within its ordinary members, who are music authors, and composers. Teosto represents almost three million foreign and more than 30,000 Finnish music publishers, composers, lyricists and arrangers. They collect and distribute royalties on behalf of the music authors they represent, for the mechanical reproduction and the public performance of their music in Finland. Teosto acts as a link between two customer groups: consumers and creators, meaning companies and communities that use music and music creators. Music licenses are provided in a centralized manner at Teosto and they eliminate and minimize the need to make individual contracts with each music composer or creator. Part of Teosto's work is also promoting the rights of music publishers, composers and creators. (Teosto, 2017)

5.3.2 VTT and Aalto University

VTT Technical Research Centre of Finland Ltd is the leading research and technology company, and one of its aim is to develop a technical view for research questions, future objectives and discover possible technical limitations for Blockchain technologies. VTT states that Blockchain technology will be an important part of novel ICT solutions in the future, and establishes Finland to be one of the leading countries in adopting Blockchain technology in various areas. Blockchain is described as a disruptive technology, which could have a profound impact on the way digital value and data is handled. It is also described as an immutable public record of data, which is protected cryptographically and secured by a peer-to-peer participants network. Blockchain is expected to provide trust between two parties without middlemen in several areas such as bank and for the public authorities. VTT is working on a BOND-project, which includes Blockchain related technical and business objectives. (VTT, 2017).

Table 2 describes the interview numbers with matching organizations represented in the interview. All responses are not directly representing the organizations standpoint and there are equally interviewees own personal experiences, which are cited in the research findings section.

TABLE 2 Interview numbers and organizations

Interview number	Organization
1	Teosto
2	Teosto
3	Teosto
4	Teosto
5	Aalto University
6	VTT
7	VTT

Teosto interviewees had a variety of experience and knowledge in the rights management field. Their background included working on developing Teosto's online services and mobile services, conducting IT projects. The interviews also included an executive level interview and also interviews from the field of development and research. (Interviews 1,2,3,4)

One of Teosto's biggest goals is organizing the IT functions, choosing technologies, which provide new business possibilities, innovation possibilities and renewing the business models. Teosto is aiming for efficiency, profitability, savings and transparency in their processes. Since Teosto has been in a monopoly position it has developed its own internal processes. For the past year Teosto has worked on future development and in Slush 2016, where Teosto was a Slush Music's spin-off partner they, published Teosto Future's Lab, which is a development frame in Teosto. Teosto has collaboration nationally, with the Nordic CMOs and European CMOs, and even other CMO's globally. Teosto also co-operates with universities, companies and start-ups, in an open innovation type of approach, aiming to find new possibilities for the future. Teosto is aiming to grow its network, increase its influence and make a difference globally. (Interviews 1,2,3,4)

The interviewee from Aalto University has a background in software engineering and jurisprudence, is a PhD in computer science, and their dissertation was associated with DRM. The Aalto interviewee has been working in the commercial field and at universities, and currently works as a Research Director at the IPR University Center, also acting as an adjudicator in the Market Court

and handling cases related to intellectual property such as piracy. This interviewee also works in co-operation with Teosto and has worked with Jyväskylä University related to music rights management. The two interviewees from VTT are researchers and work with Blockchain technology, the other interviewee is a mathematician, who has conducted cryptography research which led into Blockchain technology. Information security, research scientist at VTT. The other interviewee is a Senior Scientist at VTT, works in the cyber security team, and studied mathematics and computer science. He holds a PhD in cryptographic hash functions; encryption and applying them in authentication and privacy technologies. This interviewee is aiming to provide and combine a cryptographically safe, user-friendly user authentication system, since this has not yet been developed. For Blockchain there are various business opportunities, which have been investigated in collaboration with different partners.

5.4 Data analysis

Theme interviews are an effective approach, when the research area is not very well studied or if the research area is new. Although DRM technologies have been studied in the past years, Blockchain technology itself and applying it to the music content management is a fairly new area of study. The responses to a theme interview's questions were based on each interviewee's personal experiences and the aim was to mark the responses to each theme. The relevant interview responses did not emerge systematically in a particular order. The interviews followed an inductive approach, which was semi-structured and with only the main areas of questions determined in advance. With only partially determining the interview questions, it provided the interviews themselves to leave more room for discussions with the interviewees. There were no theories or hypotheses determined in advance and the research was performed in a conductive manner. Data analysis was done with thematic methods to help understand each research area and group the interview findings to each of the themes. (Hirsjärvi & Hurme, 2009)

The research questions dictated methods, which were used in this thesis alongside the data analysis methods needed to gain an understanding of the findings. All of the interviews were audio recorded and transcripts were written in English based on each interview. Interviews were in Finnish and all of the quotations were translated as accurately as possible, aiming to preserve the actual meaning of the quotations as originally intended. The ambiguity of language was aimed to be carefully considered already in the interview phase and clarifying questions were asked in case of misinterpretation. The interview responses were classified and organized by paragraphs and sentences and were grouped into a list of themes and theme groups. The groups were classified into four different areas as presented in advance to the interviewees, which contained the following areas: Digital Rights Management's history, Digital Rights Management's challenges, Digital Rights Management dissolving and Digital

Rights Management's resurrection. The interviewees' background information was taken into consideration when analyzing the data, and seen if there are any relations between responses. The interview responses were written in a constructed narrative form and the paragraphs were aimed to maintain the meaning of the responses as a whole. Saturation points were chosen for the analysis, based on the research questions to find similarities and differences of the responses to the research questions and also reflecting the findings of the literature review. Each theme was examined in the literature review and an overall understanding emerged related to each interview theme. The interview responses reflected the literature review findings, and additionally the interviews added new objectives to the findings. The saturation points of the interviews were gathered to a table of saturation points, illustrating all of the key findings on a single page view. This study shed light on the development of DRM technology. Based on the unanimous responses of the interviewees, the DRM's were originally created for the offline mode, the time before internet and peer-to-peer networks, and that the music industry needs a dedicated platform for digital rights management. The interview data also indicated the future roles of DRM and Blockchain technology and that these technologies might not replace each other but complete each other for more efficient music content and rights management.

