# Identification of Dimensions for the Description of Blockchain-based Token Systems

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## Table of Abbreviations

| | |
|---|---|
| BCT | blockchain technology |
| dApp | decentralized application |
| DLT | distributed ledger technology |
| ENS | Ethereum name service |
| GTM | grounded theory method |
| ICO | initial coin offering |
| P2P | peer-to-peer |
| SME | small or medium-sized enterprise |

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## 1 Abstract

Advances in blockchain technology in recent years have entailed new business models and an entirely new economy of token systems. While the blockchain enabled an open financial market without intermediaries, blockchain-based token systems do the same for processes and assets outside the scope of finance. Tokens represent assets, and the token systems set the framework for interactions. This study analyzes existing blockchain-based token systems and looks at their technical and organizational architecture. Based on these observations, a model for describing token systems is built.

## 2 Introduction

Blockchain[1] and Cryptocurrencies[2] are creating massive interest which is reflected by the market capitalization rising from $ 18 billion to $ 600 billion during 2017.[3] Research has not thoroughly addressed many parts of this new ecosystem yet.[4] While researchers are already researching blockchain technology[5], the concept of blockchain-based tokens and token systems remains scarcely covered.[6] This study aims to reflect the current state of blockchain-based token systems. More precisely this study seeks to create a model for describing blockchain-based token systems.

On the one hand, this model will provide a general idea of the parts and factors involved in blockchain-based token systems. On the other hand, this model will consist of a set of dimensions. These dimensions will be described, and possible values of each dimension will be discussed. This allows for a more precise description of blockchain-based token systems and will, in turn, make various blockchain-based token systems more comparable to each other.

As stated in the paragraphs above, the topic of research is blockchain-based token systems. This study explicitly deals only with tokens, meaning any blockchain native currencies like bitcoin or ether, the native currency of the Ethereum blockchain[7], are not considered in the study.

The first part of this study is dedicated to giving the theoretical background on blockchains and tokens. The current understanding of blockchain, associated cryptography, and distributed systems is briefly covered, and the rest of the study builds on this existing knowledge. This study of token systems will be conducted according to the grounded theory method (GTM).[8] Data is selected systematically to counteract researcher bias and choose a representative sample. The model for token systems is therefore based on an approximate representation of all token systems.[9] Grounded theory is often used in little-explored fields of research with a weak theoretical framework because it can work with unstructured data of any form.[10] For this reason, this study adopted GTM as its method. There is little formal research regarding token systems[11] however there are existing token systems which can be observed and evaluated.[12]

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[1] Mitschele 2018
[2] Chohan 2017, p. 1
[3] CoinMarketCap 2018a
[4] Yli-Huumo et al 2016, p. 2
[5] Yli-Huumo et al 2016, p. 9
[6] IEEE Digital Library has 9 entries for “blockchain token” compared to 468 for “blockchain” (02.05.2018)
[7] Ethereum Foundation 2018c
[8] Glaser/Strauss 1967
[9] Glaser/Strauss 1967
[10] Stern 1980, p. 20
[11] IEEE Digital Library has 9 entries for “blockchain token” compared to 468 for “blockchain” (02.05.2018)
[12] CoinMarketCap 2018b

In the past, GTM was often used to extract dimensions and models from raw data[13] [14] which suggests GTM is fit to accomplish the goal of this study. The entire process of conducting grounded theory from selecting the token systems, followed by open, axial and selective coding will be illustrated with examples. Deviations from the standard way of performing GTM will be discussed. The third part of the study will present the model which was build and the dimensions comprising it. The dimensions will be explained alongside the discovered values for each dimension. Additionally, the relations among dimensions will be discussed.

The goal is to come up with a new piece of theory on token systems. This new theory is supposed to be a model on token systems, explaining the individual parts and the connections between these parts. These connections are for token systems in general as they don't apply to only one or only a few of the token systems but to the vast majority of token systems.

These qualities make the research question of the study a valid research question according to the criteria set by Gläser and Laudel.[15] The research question builds on existing theory; it adds new knowledge; it explains some relation, and this relation is something general.

***Which dimensions are useful for describing blockchain-based token systems and how do these dimensions relate to each other?***

The goal of this study is supposed to become a point of reference on token systems. This study addresses two audiences in particular. On the one hand, fellow researchers in the field of token systems are part of the target audience. These researchers can gain a basic understanding of token systems and some inspiration for their research. On the other hand, the target audience includes people who are genuinely interested in blockchain-based token systems. These people get an overview of the building blocks of token systems and some guidance on which aspects they should consider when evaluating a token system.

[13] Nicotera 2016
[14] Gavois/Paulsson/Fridlund 2006
[15] Gläser/Laudel 2010, p. 65

# 3 Related Work

The chapter "related work" serves to provide the reader with the necessary understanding of the technologies, theories, and phenomena which will be referred to during this work. This chapter also seeks to set a frame of reference for this work, about where the study fits in the grand scheme of research. The contents of this chapter were developed and updated in parallel to the actual research, to make sure all relevant topics and only the relevant topics are included.

Gabler Wirtschaftslexikon defines socioeconomics as studying economic behavior with economic and social aspects in mind.[16] Therefore blockchain-based token systems[17], the subject at hand, can be understood as systems that act in a socioeconomic matter, ergo socioeconomic systems. The study of socioeconomic systems falls into the field of social research[18]. Seeing blockchain-based token systems as socioeconomic systems, they fall into the area of social research respectively.

As the name “blockchain-based token system” suggests, the subject of study is based on a blockchain. This induces the assumption that it is a socio-economic system itself, meaning there is a system and this system is in economic interaction with its ecosystem.[19] This blockchain-based token system utilizes tokens in some way.[20] These tokens are based on a blockchain, meaning there is a blockchain as the underlying infrastructure and the token sits atop the blockchain.[21]

The subsequent chapters deal with each of the before mentioned aspects separately and in enough detail, to provide the necessary understanding for the reader to follow along in the study.

## 3.1 Blockchain

The term blockchain is commonly used to describe the concept of a blockchain as a decentral database which is replicated on computers across the network[22], as well as to refer to a specific instance of a blockchain, like the Bitcoin blockchain[23]. The concept commonly referred to as blockchain was first published by a person or group of people under the pseudonym “Satoshi Nakamoto”[24]. The concept of a blockchain stems from the field of cryptography[25], which is

[16] Maurer 2018
[17] (Definition in chapter 3.3 dApps & Token Systems)
[18] Maurer 2018
[19] Maurer 2018
[20] (Definition in chapter 3.3 dApps & Token Systems)
[21] Kasireddy 2017
[22] Mitschele 2018
[23] Ethereum Foundation 2018c
[24] Nakamoto 2008b
[25] Nakamoto 2008b

enforced by the fact, that the Bitcoin whitepaper was initially published to a cryptography mailing list[26]. Blockchain aims to provide integrity of data in a decentralized way without a trusted third party.[27] Satoshi Nakamoto himself mostly referred to this concept as a "proof-of-work chain[28] in his Bitcoin-whitepaper and never specifically used the term "blockchain" in the whitepaper. Nevertheless, this was the genesis of blockchain[29] and people soon adopted the term "blockchain" to refer to this concept.

From here on out the concept of blockchain will be referred to as Blockchain Technology (BCT). Instances of BCT, e.g. the Bitcoin blockchain, will be referred to via their instance name. So the Bitcoin blockchain would be referred to as Bitcoin or "Bitcoin blockchain" but not merely as "blockchain" without specification.

In his whitepaper, Satoshi Nakamoto proposed the use case of a "purely peer-to-peer (P2P) version of electronic cash".[30] The first instance of BCT is the implementation of Satoshi Nakamoto's idea of electronic cash, the Bitcoin blockchain[31], which is the largest public blockchain by market capitalization to date.[32]

BCT is a form of information infrastructure.[33] BCT describes a protocol for arranging information in a transaction and transmitting it to the network.[34] This protocol allows the network to perform a verification of the contents of the transactions in a decentralized way.[35] The network is incentivized to keep the integrity of the data, usually by issuing new tokens or paying transaction fees to the entities participating in the creation of the consensus and working on the longest chain.[36]

Besides BCT, the term distributed ledger technology (DLT) gained popularity in recent years.[37] The two words are often used in similar cases, and there seems to be some uncertainty regarding the accurate definition and delimitation of the terms.[38] This study does not claim to have the ultimate answer to the delimitation of the two terms, rather existing definitions are used. For DLT the definition will be assumed as a "type of distributed database that assumes the possible presence of malicious users (nodes)"[39]

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[26] Nakamoto 2008a
[27] Mitschele 2018
[28] Nakamoto 2008b
[29] Mitschele 2018
[30] Nakamoto 2008b
[31] Brito/Castillo 2013
[32] CoinMarketCap 2018b
[33] Ojo/Adebayo 2017, p. 283
[34] Kiayias et al 2017, p. 357
[35] Nakamoto 2008b
[36] Nakamoto 2008b
[37] Google 2018b
[38] Mitschele 2018
[39] Hileman/Rauchs 2017, p. 11

For BCT we will assume the definition as a "type of distributed ledger that is composed of a chain of cryptographically linked 'blocks' containing batched transactions; generally broadcasts all data to all participants in the network "[40] Following these definitions, DLT is a broader concept and BCT is one type of DLT.

Going forward with these definitions in mind, we conclude that some DLTs are not relevant to answer the research question at hand, as only blockchain-based token systems are of interest. So we will e.g. not include IOTA[41] in the study since it doesn't conform to the definition of BCT used for this paper.

The awareness of BCT as a technology and its implications beyond finance are gaining traction. Google Trends clearly illustrates this, as searches for blockchain are increasing.[42] Another indicator of the growing interest in BCT beyond finance is the growth of private or consortium chains in the enterprise sector, like the enterprise Ethereum alliance or Hyperledger.[43]

Bitcoin and Ethereum are well-known public blockchains[44], with a monetary incentive for validators to perpetuate the blockchain.[45] Anyone may participate in public blockchains.[46] Private and consortium chains are different in the point, that access is usually regulated, and therefore not everyone can participate.[47] Also, some private chains forego the aspect of cryptocurrency and don't directly reward validators.[48] That kind of system creates value by using DLT to achieve business goals.

However, the acceptance of BCT is not universal, as with any new technology.[49] There are some critics of BCT, and they bring forward valid points regarding the limitations and challenges facing BCT today. This study already talked about what blockchain is, what it aims to achieve and what the typical reasons and incentives for using it are. As with any technology, there are downsides, BCT is not exempt from this. These limitations slow down the widespread adoption of BCT and cause some people to dismiss the technology altogether.[50] This means there is a technology with a lot of promise, but it still has some key limitations which need to be overcome for widespread adoption. This sounds similar to the Internet in its infancy about

[40] Hileman/Rauchs 2017, p. 11
[41] Popov 2017
[42] Google 2018a
[43] CoinDesk 2017
[44] Wikipedia 2018b
[45] Nakamoto 2008b
[46] Bauerle 2017
[47] Bauerle 2017
[48] Hyperledger Architecture Working Group 2017
[49] Rogers 2014
[50] Stinchcombe 2017

30 years ago.[51] The National Institute of Standards and Technology (NIST) mentions some distinct limitations and misconceptions about BCT.[52]

One issue they bring up is the control over BCT. A common misconception is that permissionless blockchains are systems without control and ownership.[53] This is not entirely accurate, because there is still a group of core developers who make the decisions and developments on the protocols. While these core developers usually act in the interest of the network and validators can choose to reject the changes, the core developers still maintain some level of control over that blockchain.[54]

Another misconception NIST brings to awareness is the aspect of trust. Blockchains are oftentimes said to be trustless.[55] While this might theoretically be possible, in practice blockchains are not trustless. Most users of BCT will not be technologically versatile enough to understand the underlying technology, source code, and cryptography.[56] This has the consequence that users will need to trust that the concepts and protocols involved in BCT work as promised.[57] The users need to trust developers not to write malicious code, and they need to trust that the majority of the network is not colluding to manipulate the blockchain.[58]

A third significant aspect NIST points out is the resource usage of blockchains. NIST understands this on a personal level, meaning it is rather resource-intensive to keep a full copy of the blockchain, to be able to validate all transactions yourself.[59] At the time of this writing, over 150GB[60] of storage, as well as download volume is required to obtain a copy of the Bitcoin blockchain.

