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Standardisation of a terminology for blockchains
Distributed ledger technology
Specification of the fundamentals of a new technology area

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Abstract: Blockchain technology is a revolutionary approach in the context of decentralised data systems. Starting with the introduction of the cryptocurrency Bitcoin, it has seen rapid growth in importance and investment. The clarification of basic terminology is particularly relevant for this young field of technology. To this end, the BlockOne project is developing a terminology specification based on the accelerated DIN-SPEC process. This article presents the method developed to prepare the terminology and the current status of the standardisation work.

Keywords: blockchain, standardisation, standard, terminology

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1. Introduction

1.1. Importance of blockchains

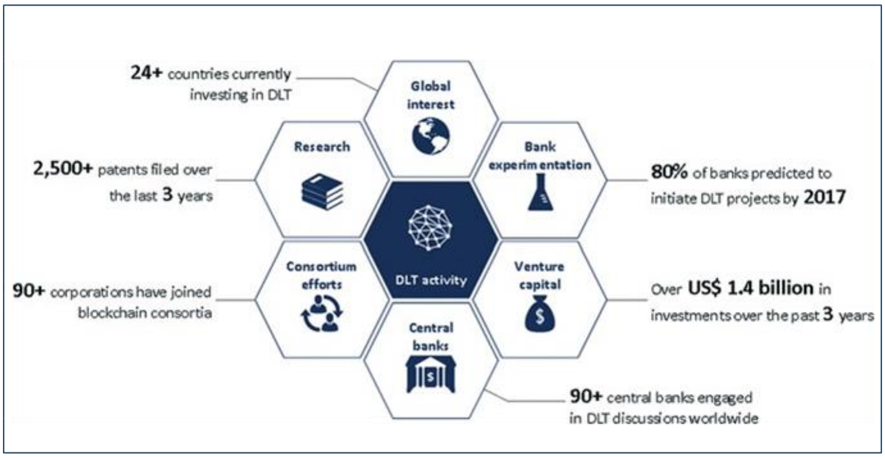
In 2015, Satoshi Nakamoto, the developer of the cryptocurrency Bitcoin, who operates under a pseudonym, was nominated for the Nobel Prize in Economic Sciences based on his 2008 article "Bitcoin: A Peer-to-Peer Electronic Cash system" (Nakamoto, 2015). According to the World Economic Forum (2016), blockchains and distributed ledger technologies (DLT) are now counted among the most important innovations of the last 50 years, on a par with the internet.

Bruce Pon, one of the blockchain pioneers in Germany, summarises current assessments of blockchains as a revolutionary technology by the specialist community as follows:

"Blockchains are a transformative technology with global significance. They are a general-purpose technology. They represent the next wave of digitalisation that will fundamentally change our relationship with all things of value (...). They offer a multi-billion-dollar perspective that will revolutionise all sectors of the economy including finance, insurance, capital markets, supply chains, manufacturing, energy, the Internet of Things (and) intellectual property and identity." (Source: Communication with the authors on 25 October 2016).

Blockchain and distributed ledger technologies are currently experiencing strong interest worldwide, which has already crystallised in extensive projects and investments (see Figure 1).

Figure 1: Current developments in the area of blockchain and distributed ledgers (Figure 1.1 of the World Economic Forum), Source: Extracts from World Economic Forum (2016)



Ernst & Young (2016) currently estimate the fintech market to be worth € 2.4 billion in Germany alone. Nevertheless, there are obstacles to the full realisation of the enormous future potential of blockchain solutions, such as unclear and contradictory terms and concepts. The need for norms and standards is discussed in the following chapter. Afterwards, BlockOne, a project to address this need, is presented and the methodological approach to developing blockchain terminology is discussed. The article concludes with a reflection on the work and further findings.

1.2 Importance of the early development of terminology standards

Norms and standards play an important role in the development of new fields of science and technology. The individual research and innovation phases as well as specific standardisation requirements are closely interlinked. As Blind & Gauch (2009) point out, terminologies and semantic standards in particular have a fundamental benefit from the outset because they support communication and collaboration.