6 RESEARCH FINDINGS

This chapter described the research findings, interview outcomes and introduces the interviewees and their organizations. Teosto provides their services and manages rights of their members, who are composers, rights owners, lyrics writers and publishers. They work in co-operation with the music industry, gaming industry and AV-industry, broadcasting services, streaming services, record industry. Almost every country has a Collective Management Organization (CMO). Teosto is a nonprofit organization, but there are several different business models in other countries. Teosto works based on mutual agreements and has over 100 of these kinds of agreements with different organizations, which provide the right to represent and collect payments of all the music included in this network owned by these organizations. CISAC is the umbrella organization of the CMOs, which produces standards and services for its organizations. CISAC allocates ISBC identification codes for music pieces and composers, CISAC is over a hundred years old. (Interview 1,2,3,4)

In the last few years the data that CMOs receive has been growing explosively. Traditionally a song or piece included the details only of record selling – nowadays, when there are streaming services in the market, CMOs get a remarkable amount of lines of metadata for handling. This requires the CMOs to think of new ways to handle information and look into new technologies. Teosto started to follow the development of Blockchain more closely at the end of 2016. Blockchain technology cannot solve all of the data management issues, but could be an essential part when integrated with other solutions (Interview 1,2,3,4).

6.1 DRM history

The Teosto, VTT and Aalto University interviewees all agreed that DRMs were originally developed for the offline world, in the time before internet. When a key or license number is issued, it cannot be controlled what the users do with the piece, except using afterwards when finding out that there was illegal activi-

ty, such as piracy. With Blockchain a music rights owner has more control, and information related to the pieces are accessible immediately. Furthermore, transactions can be audited and verified.

Of course, there are many DRM technologies, which consider the internet technology. When Napster arrived in the late 90's, which 'exploded' sharing music content through the Internet, different DRMs were developed related to that. DRM is not only one technology but a combination of several technologies. DRM attempted to adapt to the Internet, but a solid reliable solution was not found. DRM is a slow and difficult process. Old technologies made things difficult and piracy was easier, which did not solve the issues. Interviewee 6 described that DRM's reduced the audio quality of the songs. DRM's had challenges to respond to globalization and receiving these compensations from the global market

All interviewees stated that DRM was developed in the end of 90's, as a response since content was spreading through the Internet. Spreading content started from copying physical CD's, and when Internet usage started increasing, the content started to be shared through the network without any control. The Digital Millennium Copyright Act (DMCA) was initiated in the US and started a conversation about copyrights.

"Critics were concerned that the DMCA provides too much power and for the rights owners in a technical sense, since it could be used to other purposes than initially intended. As an example, facts in science cannot be protected by law, no one can own the rights to science facts. If the facts of science would be protected by DRM and the DRM would be protected by law, then it would affect on law protecting the facts of science indirectly - this was a huge obstacle in the end of the 90's. With DRM, it would have been possible to protect content, which was not supposed to be protected." (Interview 5)

The interviewee from Aalto University described that a few years ago there was an EU directive, with a similar kind of content and similar kind of criticism as the DMCA. Luckily the court of law applied the DMCA in a reasonable manner and considered what the actual content was, which should be protected. Afterwards it was noted that DRM might not be the best way to protect content, as an example Sony failed with its DRM and content providers began to withdraw from entities using DRM technology. Content providers did not want to use DRM technologies anymore, even though it would have been legal.

Teosto interviewees stated that old DRM technologies are not related directly to Teosto - The need for DRM has been an initiative from the record industry. Old DRMs felt difficult to the consumers. DRM included several different technologies and no agreed standards. The consumer was never sure if CD's or DVD's were compatible with the media players, and it was also difficult for the consumers to make limited copies of a song or a record. Only simple and easy solutions could have worked to solve the DRM challenges. Old DRMs were created to prevent piracy, but this need has changed since digital content is available online, such as through streaming services, and the aim is not to prevent the usage of the media content but to report its usage.

“Since it was possible to copy from cassettes, LP records and CD’s and when the content became digitalized, the consumers bought the license to use it, but it occurred to be too restrictive and it did not serve the consumer expectations. When buying a CD, the consumer bought the license to use the files on the CD.” (Interview 4)

“DRM’s work very well in the gaming industry and is suitable in that field, but it doesn’t work as efficiently in the music industry. This might be related to a community based mindset on the gaming development and when comparing it to consumers and rights owners, there is a significant difference between these two industries.” (Interview 3)

Teosto interviewees described that the online music stores such as iTunes protected songs with DRM, when they did not function anymore the consumers had a number of files which did not work. The same issue was evident with the copyrighted CD’s. Because of the restrictions set by the record labels, the CD’s did not work in all media players or computers. Finally, online stores abandoned DRM protected files, because these caused too many issues for the consumers. After this, when purchasing an MP3 song file, there were no DRMs to cover the copyright. When the sales of physical records went down the conversation on DRMs diminished. When streaming services arrived in the market in 2008 the DRM dissolved in the background and the consumer did not really notice its presence since it was operating out of sight. For example, when downloading music into offline mode into playlist, the songs are protected with DRM, but using it is easy. Now because of streaming services like Netflix and Spotify, it is easier to stream than to pirate.

“Apple’s philosophy was that there needs to be an agreement with the artists, rights owner themselves when bringing an iPod to the market and emphasize on digital rights management. Not bringing new products as technology first. When iTunes was created, there was a clear demand from Steve Jobs that the DRM should be taken into consideration from day one.” (Interview 1)

Teosto interviewees explained that currently reporting and transferring data between CMOs, publishers and record labels is done in various ways, sometimes via email with attached excel files, and in the worst-case scenario reporting is done through paper. The industry is moving towards faster, easier and more efficient ways to share and report data. Big entities might have challenges in how to do this correctly. The music industry had a Metadata Global Repertoire Database project (GRD), which was rejected in 2014, since it was not only challenging and difficult, but also expensive, and there were trust issues between parties related to who would own the centralized database. Google and Apple would have been involved in the GRD project, but it seems that the smaller entities were having doubts because of lack of trust in the traditional centralized database model and its associated ownership. Here Blockchain with its decentralized model could offer a possibility for the smaller entities to participate alongside the bigger players in a mutual and equal manner with a decentralized database providing revenue benefits.

Technologically DRM is not solid, as there are always ways to go around the technology. There is no bulletproof DRM, as the user can always record and duplicate the data. Also, other things to consider include: not making receiving

the content too difficult (all interviewees emphasized that DRMs should be fast, easy, and usable) and the protection mechanics should be approved by law and approved by the users. Historically there has been misuse of DRM for example trying to rule out competition in the market when using DRM in a different way than originally intended.