There are also other limiting factors, not discussed in NIST's paper. There is also the macroperspective of BCT resource usage. At the time of this writing, the Bitcoin blockchain consumes 63.8 TWh energy, which is slightly more than the entire country of Switzerland (62.1 TWh)[61]. This extensive resource usage is not accompanied with equally extensive performance.[62] There is neither remarkable performance for transactions per second nor for the confirmation time of individual transactions[63].

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[51] Iansiti/Lakhani 2017
[52] Yaga et al 2018
[53] Yaga et al 2018
[54] Yaga et al 2018
[55] Yaga et al 2018
[56] Yaga et al 2018
[57] Yaga et al 2018
[58] Yaga et al 2018
[59] Yaga et al 2018
[60] Blockchain.info 2018
[61] Digiconomist 2018
[62] Digiconomist 2018
[63] Compared to central implementations like PayPal

There are some other factors which are more peripheral than the aforementioned limitations. The team behind CryptoKitties explains, that the user experience or rather the lack thereof plays a significant role in keeping people from using and interacting with BCT.[64] Today interacting with BCT involves a lot of technical concepts like public / private keys, which confuses people and infuses them with uncertainty towards BCT rather than certainty and trustworthiness.[65]

To interact with an application on the Ethereum blockchain, a user needs to perform all of the following steps (assuming he already found the application he was looking for):

- Register and personally verify on an exchange so that the user can buy ether

- Buy ether, which is very volatile and usually costs a fee

- Create another wallet, so the user controls the private key and can send transactions to the desired application

- Transfer the ether from the exchange to the user's private wallet, which involves knowing the difference between the private key and the public key, both of which are random sequences of characters and there is no recovery process in the case of a typo

- Finding the correct application and making sure it is not a fake or otherwise compromised

- Installing a plug-in to the web-browser and importing the previously created wallet, this time using the private key

- Sending the transaction and hoping the application performs the way the developers promised

Augur notes another important problem BCT has to deal with: interactions with the real-world.[66] Assuming that BCT is a truth machine, immutable and creates consensus in a decentral way, these properties don't apply outside the BCT. In the real world not everything is deterministic and not everything can be indisputably evaluated; also there can be fraud or malicious reports. This becomes a problem for mapping a real world process on BCT or reacting to certain events from the real world, the way future markets do.[67]

This criticism is mostly valid. Nevertheless, the vision of a more decentralized and democratic economy[68] stands firm, and the developers in the BCT space are actively working to resolve these limitations. For example, Ethereum tries to be very open about their decision process on

[64] CryptoKitties 2017
[65] CryptoKitties 2017
[66] Peterson et al 2018
[67] Peterson et al 2018
[68] Lannquist 2017

the protocol by streaming their Core Developer Meetings.[69] Most blockchains offer a light client (e.g. Mist[70]) to address the resource problem on an individual scale, by reducing the load on the users. To address the environmental impact of BCT, some blockchains proposed new consensus algorithms like proof of stake, which don't waste as much electricity.[71] To improve performance in terms of transaction speed, as well as transaction volume, developers are working on off-chain payment channels and a lightning network.[72]

As stated before, BCT is an information infrastructure with built-in integrity[73] and be used as a foundation to build platforms on top of, e.g. Golem[74].

The Bitcoin protocol in itself allows for transactions of value in the form of bitcoins.[75] Creators of other blockchains looked at the characteristics a blockchain offers as an information infrastructure and took it one step further. For example, Ethereum, currently the second largest public blockchain by market capitalization[76], is built to be a smart contract platform.[77] Smart contracts are "cryptographic 'boxes' that contain value and only unlock it if certain conditions are met"[78] These smart contracts allow for autonomous, reliable and deterministic execution of code.[79] This allows developers to build decentral applications, which will be explained in detail in the chapter 3.3 Token Systems & dApps. One popularly used application for smart contracts is the creation of tokens, as this functionality is even proposed on the Ethereum.org website.[80]

### 3.2 Tokens

The following paragraphs will briefly list various types of tokens, followed by a clear description of what sort of tokens will be discussed in this work. In addition, we will briefly discuss what blockchain-based tokens are used for today and what their limitations are.

When researching tokens, it very quickly becomes clear that the term token is used in various situations and has different meanings in most of these situations. This becomes evident when the term "token" is looked up in a dictionary. E.g. dictionary.com[81] offers seven different definitions of a token, ranging from a souvenir over evidence, indication of authenticity, a part as

[69] Ethereum Foundation 2018e
[70] Ethereum Foundation 2018a
[71] Kiayias et al 2017
[72] Poon/Dryja 2016
[73] Ojo/Adebayo 2017, p. 283
[74] The Golem Project 2016
[75] Nakamoto 2008b
[76] CoinMarketCap 2018b
[77] Ethereum Foundation 2018c
[78] Ethereum Foundation 2018c
[79] Sarfarz 2017
[80] Ethereum Foundation 2018b
[81] Dictionary.com 2018

representation of the whole, paper currency all the way to a physically stamped metal coin. These definitions do not even encompass the understanding of a token in terms of software. In software, tokens have multiple meanings as well.[82] For example, a one-time password can be called a token.[83] A different use of the term token in software is business process model and notation programs like Camunda, where one token represents one instance of the process.[84] Finally, there are tokens in the context of blockchain.[85] In the context of blockchains a token can be understood as a unit of a specific digital currency.[86]

In this work, tokens will exclusively refer to cryptographic tokens based on BCT.

In the space of blockchain, there are various tokens with various functions.[87] One key factor to differentiate between these various blockchain tokens is the technical level of the token.[88] There are two basic options regarding the technical level of the token. The definitions and terminology as given by Euler in his Token Classification Framework will be used to illustrate what this distinction is.[89]

On the one hand, there are blockchain-native tokens.[90] These tokens are what keep a blockchain network running.[91] This is usually achieved through a mining reward.[92] For participating in the consensus process, the nodes are rewarded, usually with units of the blockchain-native token.[93] These blockchain-native tokens also called coins.

On the other hand, the Token Classification Framework suggests there are non-native protocol tokens, and there are dApp tokens[94]. We will not follow this separation for now, but rather group both of these under the name of non-native tokens or secondary tokens. This results in the definition for secondary tokens as blockchain-based tokens, which are not part of the incentive structure to perpetuate the existence of the underlying blockchain.

Going forward, when the term token is used, it will be referring to these secondary tokens. Blockchain-native tokens will be referred to as coins, following the same naming as coinmarketcap.com.[95]

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[82] Wikipedia 2017
[83] Wikipedia 2017
[84] Camunda 2015
[85] antonylewis2015 2015
[86] antonylewis2015 2015
[87] CoinMarketCap 2018b
[88] Euler 2018
[89] Euler 2018
[90] Euler 2018
[91] Euler 2018
[92] Nakamoto 2008b
[93] Nakamoto 2008b
[94] Euler 2018
[95] CoinMarketCap 2018c

To look at coins, their incentive structures, and game-theoretic aspects is an interesting field of study and this is currently being scientifically explored as well.[96] For this study the blockchain as the underlying infrastructure will be taken for granted and the exploration will be dedicated to what can be done on top of BCT. The goal is to explore, what sort of platforms can be built and currently are being built on top of BCT. For this reason, it was decided to look at tokens and not coins, which we see as part of the underlying infrastructure.

Tokens can be generated on various blockchains[97], with the vast majority being created on the Ethereum blockchain.[98] Most tokens today are fungible[99], meaning all units of the token are completely equal and there is no difference between any two units of the token.[100] However, there is also the rather recent concept of non-fungible tokens[101], with a few examples already published.[102] With non-fungible tokens, each unit of the token is unique and can be differentiated from other units[103], comparable to collecting stamps. Each stamp can be used to send a letter, however, they can be differentiated via their year of creation or the picture on them.

Generally speaking tokens are created using a smart contract.[104] In the commonly used ERC20 standard for tokens on Ethereum this is achieved by setting a variable to the total supply of tokens and saving this state on Ethereum.[105] Individual token balances are recorded by mapping an Ethereum public address to an integer, which indicates: this address owns that many tokens.[106] The only additional function necessary to have a viable token is the transfer function.[107] Calling this function with a value as input will reduce the number representing the balance of the senders address and increase the balance associated with the receiver address.[108] The ERC20 standard allows for some more functions; these are optional. The standard allows to increase the total supply of tokens by minting new tokens or to reduce the total supply of tokens by burning tokens.[109] ERC20 also allows to create allowances, allowing another address to transact tokens on behalf of the one giving the allowance.[110] Finally, the standard also allows a function to freeze the tokens of a specific account[111] and it allows to set buy/sell prices for the token in ether[112], which can be useful for the sale of tokens. For non-

[96] Yli-Huumo et al 2016, p. 9
[97] CoinMarketCap 2018d
[98] CoinMarketCap 2018d
[99] Ethereum Community 2017
[100] Ethereum Community 2017
[101] Schmidt/Relay 2018
[102] Schmidt/Relay 2018
[103] Ethereum Community 2017
[104] Ethereum Foundation 2018d
[105] Ethereum Foundation 2018d
[106] Ethereum Foundation 2018d
[107] Ethereum Foundation 2018d
[108] Ethereum Foundation 2018d
[109] Ethereum Foundation 2018d
[110] Ethereum Foundation 2018d
[111] Ethereum Foundation 2018d
[112] Ethereum Foundation 2018d

fungible tokens there is the ERC721 standard, which is similar to ERC20, with the addition of including the information about which token should be transferred.[113]

A keyword steadily gaining popularity over the past years is tokenization.[114] Tokenization describes the process of mapping real-world assets and processes to the digital world.[115] The concept of tokenization existed before the blockchain, as can be witnessed by the example of Camunda and BPMN from above. However the blockchain and the accompanying ability to come to a consensus decentrally and trustlessly offered a whole new set of use cases for tokenization that was not viable before.[116] Having a digital clone of a physical object can prove very valuable in certain circumstances. For example, moving $10 million physical dollars involves quite some effort. Banks facilitate the process by settling transactions among each other and never actually moving physical money.[117] They move a digital copy of the physical asset, so the bank essentially tokenized the $ 10 million and moved the tokens digitally. The blockchain allows for the same ease of transaction, without relying on banks that might regulate the transaction and collect substantial fees. This process of creating a digital copy of a physical asset or process on the blockchain is called tokenization and enables many use cases besides money.[118]

The concept of tokens in general is becoming more and more popular. This can be witnessed by the trend in crowdfunding for blockchain projects through the sale of tokens. In 2016 token sales totaled $0, 26 billion, compared to $5, 38 billion in 2017[119], which is a year over year increase of about 2000%.