Specifically, Blind & Gauch (2009) emphasise based on findings in the field of nanotechnology that new areas in science and technology require common terminology or semantic standards as a basis for their further development:

"Terminology standards are already required in basic research investigating new technologies (…) in order to allow or facilitate efficient communication, but they play a crucial role in the transfer of knowledge from basic to oriented-basic and applied researchers. However, terminology standards are even more crucial, since they provide the basis not only of the research in basic research, but for all following research activities as well as standardisation activities. If terminology questions and problems are not adequately resolved in the early stages, they are not only transferred into the later stages, but also produce a multiplication of terminology problems there, which often cannot be solved adequately anymore due to a divergence instead of a convergence of the understanding of basic components and elements of a new technology." (Blind & Gauch, 2009, 325).

Blind & Gauch (2009) emphasise the benefits of a common basis of terms and concepts for efficient and effective collaboration in technology development:

"(t)erminology standards (...) build the basis for all following phases in the in novation cycle and the following standardisation processes. Common terminology standards have to be achieved rather early in order to trigger a convergence instead of a divergence in the understanding of the basic elements of a new technology (...)." (Blind & Gauch, 2009, 326).

The BlockOne project, which is discussed in Section 2, addresses these requirements by developing fast-track standards, known as DIN SPECs.

2. Method

2.1 DIN SPEC as a fast-track standardisation instrument and the BlockOne project

2.1.2 DIN SPEC in accordance with the PAS procedure

A DIN SPEC is "a publicly available document that specifies requirements for regulatory objects of material and immaterial nature or findings, data and so on from standardisation or research projects and which is managed by committees put together at short notice at DIN, the German Institute for Standardization, and its working committees or within the framework of CEN workshops (...)" (Gaub, 2009, 36). Their advantages include above all rapid availability, effective diffusion of innovations and the possibility of entering the standardisation process. A particular added value lies in the time that can be saved. In contrast to a standard, it can already be used after around six months of development (see Wurster, 2016).

This article focuses on the development of a DIN SPEC according to the procedure of a publicly available specification (PAS), whose creation is briefly outlined below. The starting point for their development is the initiation in the form of an enquiry to DIN (see SPEC DIN, 2012). If the proposed topic is confirmed, the initiator of the project draws up a business plan, which contains in particular information on the project objectives and the planned implementation. The business plan is then published on the Beuth Verlag website for one month and offers the opportunity to indicate an interest in participating in the project within a specified publication period. The working committee is then put together. A contract regulates copyright issues and the financing of the project.

The preparation of the specification includes a kick-off meeting, the preparation of the manuscript, an optional draft publication and the likewise optional incorporation of any comments received. In the kick-off workshop, the business plan is approved, taking into account any comments received during the publication phase. It is recommended that a chairperson be elected at this meeting.

Manuscript preparation is the main activity in specification development. This phase ends when the committee agrees on the content of the DIN SPEC.

Optionally, the manuscript can be published for public comment on the Beuth Verlag website. After the deadline, the comments are discussed by the committee and, if necessary, incorporated into the manuscript. The option of publishing the draft has the advantage of receiving further suggestions and feedback, but is usually associated with a longer project period. In the next step, the DIN SPEC (PAS) is adopted by the committee by majority vote. As part of the publication process, the document is made officially available via Beuth Verlag (see Wurster, 2016).

2.1.3 The BlockOne project

BlockOne stands for "BlockOne - DIN SPEC for blockchains: terminology and use case 'block chain notary'." The aim of the project is to develop two DIN SPECs using the PAS method.

The project team is led by the Technical University of Berlin and consists of the university's department of Innovation Economics, Cryptom Technologies U.G. and BigchainDB GmbH. Associated partners are CAS AG and the IPDB Foundation. The standardisation workshops include further experts from various stakeholder groups. Overall, BlockOne has a duration of two years. This article describes the preparations for the creation of the DIN SPEC "terminology for blockchains", the methodological work in the initiation phase and the preparation of the terminology.

