Literature Survey - Ownership using Persmissioned Blockchains

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Abstract

A blockchain is a type of distributed ledger. Transactions on this ledger are stored in groups called blocks. Each of these blocks references the previous block with a hash, creating a chain of linked blocks. The distributed nature of the ledger ensures that these parties can trust each other without needing a trusted intermediary. Since all parties maintain a copy of the ledger and are able to validate the correctness of transactions. Systems that implement a structure like this are called blockchains.

Permissioned blockchains are a type of blockchain in which participants agree to comply with a set of rules. Once proven they comply to these rules they are allowed perform transactions on the blockchain. This survey evaluates the current body of work on permissioned blockchains. The reported findings are used in a Thesis on using existing permissioned blockchain technology for a music-industry use-case.

Index terms— blockchain, permissioned, survey, review, thesis, music-industry

1 Introduction

2 Approach

This survey is a modified version of a systematic mapping study defined by [1] and [2]. The modification was done to limit the time spent on the survey. The process as defined by [1] is as follows:

1. Formulate research questions to determine the scope of the survey.
2. Conduct a search collecting scope related articles.
3. Screen the collected articles based on relevancy.
4. Collect keywords from the relevant articles' abstracts to create a classification scheme.
5. Extract the necessary data in order to create a systematic map.

The survey deviates from this approach as it is undertaken as part of a Software Engineering (SE) graduate project. With the goal of evaluating the current body of work on permissioned blockchains. Certain data need not be extracted from the selected articles to serve that purpose.

Further deviation arises as a result of the surveys' scope definition. RQ2 requires a search to be performed to locate current implementations of permissioned blockchains. Both [1] and [2] do not define a process to gather literature or information on implementations of a technology. Ensuring data on implementations was gathered in a structured manner the process defined by [1] was adapted to include both implementations and literature.

2.1 Scope definition

As part of the approach the following research questions were defined to limit the scope of the survey.

RQ1 Which topics are addressed in current research on permissioned blockchains? Answering this question is important to assess which topics are being researched. This will help judge to what degree the graduate project can contribute to the field.

RQ2 What implementations of permissioned blockchains exist? Evaluating which permissioned blockchains exist and what flaws they have will help assessing the state of current permissioned blockchain technology. In turn this can create a framework for which measurements should performed when assessing a permissioned blockchain.

RQ3 What experiments are being performed on permissioned blockchains? Assessing which experiments are performed on permissioned blockchains allows determining what the state of empirical evidence gathering in the field is. This will advance future experiments by providing an overview of which measurements are deemed valuable.

RQ4 Is there any research on blockchains related to the music-industry? This question is relevant for the graduate projects' topic, relevancy and potential contributions to the field.

2.2 Search results

Based on the defined scope a set of search terms was defined. These search terms were entered into Google Scholar and the Universiteit van Amsterdam (UvA)'s online library. An overview of the defined search terms and the results yielded can be found in Table 1.

Matching: The search was performed using on exact search term matching. Meaning the terms should yield results matching the order in which keywords are entered. When a search yielded no results with exact matching default matching on keywords was done. A drawback of default matching is that it yields more results as there are no limitations on order. Which can misrepresent the amount of research done on a topic.

Exclusion: Search results excluded books, patents and citations. Books were excluded due to time-constraints on graduate project completion. Patents and citations were excluded giving a more realistic view on the amount research done.

Search term	**Google scholar**	**UvA's online library**
permissioned blockchain	81	17
permissioned blockchains	92	17
private blockchain	124	189
private blockchains	127	53
blockchain survey*	2,060	55
blockchain review*	4,360	86
permissioned blockchain survey*	91	2
permissioned blockchain review*	163	1
private blockchain survey*	1,590	23
private blockchain review*	2,340	46
music industry blockchain*	951	31
music-industry blockchain*	111	13
Total (including duplicates)	12,090	533

Table 1: Articles found by search term
*: Search terms which yielded 0 to 5 results for exact matching.

2.3 Search result screening

Selection of relevant literature was done by filtering based on title and reading an articles' abstract. Part of the literature came from fields unrelated to SE. They contain evaluations of permissioned blockchains which were deemed useful. In

particular analyses of adoption rates were added to the selection as they provide insights concerning current usage constraints.