6.2 DRM currently

Teosto faces a lot of manual work, operates several software systems, experiences integration issues between systems, uses inefficient tools for reporting like email, which is used a lot. There are no standards for transferring and sharing data between CMOs and it currently involves mainly manual work. This is all inefficient and costly. All of the CMOs have their own databases and the only agreed standard is the CRD format, which requires uploading and downloading the needed data manually. These functions could be solved with better solutions for current databases even without Blockchain technology. Solving this with current databases requires strong entities, that could act as middlemen.

Two of the Teosto interviewees explained that streaming services like Spotify are producing a lot of revenue, but also cause huge losses, which results in distributing and sharing money to music creators at a low rate. This is because of the current development costs being extremely high at this point for Spotify. One of the Teosto interviewee stated that their biggest problem at the moment is the “black box money”, which means that there are huge quantities of streamed music, which cannot be allocated to the right music owners and music creators. In other words, Spotify is unable sometimes to allocate and refund to the correct rights owners. This is one of the biggest problems from the CMOs perspective. A recording piece or track has an ISRC for the recording code and ISWC code for the song/piece, but there are no middlemen to ensure that these are connected or affiliated with each other. ISRC and ISWC are in different information pools. SACEM (France), PRS (UK) and ASCAP (US) have launched a joint Blockchain project to improve data accuracy for rights owners. The same goal is also in Teosto’s interests in the future.

“In a way piracy lead the way to a streaming world like YouTube and Spotify and disrupted the old structures of the music industry. Content is now available constantly, on-demand and mainly free and changes the determination of pricing.”
(Interview 4)

“I would be glad for earnings to be allocated from my monthly Spotify fee to artists who are not that well known. Through Spotify I find artists that I would have not found through other channels; constantly finding new music. Without streaming services, I would listen to the radio and purchase 2-3 records per year. I would prefer a fair game in the music industry and Blockchain technology could provide a solution and tools, but it also requires a cultural shift from the artists, producers, the music industry and the consumers and all these entities should change a bit of their current actions.” (Interview 6)

“At the moment Teosto is not worried about piracy, because streaming services usage has increased immensely. Conversations about piracy have disappeared and I don’t even remember when was the last time we even talked about it. Current services are so good with a reasonable price. This has changed drastically in the last 10 years for the better.” (Interview 2)

Three of the Teosto interviewees and one of the VTT interviewees discussed that streaming services have reduced piracy remarkably. Streamed content is difficult to copy and there isn’t a need to copy it since it is always available. When the content is easy to access, with high quality and at a reasonable price, then unauthorized copies are not needed. Streaming services include DRMs too, but there are different demands. Streaming is good way to share content and is a disruptive technology when compared to the traditional models. It also changes the business models and provides new ways to issue and distribute content.

All of the Teosto interviewees responses pointed out that it seems that music consumers do not see the need to own music pieces themselves anymore, but they are still willing to pay for streaming services. One of the constant challenges in the music industry is the attached metadata of the content, which is the most important part of the music industry, which provides information of whose music is consumed and who gets the royalty payments. This issue has been building up through decades since different actors have been collecting data related to publishers, artists, performers to their own databases without a systematic manner, and although there are international standards for the content it has not been possible to combine all to this data to work together. This issue has been tried to be solved before in last decade, when building the Metadata Global Repertoire Database (MGR), built on traditional databases.

The MGR was a failure which was caused by the problems related to the actors involved, and it cost millions. The projects related to Blockchain are now trying to tackle the same kinds of issues as the MGR project - aiming to build a decentralized database, where the information is equally visible to its members, and supports common updates. This is a very challenging topic to be solved and requires trust also from the bigger entities. The fear of the bigger organizations might be that if they give away data, they would lose their position in the market or lose their role, since the future is unclear and they might not understand what the change actually means.

6.3 Blockchain

Teosto explored Blockchain and its possibilities about a year ago. What Teosto is doing now is aiming to use Blockchain to solve CMOs internal issues internationally. There are globally almost 200 CMOs. Communication and reporting between CMOs are done mainly via email. Before email it was done through fax still about 10 years ago, phone and traditional mail. The shared reporting data includes musical performance data, documentation and data related to rights, composers and shares of these, as well as payment details.

"I have quite a pragmatic view, which is related the CMOs point of view. Some other companies and organizations aim to replace all actions at once with Blockchain, but from my point of view we should identify smaller areas where Blockchain technology could support some of the needed activities, and implement them gradually to investigate the added value." (Interview 2)

6.4 Case examples

6.4.1 Pigeon

Teosto is aiming to solve issues related to sharing data between CMOs. For example, the claiming process with Brazil might take 2 years, but there is no technical reason why this could not be 24 hours. CMOs need transparency. Teosto might get an amount of money from abroad but cannot allocate it all because of missing information – this is an area where Blockchain could provide support to gain transparency. CMOs need speed and transparency for data management. All interviewees agreed that the Pigeon project is a good example of what Blockchain technology could do, and that rights owners need to receive their earnings as soon as possible, as well as transparency about who earns what. They need to have access to this data on a global level like in Japan, North America and South America. This is the music industry's biggest challenge. Blockchain could also support CMOs in focusing on licensing and to ensure that the rights owners get the best possible price.

"This is our main project, which is owned by Teosto, none of the other CMOs have offered a working model like the Pigeon pilot project. The name Pigeon describes a carrier pigeon, which passes on music related messages." (Interview 2)

Pigeon is the first stage of the Blockchain implementation evolution and Teosto is still defining the future. The aim is to provide a cloud based solution primarily for the CMOs, where CMOs from all countries could use the Pigeon platform equally, and possibly also for other entities in the music industry rights owners and even eventually music creators and artists.

"Saves a lot of recourses and bureaucracy. The more users the bigger benefit. There could also be a possibility for, decentralized autonomous organization (DAO) for replacing the traditional models." (Interview 7)

6.4.2 Imogen Heap

"Imogen Heap's pilot is a good example of what can be done with Blockchain and this might be the future direction. Yet It is highly unlikely that rights owners are willing or able to manage their rights and licenses directly as Imogen Heap in the near future. The rights owners might not have resources to publish, find the market themselves and manage licensing and the money transactions and claims themselves." (Interview 4)

Teosto interviewees explained the fact that CMOs system do not provide a platform directly to the consumers. For a platform like this to work, there should be a critical mass of consumers who use cryptocurrencies to purchase these kinds of services. This would provide valuable information for the rights owners. Two out of four Teosto interviewees agreed on the proposal that something like this could be looked into in the future to provide services directly to the consumers.