2.2 Method for developing blockchain definitions for a standardised terminology

The aim of creating the terminology is to address a large user group of blockchain stakeholders. Its scope therefore focuses on general blockchain terms. A large number of existing blockchain specifications is taken into account, regardless of industry and use. Taking up the international dimension of blockchains, the terminology is written in English. A methodology with two main elements was developed for its preparation:

- Screening of topic-specific sources (existing standards and standards, high-ranking research articles, specialist books and websites, but also relevant dictionaries) to identify relevant blockchain terms, and

- Selection, amendment or, if necessary, creation of new definitions based on the exchange with experts, including the members of the German mirror committee of ISO/TC 307 "Block chain and technologies for distributed electronic journals".

The screening consists of five steps in detail:

1) A list of relevant blockchain terms is compiled based on suitable sources from the specialist community.

2) Modified by the exclusion of terms that

- refer exclusively to a specific blockchain area (e.g. "Bitcoin sentiment Index" for Bitcoin, "uncle Block" for Ethereum)[2] or

- do not represent blockchain terms (e.g. Bitcoin Investment trust, GPU, Fiat Coin)

this results in a modified list of all remaining terms in the sources.

3) An importance index is created for each of these terms. It indicates the frequency with which the term is contained in the sources analysed.

4) The index represents the basis of a further modified list consisting of

- all terms, the majority of which are contained in the documents (for example, if ten sources are considered, this requires at least an index value of 6) and

- complementary terms with a lower importance index,

[2] Bitcoin and Ethereum are the names of two major blockchains

- which are required for the definition of higher-ranking terms or
- to which experts are attaching increasing importance (example: immutability).

5) On the basis of the first selection process, a more precise modification is made with the involvement of external experts.

The resulting list forms the basis for the next step described in section 3, the determination of the definitions based on the methods and sources described above.

3. Results

This sections shows the practical development of blockchain definitions.

3.1 Selection of terms

To prioritise the relevant terms, sources and Internet pages from the specialist community were first analysed and the following ten pages were assessed as significant:

- Bitcoin.org: https://bitcoin.org/en/voca bular
- Coindesk glossary: http://www.coindesk.com/information/bitcoinglossary/
- Bitcoin Magazine I II: https://bitcoinmagazine.com/
- BC tech: http://www.blockchaintechnolo gies.com/blockchainglossary
- blockchain.com: https://blog.blockchain.com/2014/12/23/10commonlyusedbitcointermsexplained/
- ethdocs.org: https://ethdocs.org/en/la test/glossary.htm
- Eth github: https://github.com/ethereum/ wiki/wiki/glossary
- dinbits: http://news.dinbits.com/p/din bitsterminology.html
- ibm: https://www.ibm.com/developer works/cloud/library/clblockchainbasics glossarybluemixtrs/index.html
- blockchainhub: https://blockchainhub. net/glossary/

The selection was based on expert information in the context of a blockchain workshop held at DIN on 10 January 2017 as well as the knowledge of other experts, for example on the analysis of the Bitcoin.org website.

A study by KPMG (2016), for example, regards the launch of that website in 2009 as an important milestone in the development of blockchain technologies.

On 7 February 2017 the terms determined were summarised in a table, excerpts of which are shown in Table 1. Based on the importance indices shown, a modified list of terms was created, the elements of which are presented in Tables 2 to 4.

The selected terms were used as the basis for the document screening described in the next subchapter. As expected, the detailed development of the terminology will lead to an update of the list. This results in particular from definitions that require the inclusion of further terms, as well as from a modified understanding of terms that no longer requires further terms that were previously considered for explanatory purposes.