Inclusion: All inclusion criteria during screening are listed below and were checked for each article in the order in which they are listed.

1. Title similarity to defined scope.
2. Language, English or Dutch.
3. Similarity of field to SE.
4. Abstract screening.
5. Skimming [1].

Once the screening process was finished the amount of included articles was 25. Screening results per criteria can be found in Table 2.

2.4 Keyword collection

Collection of keywords was done by following a similar process as [2, p.6] and [1, p.3-5]. This was done by (1) reading the abstract and identified keywords, (2) clustering keywords into categories, (3) reading the selected articles, (4) checking references and possibly adding referenced to the selection.

This survey deviates from the approach of [2] and [1] by allowing referenced articles to be added to the article selection during keyword collection.

2.5 Data extraction

During the key-wording and screening process a number of data extraction items were decided upon. Items were selected based on relevancy to the surveys' scope and importance to the screening process. A full list of items can be found in Table 4.

[1] Skimming was done when field similarity to SE was low yet the abstract revealed interesting insights. This ensured that articles were relevant for the graduate project.

ID	Data item	Description
DIA01	Title	Title of the article.
DIA02	Year	Publication year of the article.
DIA03	Contribution keywords	Contribution keywords extracted during key-wording.
DIA04	Context keywords	Contextual keywords extracted during key-wording.
DIA05	Blockchain type	Which type of blockchain the article addressed: permissioned, permissionless or both.
DIA06	Research facet	The type of research done [1, p.4].
DIA07	Contribution facet	What type of contribution the article had in respect to blockchain-technology.
DIA08	Experiment facet	Articles with contribution facet 'Application' or 'Improvement' or research facet 'Solution Proposal' the were checked for experiments and experiment purpose.

Table 2: Article data extraction items and their description.

ID	Data item	Description
DII01	Name	Name of the implementations.
DII02	Year	Release year of the implementation.
DII03	Located year through	Short description how the release year was determined.
DII04	Type	What the type of implementation is.
DII05	Permissioning	Does the implementation allow for permissioning of the ledger?
DII06	Webpage	The webpage of the implementation.
DII07	White-paper/proposal	Location of the original white-paper or proposal. (URL)
DII08	Yellow-paper	Location of the original yellow-paper. (URL)
DII09	Consensus protocol	The name of the consensus protocol.
DII10	Consensus Repository	Location of the consensus protocol's repository. (URL)
DII11	Open-sourced	Has the implementation been open-sourced? (Yes/No)
DII12	Repository	The code repository of the implementations. (URL)

Table 3: Implementations data extraction items and their description.

3 Basic information

This section contains an overview of basic information of selected articles and blockchain implementations. Search and selection results are shown where applicable.

3.1 Articles

Data-extraction items DIA01 and DIA02, title and publication year respectively, were used to determine article basic information.

Search and selection After a scoped search was conducted and all inclusion criteria were applied a total of 25 articles remained. Results per selection criteria are shown in Table 4.

Inclusion criteria	**Remaining articles**
Search results	12,090/533
Title	31
Language	31
Similarity to SE	30
Abstract screening	29
Content skim	25

Table 4: Remaining articles after inclusion criteria application.

Publication year Figure 1 shows the amount of articles published per year. It is worth noting that out of 25 selected articles a total of 19 articles was published in 2016, showing an increase in blockchain research. This agrees with the trend noted by [2] which was published in 2016. Where it was found that most research was published in 2015 indicating an increase of blockchain research publications. This would indicate that the amount if blockchain research publications is still increasing.

3.2 Implementations

The following data extraction items were used to determinebasic information of implementations: DII01, DII02, DII04 and DII05. Representing name, year, type and permissioning.

Search and selection During the search and selection process a total of 11 blockchain-like implementations was found.

Release year Figure 2 shows the amount of blockchain-like implementations. The figure shows that along with increasing research interest in 2016 the amount of blockchain-like implementations increased significantly in the same year.