“Another case example was DJ Hardwell’s pilot. He sold a song directly to the consumers through Blockchain. Easy to do these pilots for one song where all rights are owned, but then it gets complicated when the ownership is more complicated and there is more traffic and a mass of consumers to manage.” (Interview 3)

The Aalto University interviewee stated that buying a stem might be related to small niche group, and there might not be a huge market related to these. This market might not respond well to the classic DRM challenges. What Blockchain can provide here is managing transactions between the rights owners the receiving entities. Blockchain provides tools to DRM, like the smart contract, but does not limit the content accessibility. Yet the smart contract should have the power to decide whether the content can be accessed or not, it could “read” this from the Blockchain. There are several phases between the rights owner and the consumer, and it should be determined where the Blockchain technology is actually beneficial and where not – Interviewee 5 states that Blockchain might not be beneficial for the last phase, between the consumer and the digital store, but only in the phases before this.

Generally, the DRM is usually needed in the last phase, when releasing the content to the consumer. Blockchain might, however, be beneficial in the overall cycle. VTT interviewees claimed that creating a smart contract for a rights owner to admit rights for Teosto might be a too heavy a process, and a simple web form could be much more efficient. When downloading a song from a webstore there might not be a need for the Blockchain technology, but a traditional DRM might work better for these purposes. When there is a need to handle and trace content rights globally, Blockchain would work in these cases. No benefits necessarily for traditional DRM.

The interviewee from Aalto University suggested that it might be beneficial for Right Expression Language (REL) DRM to check from a Blockchain if there is a right to use or not. Blockchain could provide different features, such as restricting access, for example allowing the playing of a song only between 6pm to 7pm; this could be done with the right expression language. This could be good in strategic pricing and could provide a new business model. For example, buying a movie could subsequently provide the soundtrack at a discount price.

6.5 Benefits of Blockchain

All interviewees from Teosto and two from VTT stated that Blockchain could provide a global decentralized model, but for it to work they should work together regardless of the market sector. Blockchain is not affected by the data type or content. In relational databases, the data format must be set in advance, unlike with Blockchain technology. For example, if a song produced by a European composer is played in Columbia or South Africa, is it possible for the owner to actually get compensation more efficiently and transparently by the assistance of Blockchain technology. A Blockchain-based system might offer a solution here, because it provides global scalability and the Blockchain technology itself is trustworthy. Blockchain could also analyze and create trust between different parties even considering different legislations of different regions. Globally the same rules apply for all users in Blockchain, and corruption is not possible.

“I have not yet encountered the benefits of Blockchain, it works well for money transactions but could not identify in sharing the content rights from a rights owner to a CMO. Not sure what is the value. Teosto pilot project seems like the optimal solution of using Blockchain technology, since they have an enormous amount of transactions, which they need to handle. Also, the CMOs need to manage the rights handling globally, for these purposes it might work. When considering managing the whole music industry with Blockchain and replacing DRM, Blockchain cannot fulfill this purpose” (Interview 5)

For interviewee number 1 Blockchain is seen as a technology among any other technology, but there might be some new features, which could support business collaboration activities. The benefits are trust and real-time responsiveness. Companies and organizations are looking for trust. Blockchain might help with solving trust issues, which could provide cost efficiency. Originally, for Teosto using Blockchain technology was more of a company strategy point of view than a technological point of view.

“A CMO might know the name of the song but cannot link it to a rights owner. For example, a song called “Love” can be in several different lines, but the issue is not having data to connect it to the owner. Blockchain could support in allocating the money and this could be public information, but agreement related content, such as publisher information and contracts could be private in the Blockchain.” (Interview 4)

“With smart contracts, artists can determine the content, for example selling a song or a record for only three weeks or a single track from a song can be sold, like a drumming track for example and the consumer can use it in another song. Smart contracts help to set for whom, partial tracks and for a certain period of time without separate written contracts, no lawyers needed in the between.” (Interview 7)

VTT and Teosto interviewees agreed that with Blockchain it is possible to get faster feedback and compensation for the artist, rights owners, direct contacts for fans and followers, and content can be sold to other artists and consumers without middlemen and using less resources. It provides more net-

working possibilities for rights owners and CMOs. The ledger should be partially private and partially public, for example contract details could be on a private ledger. It should be the right kind of ledger for these purposes, but if there are too many ledgers and platforms then the consumers might not use them. They need to be easy and simple to use like the Internet. Blockchain can control piracy, but they might not replace streaming services. Services like YouTube will probably maintain their position.

One VTT interviewee suggested that creating an own ledger for the music rights management might be the sensible approach, since then the special characteristics related to this field would be considered – including functions which are relevant. Overall the trend is showing that the industry will include dedicated ledgers for a certain field of industry and this will assist in managing the complexity, when it is known on which industry it is meant for; whether it is logistics, music or any other industry. A dedicated ledger might provide the best benefit for the music industry.

Two interviewees from Teosto and two interviewees from VTT pointed out that Blockchain technology will not replace current relation based databases, since traditional centralized databases are cost efficient and more data can be stored than in a Blockchain technology based database. Blockchain can be used for other purposes, such as analyzing user reports and consumption and this can be done on a closed Blockchain if needed. The needed data could be gathered from Blockchain and other sources. Blockchain technology is not going to replace current databases, they have their role as providing trust and part of the solution. A traditional database describes what “is” and Blockchain describes what “has been done”.

6.6 Challenges of Blockchain

One interviewee from Teosto and two interviewees from VTT were concerned that the performance capacity of the Blockchain technology is still unfamiliar in an actual business environment. It might be challenging to deploy Blockchain technology in latency critical surroundings, although the technology is developing constantly and these kinds of issues might be solved already in the near future. In latency critical surroundings such as streaming it would be more beneficial to use traditional relational database solutions. In the consumer world this might be critical, but in the CMO world if they receive data in a 1 minute delay, it is not critical.

“Usually with new technologies the implementation is done too early even though the technology itself is not ready and it is not tested yet. If an organization would like to implement a Blockchain project, in some cases they might not find the needed experience, competence or knowledge because the technology is so new and still developing.” (Interview 1)

There are already different kinds of Blockchain platforms for the rights owners/artists to manage their music rights themselves (such as a service called

Epidemic Sound), but the music industry is complex to handle. The rights owners might not have resources to publish, find the market themselves and manage licensing, the money transactions, and claims themselves.