### 3.3 dApps & Token Systems

The term dApp stands for a decentralized application. A dApp is a software application running on a blockchain.[120] An easy example for a dApp is a token contract on Ethereum, like the ZRX[121] token.[122] The contract defines the variables for the token and anyone with access to the blockchain can interact with the contract, transferring tokens or viewing the current state of the contract. Another example of a dApp is the Ethereum Name Service (ENS).[123] On the ENS any user can start an auction for a desired, not yet assigned name in the ".eth"

[113] Ethereum Community 2017
[114] Google 2018c
[115] McKeon 2017
[116] McKeon 2017
[117] Brown 2013
[118] McKeon 2017
[119] CoinDesk 2018
[120] Condon 2017
[121] Most blockchain assets have a three-character acronym, ZRX is the token oft he 0x protocol
[122] Etherscan 2018
[123] Etherscan 2017

namespace, e.g. *tokenbachelor.eth*.[124] During the auction, any user can bid on the auction for tokenbachelor.eth, and in the end, the highest bidder gets the address *tokenbachelor.eth*, all decentral without any human intervention.[125]

As discussed in the previous chapter *3.2 Tokens*, tokenization is one of the interesting applications of blockchains. It allows the mapping of real-world processes, assets, and services to the digital world.[126] The initial scope of the study was to look at and compare various blockchain tokens. However, a token in itself is likely not enough to accurately represent real-world processes, except the use case of pure financial transfer of value which is already covered by bitcoin.[127] Therefore the initial scope of the study was widened to include the entire token system.

Tokens have an economic impact which should not be overlooked. The current cumulative value of all tokens listed on coinmarketcap.com is roughly $58 billion.[128] As previously stated, the concept of tokens and tokenization is gaining popularity and there is still a lot of value that can be tapped in the future by making processes digital and decreasing various transaction costs.[129]

We understand a token system as the token, the smart contracts (dApp), and the other pieces of software needed, in order to interact with the dApp. This collection of software allows achieving an accurate representation of a real-world process. If we take the example with the token contract from above, the distinction of the dApp and the token system would be e.g. the addition of a user interface to interact with the contract, instead of manually sending a transaction in bytecode. This part is not necessarily needed for the technical functionality of the dApp, but it helps to gain acceptance and greatly increases the user experience of interacting with the dApp.[130] The difference between a dApp and a token system can be much more than the addition of a user interface. There are cases when some part of the application logic needs to happen off-chain. To explain this, consider the example of the ENS from above[131]. The ENS auctions off domain names using a Vickrey auction.[132] In this type of auction, sealed bids are submitted.[133] This means everyone knows only their own bid until the auction is over and everyone reveals their bid.[134] The fact that bids are supposed to be sealed makes it next to impos-

[124] ENS 2017
[125] ENS 2017
[126] McKeon 2017
[127] Nakamoto 2008b
[128] CoinMarketCap 2018d
[129] Ficci/pwc 2018, p. 35
[130] Yli-Huumo et al 2016, p. 16 et seq.
[131] (well knowing that ENS is not a token system, since there is no token involved in ENS)
[132] ENS 2017
[133] Wikipedia 2018a
[134] Wikipedia 2018a

sible to have the entire auction on the Ethereum blockchain, because the inputs of any transaction are publicly accessible, meaning anyone could just look up the input of the previous bids and bid a little higher just before the auction ends. This should not be possible in a Vickrey auction.[135] ENS solves this problem by putting a part of the logic off of the blockchain.[136] Specifically, there is a passphrase generated on the local computer, this phrase is combined with the actual bid and the result is hashed. This hash is uploaded to the auction. When the time to reveal the bids comes around, the user needs to publish his bid as well as the generated passphrase in order to verify his bid.[137]

This illustrates well how there can be pieces of the software in smart contracts on the blockchain and other pieces of the software off-chain. The definition for a token system given above includes this off-chain part of the application and differs from a dApp in that regard.

### 3.4 Ecosystem

While talking about blockchains in chapter *3.1 Blockchain*, blockchains were classified to be socio-economic systems. At this point, we would like to extend this classification to include token systems as socioeconomic systems. To be successful, a token system needs the technical system, as well as a community of users to interact with the system to produce a network effect.[138] So again there are two parts to it, the system and the social factor. For this reason, token systems can be considered as socio-economic systems as well. This is the reason for deciding to differentiate between the token system as the technical part of the system and the social surroundings that interact with the token system. We use the term ecosystem to describe the total of all those social surrounding factors. Having this separation will help in performing the grounded theory method later, to determine whether something is part of the technical token system, the interacting ecosystem, or whether it is disjoint and has no immediate impact on the token system at all.

It is important to keep in mind that the ecosystem is understood as all the interacting factors. What these factors are might vary from token system to token systems. This was the reason for only vaguely defining the ecosystem now. The relevant factors will be discovered later on through the process of GTM.

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[135] Wikipedia 2018a
[136] ENS 2017
[137] ENS 2017
[138] Shapiro/Varian 1999

# 4 Grounding Theory

The grounded theory method was first used and described by Barney G. Glaser and Anselm L. Strauss in their study *Awareness of Dying*.[139] They followed up this initial work with *The discovery of grounded theory*[140], specifying the method and its application.

The GTM is qualitative research that seeks to inductively discover theory, which is grounded in data.[141] GTM stems from the field of sociology. [142] As Wiesche et al point out, grounded theory gained popularity in the field of information systems research.[143] The entire process of creation and therefore the theory itself is supposed to be grounded in data.[144] This is also where the term GTM comes from. A theory entirely grounded in data. In practice, this means looking at data without having preconceptions about the topic.[145] This is in stark contrast to other qualitative research methods like the qualitative analysis of expert interviews.[146] [147] In that sort of analysis, the researcher has a pre-determined set of theory-based categories, and the analysis consists in assigning various statements made in that interview to those pre-determined categories.[148] GTM knows no such theory-based categories, rather categories are discovered during the process of GTM. As Bryant and Charmaz put it, "The most basic challenge in grounded category building is to reconcile the need of letting categories emerge from the material of research (instead of forcing preconceived theoretical terms on the data) with the impossibility of abandoning previous theoretical knowledge"[149].

The above-mentioned characteristics entail that GTM is often used in new fields of study, where the amount of existing theory is limited.[150] The researcher does not need much existing theory to perform his studies, access to empirical data is enough for GTM to be performed.[151]

Over time some variations of GTM evolved, most dominantly GTM according to Glaser (1978[152] 1992[153]) and GTM according to Strauss and Corbin (1987[154], 1990[155]). Glaser puts more emphasis on constant comparison, while Strauss presents a more structured approach to GTM.[156]

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[139] Glaser/Strauss 1964
[140] Glaser/Strauss 1967
[141] Walker/Myrick 2006, p. 548
[142] Walker/Myrick 2006, p. 548
[143] Wiesche et al 2017
[144] Gibbs 2010
[145] Gibbs 2010
[146] Gläser/Laudel 2010
[147] Mayring 2010
[148] Mayring 2010
[149] Bryant/Charmaz 2007, p. 192
[150] Wiesche et al 2017, p. 691
[151] Dey 1999, p. 1
[152] Glaser 1978
[153] Glaser 1992
[154] Strauss 1987
[155] Strauss/Corbin 1990
[156] Walker/Myrick 2006, p. 551

This study adopts the Straussian GTM with the separation of open coding, axial coding, and selective coding.

### 4.1 Data selection

The target of this study is to discover a set of dimensions, which enables the description of any given token system.

To achieve this goal, the grounded theory method will be applied. For GTM to work effectively, the data which is going to be analyzed has to be chosen considerately. The sample should be as diverse as possible, this way it is more likely to cover a large part of the spectrum of token systems in existence. To get a decent basis for the decision on which token systems to include in the study, existing classifications of token systems were evaluated in. This allowed for a process similar to quota sampling,[157] without proportionality of the starta, as the entirety of token systems is not known or categorized.

It was decided to look for token models on Medium.com because most news and ideas regarding BCT are first, or at least very quickly, published on medium.com. For the purpose of finding existing classifications a search was performed with the search term “token class”. The first 15 results of this search were taken into consideration, to keep the volume manageable.[158] The results were filtered on their relevance to the question at hand. Results which did not discuss classes or characteristics of tokens were removed from consideration. Articles of three categories were sorted out: 1. Articles which related to only one specific token, 2. Articles discussing tokens in general with no further differentiation, and 3. Articles unrelated to the topic of blockchain or tokens.[159]

The contents of the three remaining, relevant articles were analyzed. Information on what classes of tokens or token systems there are and the dimensions named by the authors were collected and summarized.

The “Token Classification Framework” as proposed by Euler presents five dimensions for describing a token. These five dimensions are: purpose; utility; legal status; underlying value; technical layer.[160] In addition, Euler describes four archetypes of tokens: cryptocurrency, tokenized asset, tokenized platform, token-as-a-share.

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[157] Lund Research 2012
[158] Query results in *Attachment 1: Finding existing models which describe tokens*
[159] Filtering in *Attachment 1: Finding existing models which describe tokens*
[160] Euler 2018

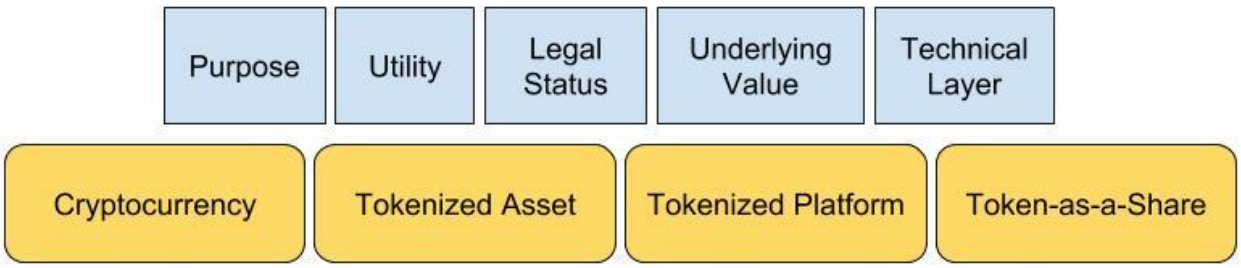


Figure 1: Dimensions and Token Classes (Token Classification Framework)

In the article “The Discount Token model” the main focus is a token model with the name “Discount Token”.[161] At the beginning of the article, the author mentions some other token models as well. Specifically, Genestoux mentions: currencies; revenue share models; work tokens; and non-fungible tokens.[162]

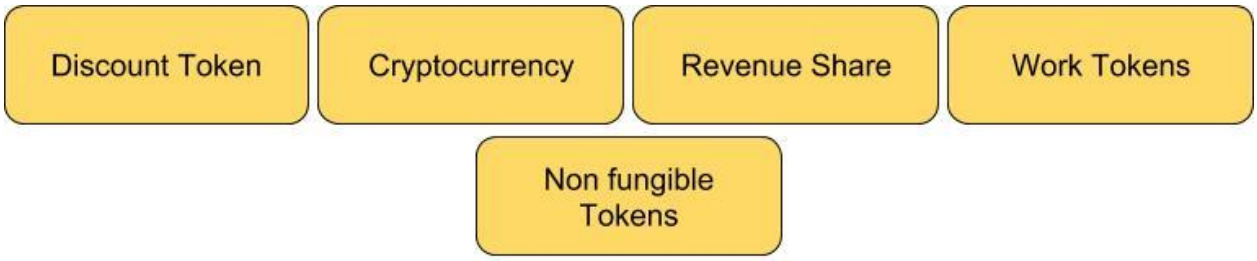


Figure 2: Token Classes (Discount Token Model)

In the article “Traditional Asset Tokenization” the token classes “traditional asset tokens” and “protocol tokens” are mentioned.[163] The article has a section regarding “Challenges for traditional asset tokenization”, where McKeon mentions four kinds of challenges for token systems, “Regulatory, Governance, Thinly traded tokens, Status Quo”.[164] These challenges can, in turn, be seen as characteristics of token systems. For each of the named challenges, at least for the first three of them, the question can be asked: How well does a given token system master this challenge? The answers to those questions can then be understood as the characteristics of legal compliance, governance, and liquidity.