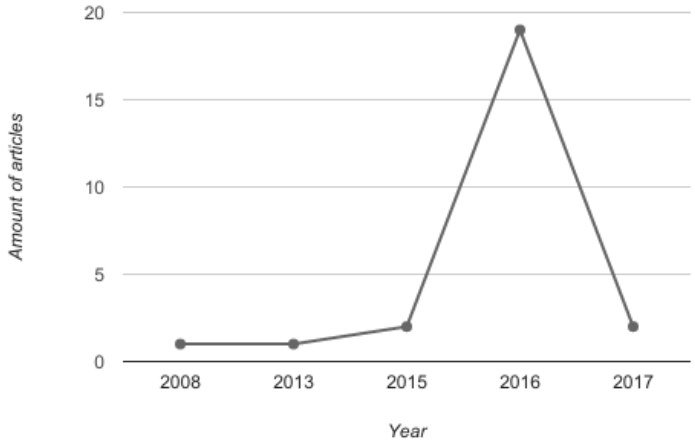

Figure 1: Published articles per year

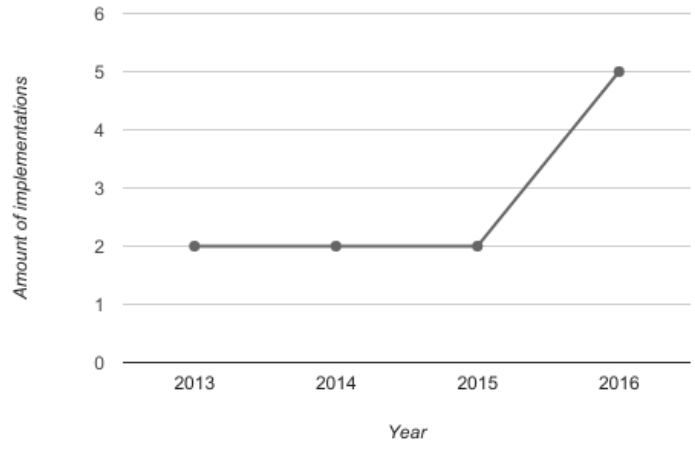

Figure 2: Released implementations per year

4 Classification

This section serves as a classification of selected articles and implementations.

4.1 Articles

Classification of articles was based on data extraction items DIA05-DIA08.

Blockchain facet Determining which type of blockchain an article targets assures that article inclusion criteria were correct. After data-extraction was performed a total it was reveaeld that of the 25 examined articles 15 articles targeted permissioned blockchains and 9 targeted both permissioned and permissionless blockchains. Only 1 article targeted permissionless blockchains. Serving as an indicator that the inclusion criteria sufficed in ensuring articles addressing permissionless blockchain were excluded from the selected articles.

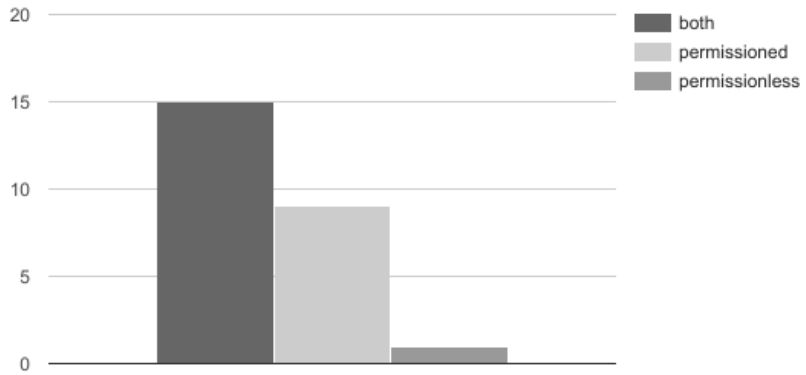

Figure 3: Researched blockchain classification

Contribution facet Figure 4 shows the classification of articles by the type of contribution they made. Out of 25 articles 12 suggested improvements and provided an application of blockchain-technology. Articles classified as reports on the state of blockchain-technology amounted to a total of 7. All other classifications had either 1 or 2 articles in total.

This suggests that research done in the field is focused on improving current flaws and exploring the state of blockchain-technology. As most articles provide improvements and applying them as a suggested solution.