Table 1: Extract of the results of the first screening of relevant blockchain terms

Terms	Bitcoin.org	Coindesk glossary	Bitcoin Magazine I II	BC tech	blockchain.com	ethdocs.org	Eth github	dinbits	ibm	blockchainhub	Importance index
Block	1		1	1	1	1	1	1	1	1	9
Double spending	1	1	1	1	1	1	1	1		1	9
Blockchain	1	1	1	1	1			1	1	1	8
Public-private keys, Asymmetric cryptography	1	1	1	1	1	1	1		1		8
Address	1	1	1	1		1	1	1			7
Hash, hashing rate	1	1		1		1	1		1	1	7
Mining	1	1		1	1	1	1			1	7
P2P, Blockchain network	1	1	1	1		1		1			6
(Digital) signature	1	1	1			1	1		1		6
ASIC		1		1		1		1		1	5
Cryptography, Encryption	1		1			1	1	1			5
Difficulty		1	1	1	1	1					5
Genesis block		1	1	1		1				1	5
Proof of work/PoW		1		1		1	1			1	5
Smart contracts				1		1	1		1	1	5
Wallet	1	1	1			1				1	5
...											

3.2 Document screening for the collection of alternative definitions

To collect possible definitions, a document screening was carried out using the selected terms. In addition to the fundamental contributions of

- Nakamoto (2008)[3]) on blockchains as a whole and the Bitcoin blockchain and
- Buterin's (2014) white paper on the Ethereum blockchain[4]).

Sources from the Web of science database, which currently contains 19.9 million articles from 33,000 scientific journals (see Web of science, 2017). At the beginning of the database work, the documents recorded on 6 March 2017 under the keyword "blockchain" were identified. The ten most frequently cited articles on blockchains were then analysed. Since blockchains are a young field of research, the overall citation rate was low.

Therefore, the number of previous readers (usage count) was analysed as a further selection criterion. The results contained some overlaps in the form of documents that are among both the

[3] The name of the author *Satoshi Nakamoto* is a pseudonym.

4 First significant general-purpose blockchain with applications beyond payment aspects

ten most cited and the ten most read articles. In total, as shown below, 17 articles were analysed that were among the top ten according to either the "citations" or the "read" criterion.

- Cocco & Marchesi (2016)
- Collins (2016)
- Eldred (2016)
- Fanning & Centers (2016)
- Goertzel, et al. (2017)
- Hurlburt, (2016)
- Kiviat (2015)
- Kraft (2016)
- Lansiti & Lakhani (2017)
- Lee (2016)
- Peck (2016)
- Rutkin (2016)
- Swan (2015)
- Sutherland et al. (2017)
- Tapscott & Tapscott (2017)
- Underwood (2016)
- Yli-Huumo et al. (2016)

The detailed references can be found in the bibliography.

Based on the source analysis, 119 possible definitions for different blockchain terms were recorded as a basis for further work. Section 3.3 provides a selected example for the subsequent development of a definition approach. The definitions developed formed the basis for the concrete manuscript preparation of the DIN SPEC in the relevant working body. Other specialist sources were therefore also analysed.

With regard to definitions that already have a broader horizon, two general patterns of interpretation for "blockchains" were identified.

One possible point of view is to regard blockchains as data structures. This view is taken up by Narayanan et al. (2016), 32-33:

"We built a linked list using hash pointers. We're going to call this data structure a block chain. Whereas in a regular linked list where you have a series of blocks, each block has data as well as a pointer to the previous block in the list, in a blockchain the previous block pointer will be replaced with a hash pointer."

Another interpretation places the consensus aspect at the centre, for example by referring to the "consensus mechanism", i.e. a consensus process without an intermediary. Structural information is possible, but is not always provided. Hash function-related information is also missing in the following two definitions:

"(A blockchain is) a distributed ledger system that uses a network consensus meaning distributed control to record and execute transactions" (Collins, 2016, 22).

"(A blockchain is) an open, global and decentral infrastructure that allows companies and individuals making transactions to cut out the middleman based on a distributed ledger structure and consensus process" (Underwood, 2016, 15).