“Exceptions for Blockchain are at the moment are too high, Blockchain cannot solve all the technological challenges, but some of the processes can be optimized to be more efficient but Blockchain will not replace everything. For example, it was speculated that the cryptocurrencies would replace banks, but now the financial sector is one of the most involved actor in the development of Blockchain.”
(Interview 3)

Two interviewees from Teosto and one VTT interviewee explained that the actual implementation of the Blockchain technology is slow and might present obstacles. The interviewees also commented that there will be great solutions and there are several business opportunities for high revenues. The music industry has narrow niche sectors and for some sectors there might be new and specialized Blockchain based solutions. For example, electronic dance music owners might move for direct licensing with Blockchain technology. Services like Ujo Music would challenge the current earnings model, which is not easy to solve. Blockchain technology might provide solutions but there needs to be a mutual understanding in the music industry to standardize and synchronize current processes, otherwise the technology will not be the one solving the industries issues. It might be that smaller entities like Ujo music will gradually come to the market and the leading ones will be finally saturated. Companies that have big resources, like IBM, might eventually take over - they will experiment in the market first and see what solutions are out there in the market. To get the benefit of Blockchain, time and money need to be invested, and in addition the more users the bigger the benefit through the network effect.

Two interviewees from Teosto and one from VTT stated that there is not yet a music platform equivalent to Google or Facebook, which controls the whole music industry. There might be a possibility that in the near future that something like this is going to be created: one global platform for the music industry. For example, Google owns YouTube, and the music and music video consumption on YouTube is enormous. Amazon is also an important player in the field. It might be that an entity like Google or Amazon are not the ones who will invent this global platform, but they would be eager to buying this kind of a solution for example from a start-up, when it is invented.

Two interviewees from VTT explained that smart contracts and transactions consume energy depending of the complexity. The more complicated the smart contract is with functionalities (which does not mean text amount) the more it uses resources and the more transactions costs are incurred. In Ethereum smart contracts can be set to run several times a day or once a day. The transaction cost is determined by the complexity of the smart contract. In Bitcoin there are no smart contracts, so in a way the transaction costs are constant. The interviewees explained that the smart contracts cause vulnerability in the system. For music content management, this could consist of not transferring media but only the information related to it - who has listen to what and which part - and the media could be transferred in the traditional way. If the

songs were recorded directly onto the Blockchain, they would be all visible on a public ledger.

One interviewee from VTT stated that threats of the technology depend of the level of Blockchain involvement. If it is heavily integrated in the music itself and aims for traceability on a global Blockchain, which cannot be deleted, then there might be a threat related to privacy, if a user's music consumption/listening history is found and recorded. It could become an issue if the information is heavily identified to an individual or an organization, for example there might be elements emerging, which are related to political matters. It could be that the level of music consumption level is not reported on this level, but it is technically possible.

The majority of the interviewees agreed that when creating a global platform for music based on Blockchain technology, it is essential to consider when aiming for better control over music consumption, how the privacy of the user needs to be protected and if all the data should be decentralized and not controlled by one entity. There should be transparency in a global platform - if music record labels have a closed platform with each other, it might not be well-functioning. An interviewee from VTT described that Blockchain is very adjustable, and as parameters can be easily changed according to its design, it is easy to adjust them wrongly. Many of the provided Blockchain music platforms might fail because of the lack of knowledge to adjust them correctly and other poorly made technical decisions. For example, with Bitcoin poor scalability is a challenge. The majority of the interviewees explained that Ethereum is better in scalability, but there are some solutions which are too sophisticated at the moment like smart contracts - which means, that solutions built on Ethereum might be too complex, which eventually is very costly. The complexity issue is caused by the users not the necessarily the technology.

"Destroying all information on a decentralized database is very difficult when comparing to a centralized database. To hack it, it depends how the Blockchain is built, the weak spots are the consensus and management." (Interview 6)

6.7 Future objectives

Blockchain as a technology, rights owners and the music markets expectations are challenging the CMOs and the current ways of operating. Current music industry markets might be changing the sociological setup so that it is not about owning music anymore. There is a sociological need for people to own, feel and see a product. Possibly the role of the record labels will change regardless of Blockchain, because the music creators want and need solutions to the current payment models and they are aiming to reduce the number of middlemen. Digitalization overall might offer several solutions of this dilemma.

Micropayment does not concern Teosto because they are not working directly with consumers. They are interested to evaluate the need for this in the future between CMOs.

“Imogen Heap was in Music Slush in 2016 as a speaker and her view was that all the current system should be replaced at one go with Blockchain technologies. It seems that in the majority of Blockchain presentation it is believed that everything should be replaced at one go.” (Interview 2)

“Using micropayments will depend on the cost efficiency, since Teosto is a non-profit organization and all the profit generated goes to its owners, the music creators. The aim is to lower the current cost, which is about 15% at the moment also globally. We are looking for solutions to lower this percentage. At the moment Teosto has been investigating solutions for this, which in the short term increases the costs temporarily. Aiming to take a strong role to benefit the CMO field and achieve a strong influencer role to achieve certain benefits. It has not been decided yet that Blockchain since we are still in the pilot phase.” (Interview 2)

There is a hype around Blockchain in the music industry and several start-ups are appearing around it. Some will find their own market in it and some will not. (For example, Funvestory is an Estonian crowdfunding organization and there have been some discussions to use Blockchain in their functions.)

“Digitalization will challenge rights management and rights ownership. It is not purely about the technical solutions but more of a moral rights issue, which is supported by laws and regulations. These issues are not solved technically, but it is more about presenting the right owner in an appropriate manner. The owner should have the moral rights and it is informed who has composed, created a song and written the lyrics. Technology could only be here as a supporting element; this information should be transferred as metadata. It might be that the metadata itself could be somehow used for owners’ rights protection.” (Interview 1)

Two interviewees from Teosto explained that Blockchain discussions have also involved direct licensing. Smart contracts could allow automatic music licensing depending on the usage and need. This would reduce the recourses needed from CMOs, but then transferring money directly from the consumer to the rights owner is something that might not happen in the near future.

Some platforms become so popular that the other ones are abandoned, or an Interledger type of a solution could be providing connectivity, where ledgers can communicate with each other. Teosto is involved with the open music initiative, where the issue of different ledgers and platforms is being handled. It is conducted by the Berklee College of Music and involves almost 200 participants globally, including big record labels, publishers, CMOs, Universities, several Blockchain startups. The aim is to build a mutual framework of standards, including rights management and licensing, where all these entities can collaborate. In this sense, it is not creating new services but building a solution on the current ones, which can communicate with each other.