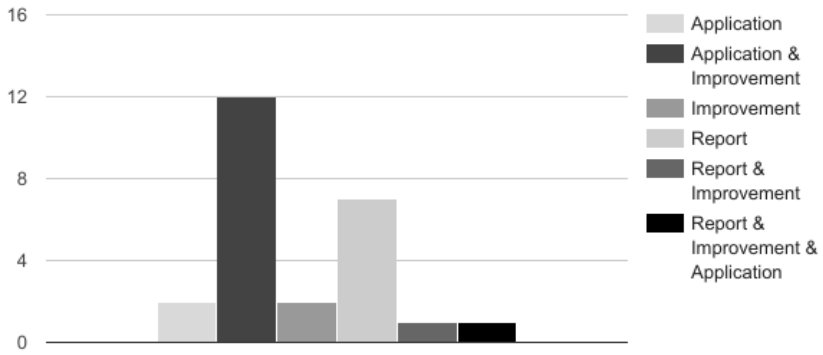

Figure 4: Research contribution classification

Experiment facet Classifying articles in terms of experimentation was done to examine the state of empirical evidence gathering. Classification was performed on articles that were classified as providing a contribution of all types excluding reports. The final classification as shown in Figure 5 reveals that out of the 16 papers included 56% performed no experimentation. Another 7 articles or about 43% performed experimentation to validate an application of blockchain-technology.

Figure 5: Performed experiment classification

4.2 Implementations

Classification of implementations was done based on data-extraction items DII04, DII05 and DII11. Respectively type, permissioning and open-sourced.

Implementation type Figure 6 shows that out of the 11 implementations that were classified 6 were blockchains implementations. Only 2 implementations were related to blockchains in the sense that they use distributed ledgers. Upon inspection it was revealed that the remaining 3 implementations had more in common with payment-systems connecting ledgers than blockchain implementations.

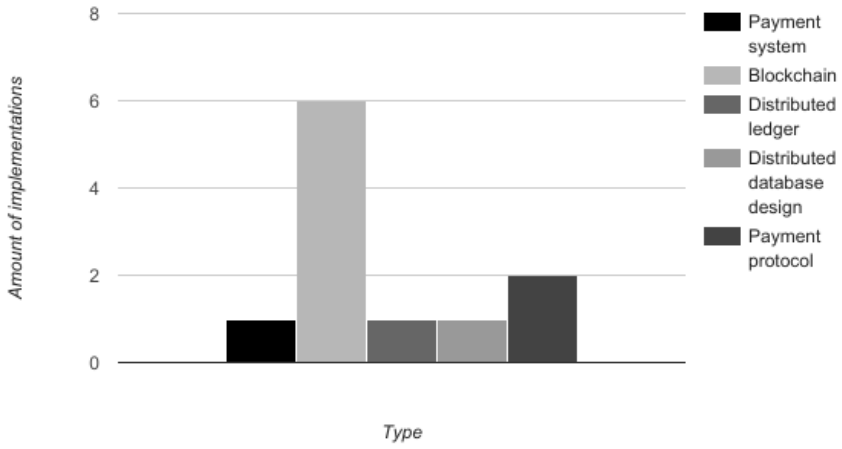

Figure 6: Implementation type classification

Permissioning NOTE: Still need to finish this. Most of the sources state that they can be used as such, though I'd rather find a reliable static source (for example in a white paper).

Open-source All of the included implementations have open-sourced their code. Clear reasoning why this was done was not investigated as it was not within the scope of this survey.

5 Discussion

This section goes through the search results and their subsequent classification answering the four research questions defined in subsection 2.1.

5.1 RQ1 – Which topics are addressed in current research on permissioned blockchains?

5.2 RQ2 – What implementations of permissioned blockchains exist?

5.3 RQ3 – What experiments are being performed on permissioned blockchains?

5.4 RQ4 – Is there any research on blockchains related to the music-industry?

6 Conclusions

References

[1] Kai Petersen, Robert Feldt, Shahid Mujtaba, and Michael Mattsson. Systematic mapping studies in software engineering. In *EASE*, volume 8, pages 68–77, 2008.

[2] Jesse Yli-Huumo, Deokyoon Ko, Sujin Choi, Sooyong Park, and Kari Smolander. Where is current research on blockchain technology?—a systematic review. *PloS one*, 11(10):e0163477, 2016.

Acronyms

SE Software Engineering. 3–5

UvA Universiteit van Amsterdam. 4