[161] Genestoux 2018
[162] Genestoux 2018
[163] McKeon 2017
[164] McKeon 2017

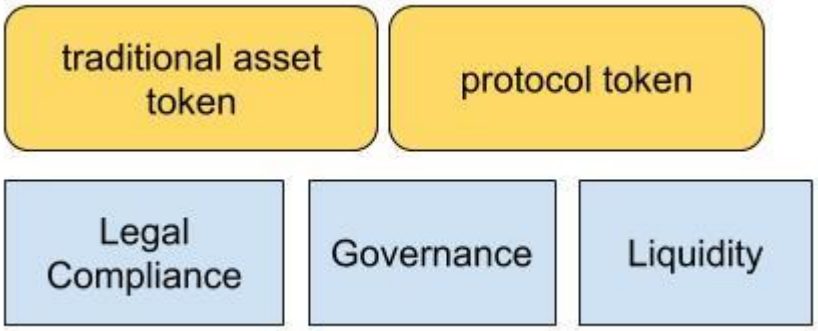


Figure 3: Dimensions and Token Classes (Challenges for traditional asset tokenization)

The three different models have some parts in common. These duplicates were reduced to a single mention and all of the dimensions and classes of tokens were merged into one model. This model as shown in *Figure 4* represents an approximation of the current research on classes and dimensions of token systems. It gives a rough idea about the sorts of tokens there are and which dimensions might be suitable for describing tokens.

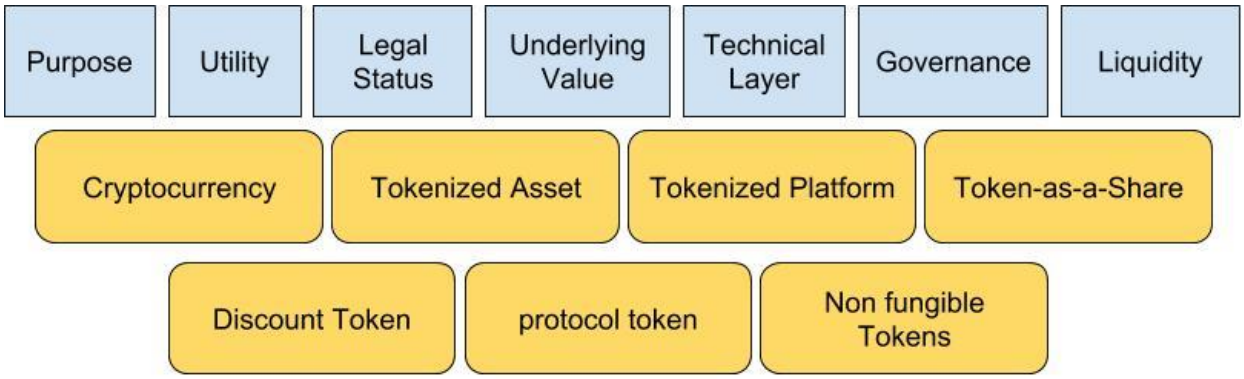


Figure 4: Dimensions and Token Classes (combination)

This basic idea about what could be relevant dimensions of a token system was not taken into account for the actual execution of the GTM. The understanding of potentially relevant dimensions was merely used to identify tokens for the study. This way tokens could be chosen in order to cover a broad spectrum of tokens. The tokens which were identified using this process were analyzed in the main study using the grounded theory method according to Strauss.

To portrait the whole spectrum of tokens with 100% accuracy and completeness, the study would theoretically need to include all token system which is utterly impractical. The rough idea of token classes and dimensions as a proxy, allowed to choose a much smaller sample size while maintaining an acceptable level of coverage.

For selecting the tokens for the study, the following criteria were chosen:

- Each class of token in *Figure 4* should be included at least once.
- For each of the dimensions from image *Figure 4* there should be at least two distinct values.
- It would be interesting to include a token which doesn't fit well into any of the given categories.
- Blockchain-native coins are excluded.

During the process of choosing the tokens, there was no complete certainty, that the tokens would actually fulfill the given criteria. This was due to the fact that the selection was based mostly on assumptions regarding the tokens. In chapter *4.1 Open Coding* possible exceptions will be discussed, and each chosen token will be validated, whether it meets the criteria for the study. As an indicator whether any given token is a blockchain-native coin or a secondary token, we followed the classification as it is given on coinmarketcap.com, since they adhere to the same definitions we set in *3.2 Tokens*.[165]

To fulfill the criteria listed above, the token classes were noted in a table, and token systems were sorted into the class they fit best.[166] When a token system was assumed to fit into a class, it was chosen and added to the table in the respective row. It has to be empathized that the tokens were classified based on assumptions and not on researched facts so that some classifications might be inaccurate. Some classes got multiple entries, this was done for two reasons. On the one hand, these duplicates were added, so there would be multiple values for each of the dimensions. On the other hand, more token systems were added to have the option to look for differentiating factors among tokens that qualify for the same class. The expectation was that differences in a given dimension can be noticed more easily when comparing token systems that are similar in many ways but differ in the dimension of interest.

[165] CoinMarketCap 2018c
[166] (based on the assumptions regarding the token systems)

| Token Class | Token |
|---|---|
| Cryptocurrency | PAN |
| Tokenized Asset | DGX |
| | USDT |
| Tokenized Platform | PPT |
| | GNT |
| | BAT |
| | REP |
| Token-as-a-Share | PAY |
| Discount Token | BNB |
| protocol token | ZRX |
| Non fungible Tokens | CryptoKitties |
| Other | EOS |
| | GAS |

Table 1: Assigning Tokens to Token Classes

An approach similar to the previously described approach for the token classes was taken with the dimensions. To ensure there are multiple values for each of the proposed dimensions, the following table was created.

| Token | Purpose | Utility | Legal Status | Underlying Value | Technical Layer | Governance |
|---|---|---|---|---|---|---|
| PAN | Cryptocurrency | ? | Cryptocurrency | Network Value Token | ? | ? |
| PPT | Investment Token | Usage Token | Security Token | Share-like Token | dApp Token | Central |
| GNT | Network Token | Work Token | Utility Token | Network Value Token | dApp Token | ? |
| REP | Network Token | Work Token | Utility Token | Network Value Token | dApp Token | Decentral |
| BAT | Network Token | ? | Utility Token | Network Value Token | dApp Token | ? |
| PAY | Investment Token | ? | Security Token | Share-like Token | dApp Token | Central |
| ZRX | Network Token | Work Token | Utility Token | Network Value Token | Non-native Protocol Token | Decentral |
| DGX | Investment Token | ? | Security Token | Asset-backed Token | dApp Token | ? |
| BNB | Network Token | ? | Utility Token | Network Value Token | dApp Token | Central |
| EOS | ? | ? | ? | ? | ? | ? |
| USDT | Cryptocurrency | ? | Cryptocurrency | Asset-backed Token | dApp Token | Central |
| CryptoKitties | ? | ? | ? | Network Value Token | dApp Token | ? |
| GAS | Network Token | Usage Token | Utility Token | Network Value Token | Non-native Protocol Token | ? |

Table 2: Assessing Dimensions of Tokens

The proposed dimensions were listed as column headers, and the tokens from *Table 1* were listed in the first column. Now each of the tokens was assessed for each of the dimensions. At this point the token systems were still understood only superficially. This is the reason for the many empty cells in *Table 2*, as well as possibly wrong assessments of token systems in some dimensions. The dimension of liquidity was left out of consideration for the table because it presented a continuous scale rather than a discrete scale, which means each of the token

systems likely has a different value for liquidity. For the five dimensions purpose, utility, legal status, underlying value, and technical layer, which are borrowed from the Token Classification Framework, the possible values for the dimensions are taken from the framework as well.[167] The possible values for the dimension of governance were central governance and decentral governance, both with some variations.

As it turned out, the 13 tokens chosen in the previous step also manage to present at least two distinct values for each of the dimensions. It has to be added, that the selection of tokens is presumably somewhat biased.[168] We inevitably favored tokens with which we were already familiar. By looking at existing models for tokens, we were able to mitigate this bias to a certain degree and get a more representative selection of tokens for the study.[169]

In summary, there were 13 token systems chosen for the study. These token systems and in parentheses the related tokens are:

> *Pantos (PAN), Populous (PPT), Golem (GNT), Augur (REP), Basic Attention Token (BAT), TenX (PAY), 0x protocol (ZRX), Digix (DGX), Binance (BNB), EOS.IO (EOS), Tether (USDT), CryptoKitties (CryptoKitties), NEO (GAS)*

Because of the process for selecting the token systems, these chosen systems should satisfy the required criteria:

- They cover each of the classes proposed by existing research.
- They produce at least two distinct values for the dimensions proposed by the existing models.
- There is a token outside the existing classes, our understanding of EOS didn't put it in any existing class.
- We followed the same classification of coins and tokens as coinmarketcap.com[170], and only considered systems classified as tokens on coinmarketcap.com[171]

Following the approach to GTM as proposed by Strauss means there is a rather ridged process to follow.[172]

The subject of research for this study is defined as token systems. For this reason the decision was to look at the whitepapers published on each of the token systems as the primary data source. This is a promising source of information, because it comes from the actual creators of the token systems and is therefore the closest to empirical data. Having original sources of data is good for performing GTM, because the data is not in any way modified by the analysis

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[167] Euler 2018
[168] Merriam-Webster 2016
[169] Merriam-Webster 2016
[170] CoinMarketCap 2018c
[171] CoinMarketCap 2018d
[172] Walker/Myrick 2006, p. 558

of some other researcher. Looking at the original data itself, allows the researchers to come up with categories themselves.[173] We are aware, that these whitepapers are oftentimes used as sales-letters to promote the token sale of the specific token and therefore might over-promise, euphemize, or blur the actual characteristics and capabilities of these token systems. The decision was to look at the whitepapers anyways and to look at secondary data where necessary in order to get clarity on questions, uncertainties and possibly unrealistic claims. Prior to the study no assumptions were formed on where secondary data is needed or what this secondary data is supposed to look like. Rather the decision was to first look at all the primary data. From studying this data, a rough understanding of token systems and the involved parts should emerge.[174] This understanding would be used to look for missing information and factors that seem odd or unrealistic about any of the token systems.

### 4.2 Open Coding

During open coding as Strauss describes it, the raw data is looked at and coded.[175] This study followed the proposed process with minor modifications. The phase of open coding represented the first meaningful contact with the tokens and token systems of the study. The very first step taken was to note down all assumptions we had regarding the individual token systems. This was done to improve the auditability of the study and to make the thought process comprehensible for the reader. The actual assumptions themselves are included in chapter *4.3 Introducing the Token Systems*, along with the introduction to each of the token systems.

The next step was to read the whitepapers of all token systems once. This step was performed in order to gain a broad understanding of the subject at hand, as well as to verify that each of the chosen tokens actually comply with the acceptance criteria set in chapter *4.1 Data Selection*. The initial reading also presented the opportunity to get an idea of the spectrum of token systems in the study.

During this first phase of scanning, it turned out that one of the selected token systems, the GAS token did not comply with the given criteria for token systems in this study. GAS does not qualify for the study, because it turned out to be a blockchain-native coin of the NEO blockchain and not a secondary token.[176] Even though GAS was not included in the main study, the preliminary assumptions and a short introduction to the GAS coin can be found in *Attachment 2: Introduction to NEO (GAS)*. During the phase of the initial scanning, it also turned out that the EOS token is somewhat special. EOS describes in their whitepaper, that EOS.IO plans to be a software, which can be used to run blockchains.[177] These blockchains using the EOS.IO

[173] Walker/Myrick 2006, p. 549
[174] Bryant/Charmaz 2007, p. 192
[175] Walker/Myrick 2006, p. 551 et seqq.
[176] NEO 2018
[177] block.one 2017

software each have their own respective native coins.[178] Seeing EOS as such a native coin would have disqualified EOS from consideration. However, there is also an EOS token. This EOS token is an ERC20 token which exists on the Ethereum blockchain.[179] The idea of the EOS software is that a new blockchain which uses the EOS software may take the balances of the EOS token holders on Ethereum and uses these balances as the starting balances for their new blockchain.[180] This put EOS in an interesting position regarding this study. After some consideration, the decision was to include EOS and focus on the ERC20 token part of EOS rather than the software / blockchain part of EOS.