Interviews with VTT explained that the Bitcoin ledger could support micropayments and other functionalities and that it is ideal for small transactions. At the moment, the issue is that small transactions with Bitcoin are no longer feasible due to costs, since the network capacity for transaction is too small. The majority of computation capacity is in China at the moment, and if the transaction amount is increased it would require more network capacity, which might be a problem in China. This would not be a problem in Europe or Western countries. Blockchain “mining” is conducted primarily in China because elec-

tricity prices are cheaper there. The technology itself supports free transactions, but due to market requirements highest transactions are prioritized.

A VTT interviewee explained that Ethereum is more scalable than Bitcoin. But it might not be scalable for streaming services since the amounts are too voluminous if each streaming function is based on a smart contract.

“It might be possible to add an outstanding amount of music services on the Ethereum platform such as Ujo music, but the capacity is not enough to manage all of the data. Ethereum can be used in multiple ways, but the suitable parameters should be selected. For the music industry, it might be difficult to find a “one size fits all” solution, but a compromised solution might work in this case.” (Interview 6)

“Of course, there is also a possibility to build a dedicated Blockchain ledger for the music industry and taking into consideration the boundary conditions and rules set by the music industry. For example, rules and boundaries set for the insurance industry and logistics industry might have many differences and these two industries again might be including different parameters compared again to the music industry.” (Interview 6)

An interviewee from VTT explained that, when examining Bitcoin, which is a totally open ledger. It means that anyone can create transactions, mine and read the system. In these cases, there is a bigger demand for the block verification technology, meaning that it needs more capacity. In a closed ledger, only users we trust can enter. This is why in Bitcoin the proof of work is very complex and conservative since it is a totally open ledger. If the ledger is managed in any other way or the proof of work is done differently, it could be lighter on a calculation bases, which means that calculation process is lighter and more transactions and blocks can enter faster.

“Blockchain will definitely make processes faster and making bureaucracy processes faster. Blockchain might also support the global music industries for faster processes. It could help the functionality of the market. There are big differences in the earnings of music creators and composers. Although Blockchain might help to balance the differences in earning it still might not change the market itself might never change; superstars are always superstars. Eventually the last ones standing are the ones which will succeed. When the functional way is found it will spread all over globally.” (Interview 6)

To tackle the capacity issues interviewee number 6 presented that it is possible to make a shorter Blockchain. In Bitcoin, a new block is created every 10 minutes; they grow quickly. A new starting hash can be created and the old one archived. Recording huge amounts of data on a Blockchain is not sensible, it should only hold records of the transaction data about who has done what. For example, who downloaded a song and what song was it. The Blockchain should record data about who bought rights to a song and who listened to a song.

7 DISCUSSION

The final chapter summarized the key research findings of the study and discussed the findings related to the literature review and the research study. The purpose was to understand Blockchain technology and its relation and impact on the DRM systems and music content management. This study included three research questions, which were answered in this study and presented as follows.

7.1 Answering the research questions

RQ1: What challenges can Blockchain technology possibly solve, compared to previous DRM technologies in digital rights management issues?

DRM was designed originally to prevent theft in the entertainment business but they have still not been able to prevent piracy. The amount of digital music is increasing, but the music industry is struggling to adapt to the new technological era. The music industry is unable to prevent free copies of songs spreading online, through for example file-sharing networks. The industry has tried to use DRM to control digital media copying in several ways and some of the DRM technologies are considered controversial causing debates surrounding legal issues and monopolies. (Hoffmann, 2009)

As explained DRM systems were originally created for the offline mode, the time before internet. There is a need for a global decentralized platform, where data is recorded related to digital rights management, providing reliable, transparent and traceable data. This is an area, where Blockchain technology could provide a solution. DRM technology would be deployed at the final stages of the DRM process cycle, collecting data possibly through REL and checking the details through the Blockchain. The system needs to be easy and accessible. The main point is to compare the improved system to the effort involved in purchasing a CD from a store, getting a receipt and making sure that the rights owner is rewarded efficiently.

The arrows in figure 12 shows the possible role of Blockchain technology, based on the research findings of this thesis, and it is proposed that Blockchain could be used for monitoring the usage as a reporting entity, providing the missing transparency and traceability, which DRM has failed to provide. The monitoring functionality could support with managing the masses of metadata and delivering the needed traceability and transparency, when used together with DRM technologies to provide the rights owners a global decentralized platform. In figure 12 the arrow with the dotted line suggests implementing cryptocurrencies in the future, when the development of technology has evolved to a point, when cryptocurrencies are commonly used and accepted by different entities and users.

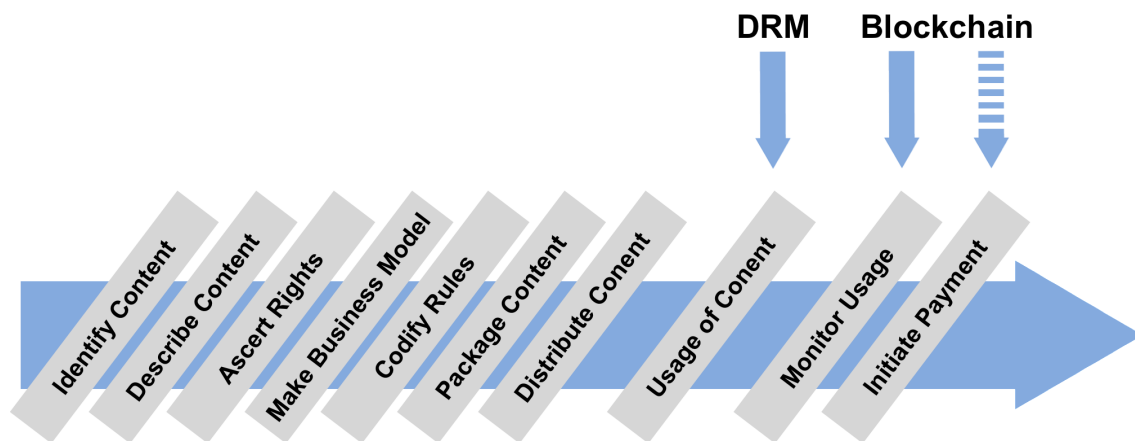


FIGURE 12 Modified from the trading content steps (Paskin, 2003)

RQ2: How does Blockchain technology relate to previous technological challenges in DRM?