3.3 Definition of terms using the example of the term "blockchain"

There were many hurdles to overcome when defining the blockchain terms. With regard to the term Blockchain "This was mainly caused by definitions that were developed at the beginning of the development of blockchain. Blockchains are defined, among other things, as

- "the technology underlying digital currencies such as bitcoin" (Tapscott & Tapscott, 2017, 1) or
- "the public ledger of every Bitcoin transaction ever made" (Lee, 2016, 128).

Table 2: Selected terms based on their dominance in the sources analysed (importance index ≥6)

• Block • Double spending • Blockchain • Public-private keys	• Asymmetric cryptography • Address • Hash • Hashing rate	• Mining • Peer to peer network (P2P) • Digital signature

Table 3: Selected non-dominant terms in the sources based on the criteria shown above (terms with importance indices from 1 to 5)

• Cryptography • Difficulty • Genesis block • Proof of work • Smart contracts • Wallet • Block reward • Confirmation • Consensus process • Nonce • Proof of stake • transaction	• Transaction fee • 51% attack • Cryptocurrency • Fork • Node • Permissioned ledger • Unpermissioned ledger • Token • Unconfirmed transaction • Account • Block header • Block height	• Block validation • Decentralised (system) • (Distributed) ledger • Hard Fork • Orphan block • Reversing transaction • Script • Soft fork • State • Time stamp • Miner

Section 1 showed, however, that the number of possible applications of blockchain solutions has increased significantly with progress has increased significantly has increased significantly. This is illustrated, among other things, by illustrated by the following quote:

"Best known as the computational underpinning of Bitcoin, they have applications beyond digital currency" (Sutherland et al., 2017, 37).

Table 4: Selected terms with an importance index of 0

When developing the terminology, current developments in the specialist community that have not yet been taken up due to the time required to develop and update the sources analysed are also taken into account. In particular, the following terms are taken into account in the terminology:	
• Block Depth (required for the definition of complex blockchain-based concepts)	• Immutability (the term was chosen due to frequent differences of interpretation in practice. For example, the question of the scope of the immutability of blockchain content is the subject of discussions among experts, e.g. in Ethereum forums on Reddit[a]).
a) see for example https://www.reddit.com/r/ ethereum/comments/59naa2/what_does_im mutability_really_mean/	

The blockchain properties are often extended to include either hash function aspects or the properties (cryptographic) "secured"/"secure" or Byzantine fault tolerant. For examples, see Rutkin (2016) and Buchman (2016):

"Cryptographically secure ledger of every transaction made in a system, stored across every computer in its network" (Rutkin, 2016, 22).

"Blockchain is, at heart, an integrity focused approach to Byzantine Fault Tolerant Atomic Broadcast. the Bitcoin blockchain, for instance, uses a combination of economics and cryptographic randomisation to provide a strong probabilistic guarantee that safety will not be violated, given a weak synchrony assumption, namely, that blocks are gossipped much more rapidly than they are found via the partial hash collision lottery" (Buchman, 2016, 14).

Buchman's (2016) fundamental view was often expressed by practitioners in dialogue with the authors. Other synonyms for the security aspect in the blockchain context are the terms "persistent", "immutable", "unchangeable" or "cannot be changed".

Another facet of the diverse interpretation landscape, which has already been expressed above, concerns the inconsistent, sometimes synonymous use of the terms "blockchain" and "ledger", including "public ledger" and "distributed ledger".

In addition to the definition provided by Rutkin (2016), this is exemplified in the following definition proposal for blockchains, which also equates blockchains with distributed databases: "A public ledger system maintaining the integrity of transaction data - a distributed database" (Yli-Huumo et al., 2016, 2).

To summarise, the aim of the work was to find a definition solution that avoids the conflicts shown above and that meets current definition requirements.