After looking at various token systems and reading the associated whitepapers, it turned out, that most tokens are implemented very similarly on a technical level. Many tokens even use exactly the same code to define their tokens on the blockchain.[181] This meant that looking at the technical aspects of the tokens as a differentiating factor would not yield much to look at.

Knowing that it takes some sort of effort to create a token system, it is fair to assume that a token will only be created with the intention of achieving some sort of result.[182] This result can theoretically take on a variety of forms. A desired result could be to build a business model, it could be the championing a non-profit cause, or the desired result could be a financial exploit or an attack on the network. The outcome might as well be to help the creator to learn more about tokens, how they function and what they are used for.

Assuming that every token has such an intention behind its creation, then it is a valid assumption that this outcome will be a driving force for decisions regarding that token. For this reason, it is assumed that much can be learned about a token system, by finding the creators intention for building the token system.

This hypothesis will be the basis for the analysis of the token systems in this study. Meaning: When analyzing a new token, the first objective will be to identify the outcome with the creator wanted to achieve by creating this token system. This outcome of a token system will be kept in mind all throughout the process of the GTM. This also means the outcome behind the token system will function as a filter while coding the whitepapers. The outcomes of the token systems will continue to play a role in deciding which information is included in the further analysis and what is left out.

If the creator of a token published a document about the token, say a whitepaper, then the expectation is to find information about the creator's desired outcome for the token system in this document. Most likely this information will be found in the abstract of that document, since

[178] block.one 2017
[179] CoinMarketCap 2018d
[180] block.one 2017
[181] Ethereum Foundation 2018d
[182] Ajzen 1991, p. 182

the abstract usually conveys the key idea of the document.[183] Based on these assumption, the abstracts of the token-whitepapers will be closely looked at in order to identify the driving idea behind each of the token systems.

To illustrate the process, consider the following example of the Basic Attention Token (BAT).

# Basic Attention Token (BAT)

## Blockchain Based Digital Advertising

Brave Software

March 13, 2018

**Abstract**

Digital advertising is broken. The marketplace for online advertising, once dominated by advertisers, publishers and users, has become overrun by "middleman" ad exchanges, audience segmentation, complicated behavioral and cross-device user tracking, and opaque cross-party sharing through data management platforms. Users face unprecedented levels of malvertisements and privacy violations. Mobile advertising results in as much as $23 per month in data charges on the average user's data plan, slow page loads, and as much as 21% less battery life. In response, over 600 million mobile devices and desktops (globally) employ ad blocking software and this number is growing. Traditional publishers have lost approximately 66% of their revenue over the past decade, adjusted for inflation. Publishers face falling revenue, users feel increasingly violated, and advertisers' ability to assess effectiveness is diminished. The solution is a decentralized, transparent digital ad exchange based on Blockchain. The first component is Brave, a fast, open source, privacy-focused browser that blocks third party ads and trackers, and builds in a ledger system that measures user attention to reward publishers accordingly. Brave will now introduce BAT (Basic Attention Token), a token for a decentralized ad exchange. It compensates the browser user for attention while protecting privacy. BAT connects advertisers, publishers, and users and is denominated by relevant user attention, while removing social and economic costs associated with existing ad networks, e.g., fraud, privacy violations, and malvertising. BAT is a payment system that rewards and protects the user while giving better conversion to advertisers and higher yield to publishers. We see BAT and associated technologies as a future part of web standards, solving the important problem of monetizing publisher content while protecting user privacy.

Figure 5: BAT Abstract[184]

[183] Merriam-Webster 2016
[184] Basic Attention Token 2018

The abstract of the whitepaper, as shown above, was looked at. The aim was to extract the content, and therefore the intention of the token system. Afterwards this content was brought into a format that could function as a relevance-filter for coding the rest of the whitepaper.

In the very first sentence, the target market for this token system is identified. When BAT writes "Digital advertising is broken." it can be assumed, that BAT will target the market of digital advertising.[185] This assumption is confirmed a few lines later: "The solution is a decentralized, transparent digital ad exchange based on Blockchain. […] introduce BAT (Basic Attention Token), a token for a decentralized ad exchange."[186] As the target market is clear, the next question becomes: What specifically does BAT do? Which problems does it want to solve in the digital advertising market?

Some specific problems the whitepaper names are:[187]

- The industry is "overrun by 'middleman' ad exchanges"
- "Users face unprecedented levels of malvertisements and privacy violations"
- "Mobile advertising results in […] data charges […], slow page loads, and […] less battery life"
- "Publishers face falling revenue"

BATs actions to alleviate these problems:[188]

- Publish a "privacy-focused browser […] that measures user attention to reward publishers accordingly."
- "Introduce BAT […], a token for a decentralized ad exchange."
- "It compensates the browser user for attention while protecting privacy."
- "removing social and economic costs associated with existing ad networks"
- "better conversion to advertisers and higher yield to publishers"

The last sentence gives a good summary of the goal for BAT: "We see BAT and associated technologies as a future part of web standards, solving the important problem of monetizing publisher content while protecting user privacy."[189]

Synthesizing and summarizing this information from the abstract of the BAT whitepaper, the following becomes the guiding content-filter for coding the rest of the BAT whitepaper:

> *BAT targets the digital advertising industry and wants to establish a decentralized ad exchange which allows publishers to monetize their content and protects user privacy.*

This process was performed for each of the whitepapers in the same fashion. The following *Table 3* shows the intentions of each of the token systems as the results of this process.

[185] Basic Attention Token 2018
[186] Basic Attention Token 2018
[187] Basic Attention Token 2018
[188] Basic Attention Token 2018
[189] Basic Attention Token 2018

| Token | Intention of the Token System |
|---|---|
| PAN | PAN wants to create a multi-blockchain token system, which promotes synergy between blockchains by allowing easy transfer of value to another blockchain.[190] |
| PPT | Populous aims to be a P2P invoice seller for small and medium businesses. Blockchain is used to reduce costs and increase security.[191] |
| GNT | Golem seeks to become a global decentralized market for computing power, connecting individual requestors and providers and lowering the cost of computation.[192] |
| REP | Augur aims to be a decentralized platform for future markets and defines a process for reporting events from the real-world and resolving possible disputes of the reported outcome.[193] |
| BAT | BAT targets the digital advertising industry and wants to establish a decentralized ad exchange which allows publishers to monetize their content and protects user privacy.[194] |
| PAY | TenX aims to make blockchain assets easily spendable with a debit card.[195] |
| ZRX | The 0x protocol seeks to facilitate P2P exchange of ERC20 tokens and is free to use. Other dApps can utilize the protocol and charge fees for providing a liquidity pool. Decentralized governance is used to update the protocol.[196] |
| DGX | Digix wants to offer a protocol for tokenizing and documenting physical assets on the Ethereum blockchain.[197] |
| BNB | Binance wants to build a functional exchange, dealing purely in crypto.[198] |
| EOS | The ERC20 part of EOS is wants to raise funds and set the distribution of tokens. This distribution can be used in future blockchains which use the EOS software.[199] |
| USDT | Tether wants to offer a digital token, fully backed by fiat currency.[200] |

[190] Bitpanda 2018
[191] Williams 2017b
[192] The Golem Project 2016
[193] Peterson et al 2018
[194] Basic Attention Token 2018
[195] TenX 2017
[196] Warren/Bandeali Amir 2017
[197] Eufemio/Chng/Djie 2016
[198] Binance 2017
[199] block.one 2017
[200] tether 2016

| | |
|---|---|
| CryptoKitties | CryptoKitties wants to make blockchain more accessible to the average customer. CryptoKitties also wants to do practical experimentation with digital scarcity and non-fungible tokens.[201] |

Table 3: Intentions of Token Systems

During open coding it was attempted to interpret little and to stay close to the original data. To enhance this connectedness to the original data, each code was connected to a paragraph of the original whitepaper. After writing down the initial assumptions towards each of the token systems, reading the whitepapers for the first time and identifying the objectives behind each token system, the actual open coding began. Applying a code to data inevitably results in some abstractions and interpretation.[202] In order for this abstraction not to be done arbitrarily, there needed to be a defined filter or perspective which was applied during the coding. The intention behind the token system was chosen as this filter. Defining this filter beforehand allows other researchers to replicate the study and obtain similar results.

The actual step of open coding meant putting labels on passages of the original data.[203] This is done so the different pieces of data can more easily be compared and worked with. These codes are supposed to encapsulate the contents of the text.[204] The focus during open coding is on the intention behind the token systems and these intentions are expected to be different for each token system. Therefore, the codes for the token systems are expected to have a large variance as well. This circumstance, along with time constraints, led to the decision of performing open coding on paragraph-by-paragraph level. Usually coding is done on a phrase or even word level and there will be some loss of data when coding on a paragraph level due to more abstraction and paraphrasing.[205] This constraint was considered and the decision was to do open coding this way regardless. It is acceptable in this study, because a more detailed coding process would have resulted in a disproportionally larger amount of codes, compared to the additional insights. It is expected, that more fine-grained coding would yield more details on the specific modalities of the individual processes for each of the token systems. However, this is not necessarily needed for this research, since the goal is to get a more high-level understanding of token systems, the involved actors, and the interactions between them.

To illustrate the open coding process, consider the following example from the Basic Attention Token. The original text reads:

[201] CryptoKitties 2017
[202] Bryant/Charmaz 2007, p. 36
[203] Bryant/Charmaz 2007, p. 201
[204] Walker/Myrick 2006, p. 552
[205] Bryant/Charmaz 2007, p. 201

### 2.2 The Attention Marketplace:

Sales planners currently budgeting for brand advertising are required to account for an excessive number of intermediaries that stand between the ad and the end user. Agencies, trading desks, demand side platforms, desktop and mobile network exchanges, yield optimization, rich media vendors and partnered services often consume significant portions of creative and delivery ad budget. It is also common for agencies in charge of packaging brand campaigns to use data aggregators, data management platforms, data suppliers, analytics, measurement and verification services to fight fraud, enhance targeting, and confirm attribution. These factors add up to a high transaction cost on the efficient provision of attention to brand ad campaigns.

Figure 6: BAT – Attention Marketplace[206]

This text stems from the section “introduction” of the BAT whitepaper. Considering the intention of BAT as described above as:

*“BAT targets the digital advertising industry and wants to establish a decentralized ad exchange which allows publishers to monetize their content and protects user privacy.”*

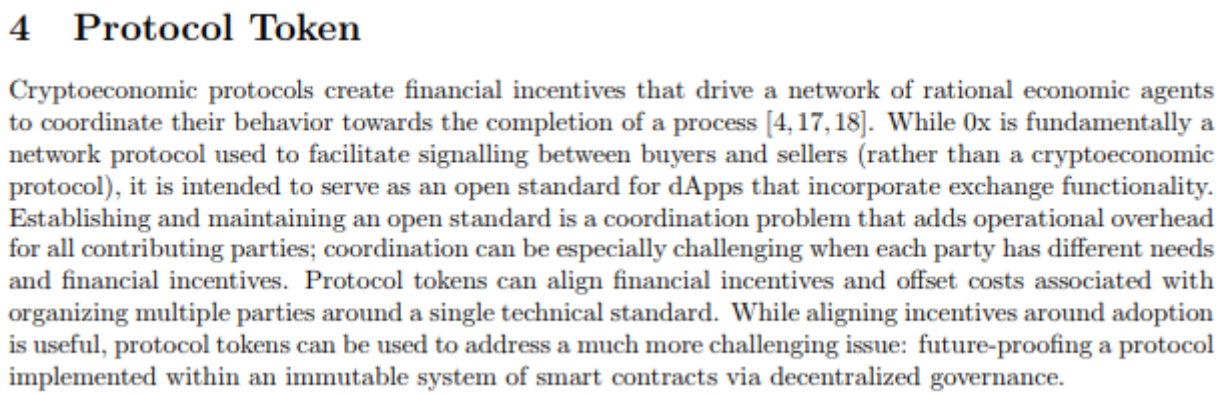
The following code was applied to this paragraph:

*Brand advertising has an excessive number of intermediaries, resulting in high transaction costs.*

The target industry, the fact that there are intermediaries, and the resulting high transaction costs were considered as the relevant factors of this paragraph. Knowing the specific intermediaries in the advertising industry was not expected to add value for understanding token systems at large, or the achievement of the intention of BAT. Therefore this information was omitted.