DRMs have not solved the issues of piracy, even though there are many DRM technologies in the field. Consumers feel digitally restricted and it is complicated or sometimes even impossible to use the content on other media players or operating systems. DRM technologies do not serve the intentions they are designed for and in some cases users feel that piracy is a better option. (Bridy, 2008)

To summarize the findings of digital rights management in relation to Blockchain technology, figure 12 and the arrows added in relation of the research findings. The different steps in the figure are presented by Paskin (2003) when describing the role of digital rights management and it is mentioned that the steps could be omitted in certain circumstances to production, digitalization, distribution, identification, ascription of descriptions, the use by a consumer, monitoring and money collection (Paskin, 2003). DRMs provide identification, id codes, monitoring the usage and limiting the usage, but they can be very restrictive and make systems complicated for the users to interact with. Based on the research of this thesis and its findings, Blockchain technology is not for replacing digital rights management, but it is an essential part to support and aid DRM systems. Blockchain might be the missing piece of DRM even though it seems not to be classified as a DRM technology.

RQ3: What are the possible impacts provided by Blockchain technology on music content digital rights management?

DRM has been used for two different licensing models, which are management of payments and the usage rights (Kwok, 2002). DRM did not disappear, but its role changed to be in the background so that the consumer cannot see it anymore. DRMs are used in streaming services but the usage of the services is user friendly and that is why it appears that the DRMs have disappeared.

As described in the literature review, the current trend is moving towards a de-materialization of commodities, which means that the consumer does not own the music itself anymore, since consuming is done through streaming videos or music (Magaudda, 2011; Halttunen, 2016). It appears that music consumers generally do not see the need to own and pay for single music pieces or records anymore, but they are still willing to pay for streaming services, were their perception is that they get more value for their money. Streaming services are reducing a remarkable amount of data constantly, and these rows of metadata are increasing rapidly; there needs to be a solution to manage the dataflow for allocating compensations to rights owners. DRM system cannot solve these issues of handling metadata alone, as discussed in the research findings Teosto and other CMOs are dealing with “black box money”, which means that there are huge quantities of streamed music, which cannot be allocated to the right music creators and music owners. Blockchain technology could support in providing the rights owners and collective management organizations, a global decentralized platform, which seems to be needed in the music industry. The music industry needs a profound renewal of their current management and reporting systems to manage metadata handling and compensation allocation to the rights owners efficiently and transparently.

7.2 Summary of the study

The following research questions were studied in this thesis:

RQ1: What challenges can Blockchain technology possibly solve, compared to previous DRM technologies in digital rights management issues?

RQ2: How does Blockchain technology relate to previous technological challenges in DRM?

RQ3: What are the possible impacts provided by Blockchain technology on music content digital rights management?

Research questions responses were based on the literature review and on semi-structured theme based interviews. The theme groups were classified into four different areas and presented in advance to the interviewees, which contained

the following topics: Digital Rights Management's history, Digital Rights Management's challenges, Digital Rights Management dissolving and Digital Rights Management's resurrection. Based on the unanimous responses of the interviewees, the DRM's were originally created for the offline mode, the time before internet and peer-to-peer networks, and that the music industry needs a dedicated platform for digital rights management. The interview data also indicated the future roles of DRM and Blockchain technology and that these technologies might not replace each other but complete each other for more efficient music content and rights management. Blockchain technology could support in providing the rights owners and collective management organizations, a global decentralized platform, which seems to be needed in the music industry. The music industry needs a profound renewal of their current management and reporting systems to manage metadata handling and compensation allocation to the rights owners efficiently and transparently.

The research questions assisted for elaborating the saturation points, and these points were chosen to illustrate the similarities and differences of the responses based on the research questions. The saturation points were gathered to a table of saturation points (table 3) as a supportive tool, illustrating all the findings on a single page view. The table itself does not indicate the saturations but instead was used for evaluating the saturation points and see the variations.

included the following topics: DRMs were originally created for the offline mode, the time before the Internet. DRM has disappeared into the background since streaming services arrived. Streaming services have reduced piracy. Consumers do not need to own songs or records anymore but are willing to pay for streaming services. The music industry needs a dedicated platform for rights management. The suggestion to create a dedicated rights management ledger run on Blockchain technology. Concerns of Blockchain performance capacity in rights management. Suggestion to use Rights Expression Language (REL) to support DRM interaction with Blockchain. Have not yet seen the benefit of Blockchain technology or that it is seen as a strategical technology to use, that Blockchain will not replace current relational databases in rights management. Blockchain technology could support DRM technologies, but not replace them. Blockchain could provide a decentralized model for rights management.

All interviewees agreed on about DRM' s being originally created for the offline mode, the time before internet and that the music industry needs a dedicated platform for rights management and 6 out 7 interviewees agreed that Streaming services have reduced piracy, Blockchain technology could support DRM technologies, but not replace them and that Blockchain could provide a decentralized model for rights management. One out of seven suggested to use Rights Expression Language (REL) to support for DRM interact with Blockchain and one Suggested to create a dedicated rights management ledger done on Blockchain technology. The results of the saturation points do not represent the whole opinions of the interviewees and only describe the emerging topics of conversation. Two out of seven interviewees described Blockchain as an equal technology when comparing it to other technologies and saw it mainly as a strategical technology in the market.

TABLE 3 Table of saturation points

Interview	1	2	3	4	5	6	7	Total
DRM' s were originally created for the offline mode, the time before internet.	X	X	X	X	X	X	X	7
DRM has disappeared to the background since streaming services arrived.			X		X			2
Streaming services have reduced piracy.	X	X	X	X	X		X	6
Consumers do not need to own songs or records anymore but willing to pay for streaming services.	X	X	X	X				4
The music industry needs a dedicated platform for rights management	X	X	X	X	X	X	X	7
Suggestion to create a dedicated rights management ledger done on Blockchain technology.						X		1
Concerns of Blockchain performance capacity in rights management.		X				X	X	3
Suggestion to use Rights Expression Language (REL) to support for DRM interact with Blockchain.					X			1
Have not yet seen the benefit of Blockchain technology or sees it as a strategical technology to use.	X				X			2
Blockchain will not replace current relational databases in rights management.		X	X			X	X	4
Blockchain technology could support DRM technologies, but not replace them.	X	X	X	X	X	X		6
Blockchain could provide a decentralized model for rights management.	X	X	X	X		X	X	6

Six out of seven interviewees suggested that Blockchain should be implemented partially and not to replace all of the technologies in the rights management field. Table 3 summarizes the saturation points of the interviews related to the

topics, which emerged from the interviews. The interview responses were written in a constructed narrative when analyzing the data and grouped accordingly based on the themes. The interview themes contained of the following areas: Digital Rights Management's history, Digital Rights Management's challenges, Digital Rights Management dissolving, Digital Rights Management's resurrection. The saturation points were selected by choosing the key element based on each theme.