At the same time, the "secure data structure" property was recognised as particularly important. In the course of further considerations, the project team became aware of an early definition by the pseudonymous pionier Nakamoto, in which he described blockchains in a supplementary document to Bitcoin's source code (file"main.h") as follows, thereby underlining the "structure" feature:

"A tree shaped structure starting with the genesis block at the root, with each block potentially having multiple candidates to be the next block."

In an exchange of experts, this definition was expanded as follows to include data security and immutability properties:

"(A blockchain is) a tree shaped structure, starting with the genesis block at the root, with each block potentially having multiple candidates to be the next block. Each block, besides the genesis block, contains a calculated hash value of its parent block. since adding a leaf to the tree involves calculating a new hash over its parent, all entries in a tree path cannot be changed without invalidating the hash of the leaf."

Note 1 to entry: since adding a child block to the tree involves calculating a new hash over its parent, no block in a tree path can be changed without invalidating the hash of the child block.

Note 2 to entry: usual applications connect child and parent blocks to lists, which is only a specific form of the more general tree.

To summarise, the definition currently being developed primarily follows those stakeholder groups that see a blockchain as an immutable (data) structure.

The findings were summarised in a list that currently provides definitions for 52 terms. The compiled list formed the basis for a series of workshops to further develop the definitions and create a DIN SPEC based on the steps shown above.

As part of the DIN SPEC workshop series, all blockchain attributes were analysed again after the kick-off meeting. In July 2017, the definition was further modified as follows:

Blockchain

distributed database that is practically immutable by being maintained by a de- centralized P2P network using a consensus mechanism, cryptography and back-referencing blocks to order and validate transactions

Note 1 to entry: A blockchain has a tree shaped structure where each element in the tree is a block that starts with the genesis block at the root, with each block potentially having multiple child blocks. Each child block, besides the genesis block, contains a hash-value of its parent block.

Note 2 to entry: since adding a child block to the tree involves calculating a new hash over its parent, no block in a tree path can be changed without invalidating the hash of the child block.

Note 3 to entry: Practically immutable means that within the confines of current technology and known attack vectors records are immutable.

Note 4 to entry: usual blockchain applications connect child and parent blocks to lists, which is only a specific form of the more general tree.

(The source references have been omitted for the sake of readability of this article).

By the time of writing this article, the DIN SPEC was undergoing further development. The final version is available here: https://www.beuth.de/de/technische-regel/din-spec-16597/281677808.

4. Discussion and Conclusion

The definition of common terms for blockchain technology takes place in a field of tension between the clearest possible definitions for joint cooperation and consideration of the open development of the young technology field. On the one hand, clear and precise definitions are helpful for efficient communication and collaboration in research and development. On the other hand, a DIN SPEC does not restrict further potential development paths and the risk of hindering technology development can be avoided. When using terminology, both overly general (unspecific) definitions and over-specification are problematic. Aspects that have not yet been clarified should be formulated in a general way and excessive concretisation should be avoided. Two examples of previous findings from the standardisation project discussed here are given below using the terms "colored coins" and "address".

As mentioned in section 3, the discussion on blockchains and distributed ledger technologies is still predominantly characterised by the initial reference application Bitcoin, by which the technology became known. for example, the term "colored coins" is used when financial instruments in the Bitcoin area are labelled using a cryptocurrency technology based on the Bitcoin blockchain (see Buterin, 2014). The measures described in this article attempted to adequately characterise the content of the terminology through a suitable selection of sources and terminology.

In addition, some terms are currently used ambiguously or unclearly in practice. both this and the points mentioned above are the subject of an open discussion process in the formulation of DIN SPEC. For example, the term "address" can be used for the recipient address of a transaction as well as for an identification code of a transaction itself (see Lee, 2016).

Overall, the creation of the DIN SPEC on blockchain terms is based on the general characteristic of DIN SPECs as open documents in the creation of which all interested parties can participate and which are developed in several versions until a consensus is reached. The mere initiation of a clarifying discussion of terms can represent an important added value for practice.

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