There were other instances, where the code was longer in proportion to the original paragraph than in the previous example. To illustrate this, consider this example from the 0x protocol.

[206] Basic Attention Token 2018



## 4 Protocol Token

Cryptoeconomic protocols create financial incentives that drive a network of rational economic agents to coordinate their behavior towards the completion of a process [4, 17, 18]. While 0x is fundamentally a network protocol used to facilitate signalling between buyers and sellers (rather than a cryptoeconomic protocol), it is intended to serve as an open standard for dApps that incorporate exchange functionality. Establishing and maintaining an open standard is a coordination problem that adds operational overhead for all contributing parties; coordination can be especially challenging when each party has different needs and financial incentives. Protocol tokens can align financial incentives and offset costs associated with organizing multiple parties around a single technical standard. While aligning incentives around adoption is useful, protocol tokens can be used to address a much more challenging issue: future-proofing a protocol implemented within an immutable system of smart contracts via decentralized governance.

Figure 7: 0x protocol – Protocol Token[207]

This text stems from the section “Protocol Token” and is the introduction to the ZRX token. The intention of the 0x protocol as discovered before is:

*The 0x protocol seeks to facilitate P2P exchange of ERC20 tokens and is free to use. Other dapps can utilize the protocol and charge fees for providing a liquidity pool. Decentralized governance is used to update the protocol.*

Considering this intention, the following code was applied to the above paragraph:

*0x is a network protocol, an open standard for dApps with exchange functionality. Maintaining an open standard is a coordination problem that adds operational overhead. Protocol tokens can align incentives and offset costs and can be used to future-proof a protocol implemented within an immutable system of smart contracts via decentralized governance.*

This code is significantly longer than the code from the previous example. This is because this section introduces the concept behind the ZRX token and why it is needed as a tool for decentralized governance, a central aspect of the 0x protocol.[208]

All the whitepapers were codified following this procedure. During the open coding phase of the 12 whitepapers a total of 252 pages were codified with a total of 872 codes as shown in *Table 4*. It is quite interesting to see how the number of codes per page varies between the papers. It could mean that some papers are denser in content than others. However, this is not conclusive, since codes were assigned on a paragraph-level and the authors of some papers might have made a purely stylistic choice to write longer paragraphs than authors of other

[207] Warren/Bandeali Amir 2017
[208] Warren/Bandeali Amir 2017

papers. There is also the possibility that we, as the researcher were in a different mood while coding the various papers and that might have caused the variance in codes per page.

| Token | Pages | Codes | Codes /Page |
|---|---|---|---|
| PAN | 42 | 89 | 2,12 |
| PPT | 19 | 68 | 3,58 |
| GNT | 26 | 73 | 2,81 |
| REP | 11 | 101 | 9,18 |
| BAT | 25 | 102 | 4,08 |
| PAY | 39 | 88 | 2,26 |
| ZRX | 13 | 37 | 2,85 |
| DGX | 11 | 33 | 3,00 |
| BNB | 15 | 39 | 2,60 |
| EOS | 25 | 115 | 4,60 |
| USDT | 18 | 79 | 4,39 |
| CryptoKitties | 8 | 48 | 6,00 |
| Total | 252 | 872 | - |
| Average | 21,00 | 72,67 | 3,95 |
| Min | 8 | 33 | 2,12 |
| Max | 42 | 115 | 9,18 |

Table 4: Open Coding – summary codes

Usually Straussian GTM proceeds directly to axial coding[209], where individual codes are gathered and connected around themes, also called axes.[210] In this study an intermediary step was performed. This step sort of connected the codes from open coding with the constructs of axial coding. The decision was to assign keywords to the codes from open coding. These keywords give a rough idea about the content, without grouping them too much. The goal was to create a common language basis through assigning keywords, which can be used to describe the contents of the codes with the same terminology. On the one hand, this procedure allows to connect the individual codes much faster in the phase of axial coding. On the other hand, the keywords make this part of the research recyclable. Having keywords enables other researcher to utilize the dataset and quickly analyze it with a focus on specific keywords, look for other connections of the keywords or focus only on a specific subset of keywords.

[209] Walker/Myrick 2006, p. 553
[210] Walker/Myrick 2006, p. 553

To illustrate how keywords were utilized in this study, the examples for open coding will be looked at again.

The code from BAT, "*Brand advertising has an excessive number of intermediaries, resulting in high transaction costs"*, was assigned the three keywords:

*advertising; intermediary; transaction fee*

The code from the 0x protocol, "*0x is a network protocol, an open standard for dApps with exchange functionality. Maintaining an open standard is a coordination problem that adds operational overhead. Protocol tokens can align incentives and offset costs and can be used to future-proof a protocol implemented within an immutable system of smart contracts via decentralized governance"*, was assigned a total of 15 keywords:

*cryptoeconomy; protocol; incentive; network; coordination; standards; dApp; exchange; overhead; token; update; smart contract; immutable; decentral; governance*

This way all the 872 codes were assigned with keywords, resulting in a total of 2980 keywords.

| Token | Pages | Codes | Codes /Page | Keywords | Keywords /Page | Keywords /Code |
|---|---|---|---|---|---|---|
| PAN | 42 | 89 | 2,12 | 162 | 3,86 | 1,82 |
| PPT | 19 | 68 | 3,58 | 127 | 6,68 | 1,87 |
| GNT | 26 | 73 | 2,81 | 167 | 6,42 | 2,29 |
| REP | 11 | 101 | 9,18 | 234 | 21,27 | 2,32 |
| BAT | 25 | 102 | 4,08 | 423 | 16,92 | 4,15 |
| PAY | 39 | 88 | 2,26 | 335 | 8,59 | 3,81 |
| ZRX | 13 | 37 | 2,85 | 246 | 18,92 | 6,65 |
| DGX | 11 | 33 | 3,00 | 162 | 14,73 | 4,91 |
| BNB | 15 | 39 | 2,60 | 109 | 7,27 | 2,79 |
| EOS | 25 | 115 | 4,60 | 528 | 21,12 | 4,59 |
| USDT | 18 | 79 | 4,39 | 326 | 18,11 | 4,13 |
| CryptoKitties | 8 | 48 | 6,00 | 161 | 20,13 | 3,35 |
| Total | 252 | 872 | - | 2980 | - | - |
| Average | 21,00 | 72,67 | 3,95 | 248,33 | 13,67 | 3,56 |
| Min | 8 | 33 | 2,12 | 109 | 3,86 | 1,82 |
| Max | 42 | 115 | 9,18 | 528 | 21,27 | 6,65 |

Table 5: Open Coding summary Keywords

Just like with the codes, there is a significant variance in the number of keywords per page between the different token systems. Again, this could be a stylistic choice of the author on how dense he wrote the paper or the variance could stem from a difference unconsciously imposed by us, as the researcher.

### 4.3 Introducing the Token Systems

As stated above, the study looked at a total of 13 token systems, of which 12 were included in main part of the study. This chapter will give a short introduction to each of the token systems, so the reader can understand where various codes, dimensions and specifications are coming from. The knowledge conveyed in this chapter will also provide the reader with the ability to track any general statements back to the actual data. Additionally, this chapter serves to display the researcher's understanding of the various token systems prior to the actual study, furthering the reader's ability to follow along the reasoning of the study. This may help the reader by giving him an idea where possible misconceptions and differences in opinion originate. The attempt is to base everything in this study in data and to make the reasoning transparent to the reader. This background information is provided, in case we mess something up or have a misconception about one of the token systems. Since these preliminary assumptions were formed without any actual research to back up the assumptions, these statements are clearly qualified as unsubstantiated assumptions. Some of the assumptions turned out to be wrong and there will be no references provided to back up any of the preliminary assumptions.

#### 4.3.1 Tether (USDT)

The entire chapter *5.2.1 Tether (USDT)*, except for the preliminary assumptions, is based on the tether whitepaper.[211] Instances where information from other sources is included will be marked with a footnote.


Figure 8: Tether logo

The technology stack for tether has three layers. The first layer, the basis is the Bitcoin blockchain. The Omni Layer protocol sit on top of the Bitcoin blockchain. Omni enables users to create custom currencies on top of the Bitcoin blockchain by adding some data to transactions on the Bitcoin blockchain.[212] Tether uses the Omni Layer protocol as the foundation for their USDT tokens. The legal entity behind the USDT tokens is Tether Limited which sits in Hong-Kong. This means the implementation of the token and the service in general stem from a

[211] tether 2016
[212] Omni 2017

central instance, the Tether Limited. Price stability of 1 USD to 1 USDT is achieved through Tether Limited as the central instance. Tether Limited is the only entity allowed to emit or destroy new tokens. Tether Limited claim they directly link the emission / destruction of USDT tokens to fiat transactions to / from their bank account. This means, when a verified user sends fiat money (USD) to Tether Limited, then they will emit new USDT tokens equal to the number of USD they got in the fiat transaction and credit these new tokens to the sender. The same process applies when someone wants to convert his USDT back to fiat. The person transacts his USDT to Tether Limited. If the person is verified, Tether Limited will destroy the tokens and send the user the same amount in fiat (USD). This means the total supply of USDT tokens in circulation is variable and not programmatically set to a fixed maximum amount. USDT tokens can be transferred freely, independent of the organization Tether Limited.

In summary USDT aims to be a token with a stable value in the real-world. The stability in the price of 1 USD to 1 USDT token is achieved, because new tokens can be obtained from Tether Limited at any time and existing tokens can be liquidated at any time for 1 USD per token. This mean there shouldn't be any rational reason to buy or sell a USDT token above or below the value of 1 USD per token.

Our preliminary assumptions regarding the USDT token:

We assumed that 1 Tether, or USDT, has a stable value of 1 US dollar. We had the assumption that tether runs on the Omni platform, but no assumption regarding the blockchain that supports the Omni Protocol. We had no assumption regarding the total supply of USDT. We had no assumption regarding the technical implementation of a token with the Omni platform. We had no assumptions on how tether achieves price stability for the tokens or how the governance for the tokens looked like.

### 4.3.2 EOS.IO (EOS)

The entire chapter *5.2.2 EOS.IO (EOS)*, except for the preliminary assumptions, is based on the EOS.IO whitepaper.[213] Instances where information from other sources is included will be marked with a footnote.