7.3 Implications

This research provides valuable findings related to Blockchain and digital music content management. Since the findings implicated that Blockchain might not be suitable to be purely classified in the DRM framework, but applied as a supporting entity for DRM and possibly completing the DRM technology with its ledger registry and reporting functionalities. The findings indicated that Blockchain technology should be examined from a different framework, as for example a reporting technology. Blockchain technology might provide valuable functionalities for managing and reporting metadata, which is generated by streaming services. DRM system cannot solve these issues of handling metadata alone, CMOs are dealing with "black box money", which means that there are huge quantities of streamed music, which cannot be allocated to the right music creators and music owners. Metadata management is an area, were closer examination might be needed since it is causing great financial losses in the music industry.

7.4 Reliability and validity

For evaluating the reliability of the research, the following issues were considered: if the ambiguity of the language is considered, does the interview include the right questions and themes, and making sure that the interviewees understand the interview questions (Myers & Newman, 2007). Themes in a semi-constructed interview should be carefully considered, constructed efficiently in a consistent manner to cover the topic, and there should be back up questions for each theme in case discussions of the topic do not emerging.

When evaluating reliability, trust is also a key point to address. It needs to be considered if materials and interview findings are trusted, can the research process, viewpoints and findings be relied upon, and is there any background information to be considered. Evaluating reliability in the research field is done through evaluating conformability, dependability, transformability and trustworthiness, and minimizing the amount of occurring contradictions. (Golafshani, 2003)

For this research, there was an emphasis on finding saturation points, so there was a need to have enough interviewees to identify them and get the

points saturated in an efficient manner. Validity was determined and examined by evaluating the responses to the research questions and investigating whether these issues were truly answered. In this thesis, all four research questions are listed and answered based on the literature review and the interview findings. Golafshani describes validity as follows, which provides support for identifying it:

“Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit “the bull’s eye” of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others”. (Golafshani, 2003)

7.5 Limitations and suggestions for future research

Limitations in this study arose from the challenge of reflecting on the responses of previous studies, since the research related to Blockchain is fairly new and there are not many similar studies or findings in the research field. On the other hand, all of the interviews had several saturation points regardless of the organization the interviewee were representing. Limitations were also set by the DRM framework, which made it challenging to build a consistent thesis and provide relevant interview structures. This thesis emphasized the research section and there were many valuable findings that emerged.

Since digital content production is growing rapidly and new media is produced and shared every day all around the world digitally. It is clear that current DRM technologies cannot keep up with the current trends. The Internet has enormous musical resources and multiple streaming options with free access. Even though there is a huge offering of music, it seems that the economic situation is not that successful since consumers are not willing to pay for the digital content. Streaming services and music industries are not benefiting, not to mention the professional musicians, composers and artists. The current situation needs a profound development in the whole system. The whole music industry is being revolutionized and there are many field yet to be researched. The essence of the findings in this thesis is explained in chapter 7 with figure 12, namely that Blockchain technology is not for replacing digital right management, but it is an essential part to support and aid it. Blockchain might be the missing piece of DRM even though it seems not to be classified as a DRM technology. DRMs provide identification, id codes, monitoring the usage and limiting the usage, but can be very restrictive and make systems complicated for the users to use. As a suggestion for future research, it would be relevant to understand how to combine DRM technologies with Blockchain and relational databases for a global decentralized database for managing metadata efficiently and allocating compensations to rights owners in a sensible timeframe. Future research could also be focused on investigating the need, benefit and value for the music industry to create a dedicated ledger only for rights owner functionalities.

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APPENDIX 1

Taustatiedot

- Taustakysymykset

Digital Rights Managementin (DRM) synty ja kehittyminen

- Minkälaisia DRM teknologioita olet kohdannut?
- Mihin suuntaan DRM on mielestäsi kehittynyt?

Digital Rights Managementin (DRM) haasteet

- Minkälaisia puutteita aiemmissa DRM teknologiassa on ollut?
- Olisiko piratismi voitu kuitenkin estää nykyisilläkin teknologioilla? kuinka?

Digital Rights Managementin (DRM) katoaminen

- Minkälaiset asiat saivat käyttäjän hylkäämään sen?
- Oletko tunnistanut syitä miksi ne on hylätty?

Digital Rights Managementin (DRM) uusi tuleminen

- Minkälainen visio on DRM:stä tulevaisuudessa?
- Minkälaisia haasteita lohkoketjut voisivat ratkaista verrattuna DRM teknologiaan?
- Miten lohkoketjut vastaavat aiempiin teknologiahaasteisiin tekijänoikeushalinnassa?
- Mitkä ovat lohkoketjujen mahdolliset vaikutukset musiikin tekijänoikeushalinnassa?

Case-esimerkin kysymykset:

- Teoston sivuilla 29.05.2017 julkaistussa artikkelissa kerrotaan lohkoketju alustan kehityksestä ja että prototyyppi keskittyy tekijänoikeusjärjestöjen väliseen tietovaihtoon – Minkälaisia ajatuksia tämä herättää?

-<https://hbr.org/2017/06/blockchain-could-help-musicians-make-money-again>

APPENDIX 2

Background

- Background questions

Digital Rights Management's (DRM) history

- What kinds of DRM technologies have you confronted?
- How do you see the development of DRM technologies?

Digital Rights Management's (DRM) challenges

- What kind of weak points DRM technologies have?
- Would the DRM technology be able to stop piracy?

Digital Rights Management (DRM) dissolving

- What reasons made the industry abandon DRM's?
- Have you identified or noticed these reasons?

Digital Rights Management's (DRM) resurrection

- How do you see DRM's in the future?
- What kind of issues could Blockchain solve compared to DRM technologies?
- How does Blockchain respond to previous technological challenges?
- What are the possible impacts of Blockchain towards rights management?

Case-example questions:

- On Teosto's website there is an article published on 29.05.2017 about a Blockchain project development concerning a pilot - what kind of inputs do you have on this article?

-<https://hbr.org/2017/06/blockchain-could-help-musicians-make-money-again>