Figure 9: EOS logo

It turned out, that EOS is sort of a special case regarding the classification of either blockchain-native coin or secondary token. This presented a scenario not expected at the beginning of the study. Currently EOS is implemented as an ERC20 token on the Ethereum blockchain[214], however the

[213] block.one 2017
[214] block.one 2018

vision for EOS is to be a software that can be used to run one or multiple blockchains. The EOS software is supposed to enable blockchains with far better performance in terms of possible transactions per second, compared to Ethereum or other existing blockchains. The account balances of the ERC20 token EOS may eventually be copied to blockchains adopting the EOS software and represent the initial state of the native currency of that blockchain, but this is not guaranteed.[215] This future role as a blockchain-native coin would eliminate it from consideration for this study. Nevertheless, today it is a token on the Ethereum blockchain and therefore qualifies for consideration in this study.

To conform to the given criteria on the selection of token systems, the study will predominantly look at the ERC20 part of EOS and only consider the future function of a blockchain-native token peripherally. Behind EOS there is the company block.one with its headquarters located on the Cayman Islands. The only purpose of the EOS ERC20 token is to distribute the tokens via their token sale or initial coin offering (ICO), which runs for an entire year. At the end of this ICO, the EOS ERC20 tokens will become non-transferable. This locked state of EOS ERC20 token-ownership may be used as the initial distribution of the native coins on blockchains adopting the EOS.IO software. During the EOS ICO, the EOS ERC20 tokens are freely transferable, this means users can obtain EOS ERC20 tokens via exchanges, as well as via the ICO. The ICO runs from June 26th 2017 – June 1st 2018. The EOS ICO has no fixed maximum amount of ether, at which the ICO will end, instead the time of the ICO is fixed.[216] EOS emits the same amount of new tokens each day and divides these new tokens among the participants of the day proportionally to their contributions.[217] This means there is no fixed conversion rate like 1 ether = 100 EOS tokens, but the price is flexible each day, depending on the total amount of contributions on that day.

Our preliminary assumptions regarding the EOS token:

We assumed EOS was a new blockchain and were surprised to see coinmarketcap.com listing EOS as a token. We assumed that EOS is capable of performing significantly more transactions per second than Ethereum. We assumed EOS was somehow implemented on the Ethereum blockchain, but did not know how they would be able to achieve higher transaction volume than Ethereum itself. We had no assumptions regarding the functionality the EOS token offers, or how EOS does governance. (As you can see these assumptions turned out to be quite a ways away from the truth.)

[215] block.one 2018
[216] block.one 2018
[217] block.one 2018

### 4.3.3 Binance (BNB)

Figure 10: Binance logo

The entire chapter *5.2.3 Binance (BNB)*, except for the preliminary assumptions, is based on the Binance whitepaper.[218] Instances where information from other sources is included will be marked with a footnote.

The legal entity behind Binance Coin or BNB is Binance, an exchange for cryptocurrencies. Binance is an exchange, purely dealing in cryptocurrency and not accepting any fiat currencies. Binance is a central exchange, meaning all transactions on the Binance exchange are processed through the servers of Binance.

The BNB token is an ERC20 token with a maximum supply of 200 million tokens. There will never be any new BNB tokens created. The tokens were sold throughout the course of three weeks. In the first week the rate was 1 ETH = 2.700 BNB, in the second week the rate was lowered to 1 ETH = 2.500 BNB and in the third week the tokens were sold at a rate of 1 ETH = 2.300 BNB.

BNB can be used to pay for all kinds of fees on the Binance exchange. This includes the exchange fee and the withdrawal fee among others. The incentive for users to pay these fees in BNB instead of some other currency is a discount on the fees. This discount on fees begins at 50% in the first year and will be decreased over time. From the 5th year onward, there will be no more discount for using BNB tokens to pay for fees. There is another monetary incentive to the BNB tokens. Over time, Binance will reduce the BNB tokens in circulation from originally 200 million to 100 million, by using 20% of their operating profit on a quarterly basis to buy back tokens and consecutively burn them. Binance will continue to buy and burn BNB until there are only 100 million BNB tokens left in existence. This scarcity effect will increase the value of the token over time. The proceeds from the ICO will become available to the Binance team over the course of four years.

Our preliminary assumptions regarding the BNB token:

We assumed, that the BNB tokens are associated with the Binance exchange, because both carry the same logo. Further we assumed that BNB can somehow be used to get a discount on the transaction fees on the Binance exchange. Regarding the technical implementation, we assumed that the BNB token is implemented on the Ethereum blockchain. We had no assumptions regarding the total supply of BNB tokens. Neither had we assumptions on the governance or any additional functionality of the BNB tokened.

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[218] Binance 2017

### 4.3.4 Digix DAO (DGX)

Figure 11: Digix logo

The entire chapter *5.2.4 Digix DAO (DGX)*, exception for the preliminary assumptions, is based on the Digix whitepaper.[219] Instances where information from other sources is included will be marked with a footnote.

The DGX token was conceptualized and implemented by the Singapore-based DIGIXGLOBAL PTE LTD.[220] The idea of Digix is to have a token that has a stable value of 1g gold and can be traded without much hassle. Dixig proposed various processes, to ensure every token is backed and the risks are kept to a minimum. The process of depositing gold for DGX tokens looks roughly as follows: When a verified user deposits the physical gold, all the relevant information about the gold is recorded and permanently stored on the IPFS.[221] The gold is put in a storage vault and in return the user gets a digital Asset Card with the information about his deposited gold, which he stores in his Ethereum wallet. This Asset Card can then be used to create new DGX tokens, which are also stored in the users Ethereum wallet. To provide the users with certainty about the actual backing of the tokens with gold, there is a regular audit process. The auditor, the custodian and the vendor of the physical gold all gains fees of some kind for the services they provide for Digix, this is assumed to be enough of an incentive for them to act honestly in the long term.

The Digix whitepaper does not once mention the DGD which is also related to Digix and currently in circulation at all. There is neither a comment about the function of DGD nor on the distribution of those tokens.

Our preliminary assumptions regarding the DGX token:

We assumed DGX to be a token that is backed by gold. We assumed the token was created to facilitate the trading of gold. We assumed the DGX token is implemented on the Ethereum blockchain. We had no assumptions regarding any further functionality, the governance or regulations for the DGX token.

[219] Eufemio/Chng/Djie 2016
[220] Digix 2018
[221] Benet 2014

### 4.3.5 0x Protocol (ZRX)

Figure 12: 0x protocol logo

The entire chapter *5.2.5 0x Protocol (ZRX)*, except for the preliminary assumptions, is based on the 0x whitepaper.[222] Instances where information from other sources is included will be marked with a footnote.

The 0x Token, or ZRX, is a protocol token. The 0x protocol doesn't have an underlying business model and doesn't generate any revenue in itself. The 0x protocol wants to enable effective decentralized exchanges for tokens. The 0x protocol consists of smart contracts which allow a peer-to-peer exchange of tokens at a price, set by the user. The 0x protocol itself does not raise any fees for this service. With the 0x protocol, anybody can choose to operate a decentralized exchange. Now for an exchange to work effectively, the participants need to know the exchange rates, standing orders, and there needs to be a sufficient trading volume to grant liquidity. The big challenge for the 0x protocol is to get this part of an exchange right. There is no revenue and therefore no incentive for anyone to host an order book, the vital part of the exchange. For this purpose, the protocol planned for the role of a Relayer. A Relayer is someone hosting an order book. For this service of hosting an order book, the Relayer may raise fees, which are deducted from the tokens of the transaction volume.

Up to this point in the whitepaper there was no mention of any token connected to the 0x protocol. The ZRX token is a token, purely for the governance of the protocol. There may be new developments in the space of tokens, which could make it necessary to upgrade the smart contracts used as the basis of the decentralized exchanges. To ensure that the upgrade doesn't happen arbitrarily and doesn't disrupt orders on the exchange at the time of the update, the 0x protocol decided to implement a governance token. The holders of this tokens will have to come to an agreement in the case of an update. This is also the reason, why 0x did not have a token sale for the ZRX tokens. They gave the tokens away to partnering dApps and exchanges, since they are the ones most affected by upgrades to the exchange protocol. ZRX is an ERC20 token on the Ethereum blockchain.

Our preliminary assumptions regarding the ZRX token:

We didn't really have any assumptions about ZRX prior to actually looking at the whitepaper. Not about its purpose, functionality, implementation, governance or token supply.

[222] Warren/Bandeali Amir 2017

### 4.3.6 TenX (PAY)

Figure 13: TenX logo

The entire chapter *5.2.6 TenX (PAY)*, except for the preliminary assumptions, is based on the 0x whitepaper.[223] Instances where information from other sources is included will be marked with a footnote.

The company TenX is a payment provider. Specifically, they issue debit cards which can be used very much like any other debit card at all associated points of acceptance. The difference between the TenX card and other debit cards is the backend. Usually debit cards are connected to a bank account and allow to spend the funds of this bank account. TenX doesn't link a bank account, they link a cryptocurrency wallet. This enables users of the TenX card to spend their cryptocurrency funds, just like they would spend fiat currency. TenX doesn't allow every kind of cryptocurrency. Currently Bitcoin, Ethereum and Litecoin are compatible[224], but they plan to offer a wider variety in the future. The company TenX and their product already existed, before they created the PAY token. They created the PAY token to raise funds to scale their business.

As a payment provider, TenX gets a share of all payments done with their cards as commission. TenX decided to share this commission. For one, they share a part of the commission with the actual customers who made the payments with their TenX cards. TenX also shares a part of the commission with the PAY token holders.

The customers who pay with a TenX card are rewarded, similar to cashback rewards. The customers get 0.1% of their transaction volume as a reward. This reward is paid in the form of PAY tokens. This has various effects. The customer is happy about getting something back when he buys, which may encourage the customer to spend more, increasing his rewards, as well as the commission TenX receives. Secondly, by paying the reward in the form of PAY, the demand for PAY is increased and therefore the price per token will rise. This also turns customers into part of the PAY community and gets them interested in the long-term success of TenX and PAY. Assuming the TenX card generates a lot of transaction volume, this also increases the liquidity of the PAY token, by creating a steady demand for tokens.

Together the token holders of PAY are rewarded with 0.5% of the total payment volume spent by all TenX Card users. The reward is distributed proportionally to the amount of PAY each individual token holder holds. This reward is paid out in the form of ether. This means, that token holders essentially get a dividend for holding PAY tokens. This dividend will be priced in and therefore push the price of the PAY tokens upwards, especially if the transaction volume increases over time.

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[223] TenX 2017
[224] TenX 2018

The PAY token is an ERC20 token on the Ethereum blockchain. Tokens were sold at 350 PAY for 1 ETH, with a bonus of up to 20% for early buyers. The cap for the token sale was at 200k ETH. The amount raised will equal 51% of all tokens to be created, leaving 49% of the tokens for TenX, regardless of the fundraising amount. This means the theoretical maximum supply of tokens should be 350 * 200.000 * 1.2 / 51% which roughly equals 164.705.882 PAY tokens.[225]

Our preliminary assumptions regarding the PAY token:

We assumed, that TenX offers the ability to spend cryptocurrencies with a credit card and the PAY token was in some way affiliated with the company TenX. We had no specific assumptions regarding the affiliation of PAY to TenX. Further we assumed, that PAY was implemented on the Ethereum blockchain. We had no further assumptions regarding the number of tokens, technical specifications, governance, or regulations.

### 4.3.7 Basic Attention Token (BAT)

The entire chapter *5.2.7* Basic Attention Token (BAT*)*, except for the preliminary assumptions, is based on the BAT whitepaper.[226] Instances where information from other sources is included will be marked with a footnote.

Figure 14: BAT logo

The Basic Attention Token (BAT) is targeting the advertising industry. It aims to overhaul the way this industry works, improving the conditions for content publishers, advertisers and users. Today there are issues with the way advertising is done. The industry is dominated by a few big players, who basically get to control prices and decide which commercials are shown / banned. These big players also have a downside when it comes to reporting and analysis. There is an issue, because the same entities that offer advertisers to display advertisements on their platform, also do the vast majority of the reporting on the effectiveness of the advertisements. This bears the risk of being intransparent to advertisers and facilitates the potential of manipulating the reported data. This reporting issue is further amplified by the general inaccuracy of reporting methods used today. Another big problem in the ad industry are ad-blockers. These ad-blockers reduce the revenue of everyone in the industry. This means also the publishers' revenue gets smaller, making it less viable and potentially even driving some publishers out of business. This can't be in the best interest of the users either, since they want to consume the content published by the

[225] etherscan.io puts the total supply at ~205 million PAY, no explanation for the surplus was identified
[226] Basic Attention Token 2018

publishers. The biggest problem by far are intermediaries in the ad industry. A large portion of profits is taken up by intermediaries, who don't really add value to the industry.

BAT offers a possible solution to this. The BAT implements a ledger system for payments of microtransactions. These payments are based on new metrics for recording attention. BAT is closely related to the Brave browser, therefore they have more accurate means of recording user activity directly in the browser. This way only attention on content in the open tab is recorded, and therefore offers a more accurate measurement of attention. By omitting the intermediaries in the traditional ad industry, prices for advertising and rewards for publishers are competitive. The Brave browser focuses on user privacy. There is more data collected, but it is collected anonymously and evaluated locally. This way BAT can display more personalized ads to the user, without revealing information about the users.

The browser and metrics for recording user attention already exist and are publicly available. The BAT token is exclusively for the ad industry, it is only spendable to verified publishers, which gives BAT a centralized character regarding this control of spendability.

There is a total of 1.5 billion BAT, of which 1 billion was sold during the token launch. The tokens were sold at a rate of 1 ETH = 6.400 BAT, meaning the maximum funding through the token sale was set to 156.250 ETH.

The benefit for the users is the improved privacy through the Brave browser. There are less invasive ads and the displayed ads are likely more relevant to the user. The BAT also has a participation system, where users get a small reward for consuming content in the browser. When a payment occurs from the advertiser to the publisher, a small portion is sent to the user who watched the ad.

The benefits for the publisher include foremost a better profit margin. By removing most of the intermediaries, more money reaches the publisher. Publishers would likely also get better ratings from users, because the site can load faster, and the displayed ads are less invasive.

Advertisers benefit in this new advertising economy as well. Because BAT and the Brave browser have better capabilities to record and analyze user behavior, advertisers get to show their ads to a better targeted audience, increasing the effectiveness of their ads. By removing intermediaries, the prices for advertising with BAT are competitive with the ad industry today.

Our preliminary assumptions regarding the BAT token:

We assumed the BAT token rewarded users with tokens for watching ads. We assumed that BAT would introduce a new structure for advertisers and end-users. We assumed that the same person who founded Mozilla, also founded the organization behind BAT. We assumed

there was some connection between the BAT and the Brave browser. We had no further assumptions regarding technical details, specific function of the token, governance, regulations, or token supply.

### 4.3.8 Augur (REP)

The entire chapter *5.2.8 Augur* (REP*)*, except for the preliminary assumptions, is based on the Augur whitepaper.[227] Instances where information from other sources is included will be marked with a footnote.


Figure 15: Augur logo

Augur is a future markets platform on the Ethereum blockchain. Future markets mean people can bet on the outcome of future events. This can be understood as gambling or as insurance. A future market for gambling could use the outcome of a soccer match as the future event. Bets are placed on the various outcomes. After the outcome is reported, the people who bet on the winning result get the money placed on all other outcomes. Insurance basically does the same thing, only with a different focus. In an insurance scenario, a farmer could open a future market, saying he will harvest no more than a specified amount of crops that year and bet on it. Now if there were to be a bad harvest that year and the farmer actually harvested less than the specified amount of crops, he at least gets the winnings from his insurance future market, giving him enough to get by. There is a fee for settling a future market on augur.

The real challenge for a decentralized future market platform is to get accurate reports on the outcomes of events. Augur dedicated most of their whitepaper to finding a solution for this problem. This is the point where the REP token has its first entrance. The bets on future markets are placed in ether. REP is used in the mechanism to ensure accurate reporting on events.

The users reporting on the outcomes of events are called reporters. The incentive for reporters to participate is a share of the fees which accumulated over the course of a week. When reporting, the reporter states what he believes is the accurate outcome of the event and stakes some REP on that outcome, signaling to the community he believes this to be the true outcome. After this, there is one week time for disputing the outcome. To do this, the other person stakes REP on the other outcome, they believe to be the valid one. If a mathematically set threshold of dispute stake is reached on another outcome, that outcome gets a chance to become the final outcome. A new round (week) for disputing takes place. There is a mechanism in place, which mathematically ensures, there is a 50% ROI for people who successfully disputed the outcome of a market. In the case that two outcomes of a certain future market have strong support and the dispute stake grows to a significant amount, Augur will go into a

[227] Peterson et al 2018

fork state. During a fork no new markets can be opened and the open markets are put on hold until the fork is settled. At a fork, Augur creates new “child universes” for each possible outcome of the forking market. REP token holders can now migrate their REP to only one of these child-universes. This process takes 60 days and at the end of the period the child universe with the most REP will be considered the true outcome of the forking market and REP in all other child universes should lose all financial value. The Augur whitepaper does not give any specifics about the supply of tokens or the distribution thereof.

Our preliminary assumptions regarding the REP token:

We assumed that the REP token was used on the Augur platform to bet on the outcome of future events. We assumed that REP was implemented on the Ethereum blockchain. Further we assumed, that REP was used as the value to bid in the future markets. There were no further assumptions about REP. Not on governance, regulations or the number of tokens.

### 4.3.9 Golem (GNT)

Figure 16: Golem logo

The entire chapter *5.2.9 Golem* (GNT*)*, except for the preliminary assumptions, is based on the Golem whitepaper.[228] Instances where information from other sources is included will be marked with a footnote.

Golem aims to enable a decentralized supercomputer, a global market for computing power. Golem allows requestors to rent computing resources from providers to complete some computational task. Providers are users who are willing to rent out some of their computing power in return for monetary compensation. By being an open platform, Golem claims to allow for any amount of computing resources to be rented, resulting in great scalability.

Golem is in competition with the existing cloud computing providers Amazon, Google, etc. Today these big players use their market power to their advantage, resulting in high margins for them and inefficiently priced computing resources. Golem counters this by allowing providers of any size to participate in the platform. Private persons can rent out their spare computing power and earn some income on it. This diverse structure of providers results in more efficient pricing and in a market with almost complete information. In the future Golem hopes to be an essential building block of the decentral Web 3.0 by offering various micro services.

[228] The Golem Project 2016

Golem can be seen as Infrastructure-as-a-Service or as Platform-as-a-Service. The biggest advantage of Golem is its application marketplace. Golem allows anyone to publish their programs to the Golem application registry. This means Golem needs three groups of users for their long-term success, providers, requestors, and developers. Golem incentivizes each group separately.

Providers are incentivized monetarily. They receive payments from the requestor for renting out their computing resources. The providers can set their own prices for their hardware and the requestors then choose which provider they want at the given prices. Providers can select which applications from the Application Registry they allow to run on their hardware.

The incentive for requestors to use Golem is a market with almost complete information, which results in a much more efficiently priced service than it is currently available through the existing cloud computing providers. Another incentive for requestors is an easy user experience for renting the needed computing power. A third incentive is the Golem Application Registry, which offers an assortment of available services via a common platform. This makes it rather easy for the requestors to find the service that best fits their current need.

Golem does not enforce restrictions on who can act as a provider or as a requestor, this means that requestors can become providers during idle times and rent out their computing power themselves.

Developers and the software they publish to the Golem Application Registry are key to the long-term success of golem. For this reason, Golem decided to offer a set of tools to developers, facilitating the deployment, distribution and monetization of their software.

The Golem Application Registry has three predominant usages. The first usage of the Application Registry is for publishers to publish their software on the Golem platform. The second usage is closely related. The application registry allows requestors to look for available software tools and find the best fit for their current problem. The last usage for the Application Registry is related to security. In the Application Registry, there are so-called validators. These validators examine the uploaded applications in the Application Registry and evaluate whether they are safe or malicious and accordingly put them on their whitelist or blacklist. Providers can choose to trust a certain validator and accept his white/blacklists for themselves and only run application on the whitelist of the validator, or respectively not run applications on the blacklist of that validator.

The token on the Golem platform is called the Golem Network Token (GNT). The GNT is used for payments on the platform. For payments to providers, as well as for payments to software developers. The token can also be used for other interactions on the platform, e.g. for the participation in the validation process.

Golem gives its users some freedom regardingf the structure of the payments. There is a Transaction Framework which enforces some basic rules all payment schemes have to follow, but besides these basic rules, the providers, requestors and developers have freedom in customizing their payment scheme to their specific needs. The rules enforced by the Transaction Framework are:

- The application has to be registered in the Application Registry.
- The code for the application has to be open source and / or deterministic.
- The transaction has to utilize the GNT token.

There was an ICO for the GNT token in November 2016. The tokens were offered at a rate of 1.000 GNT = 1 ETH, with a maximum supply of 1 billion GNT.

Our preliminary assumptions regarding the GNT token:

We assumed that Golem offered a peer to peer cloud computing platform. We assumed users could obtain computing power from Golem in return for payment. We assumed Golem was implemented on the Ethereum blockchain. We no specific assumptions regarding the technical specifications, or the exact function of the GNT token in Golem. We also did not have assumptions regarding the governance of Golem or the total token supply.

### 4.3.10 Populous (PPT)

The entire chapter *5.2.10 Populous* (PPT*)*, except for the preliminary assumptions, is based on the Populous white-paper.[229] Instances where information from other sources is included will be marked with a footnote.

Figure 17: Populous logo

Populous aims to be a peer-to-peer platform for short-term financing (or factoring) for small and medium sized enterprises (SMEs). Factoring means buying the invoices of the SMEs at some discount.[230] This way the SME immediately has the cash to keep operations running or make investments. The incentive for investors to buy the SMEs invoice is the discount, meaning the investor makes a profit when the invoice is finally paid back in full by the customer of the SME.[231]

Populous seeks to build a P2P platform, connecting invoice selling SMEs to invoice buyers. Populous chose this market, because they believe they can get an edge over the traditional

[229] Williams 2017b
[230] Tiedtke 2007, p. 168 et seqq.
[231] Tiedtke 2007, p. 168 et seqq.

invoice financing banks. This edge is derived from the in-house credit scoring algorithm Populous uses. Populous gets the raw data that serves as the basis for the analysis in form of XBRC data. In the UK, every company needs to report their financial numbers in this format and the data is publicly accessible. Analyzing this data, Populous identifies SMEs with a low risk to default, which are not serviced by the existing invoice financing industry.

Populous uses blockchain to reduce transaction costs, increase security against fraud and for the smart contract functionality. Specifically, smart contracts are used to automatically execute the terms of contracts and process payments.

The Populous platform knows three categories of users: administrators, sellers, buyers. The administrator is an element in Populous that gives it a centralized character. The administrator has to approve sellers and buyers before they can participate on the platform. Administrators are also responsible for screening invoices of sellers and starting the auctions for accepted invoices. The sellers on Populous are the SMEs looking to sell their invoices on the Populous platform. All sellers and invoices have to be approved by an administrator. The buyers are people looking to invest in the invoices posted on the Populous platform. Buyers generally need to be approved by an administrator as well. The exception are buyers using only crypto-currency for deposits and withdrawals.

Invoices are sold in auctions, and each invoice is connected to a document hash on the IPFS.[232] Before the auction for an invoice begins, an administrator has to verify the data and start the auction. An auction runs for 24 hours and ends if the funding goal is reached, time runs out or the seller decides to cancel the auction. All losing bids are returned and the winning bid is given to the seller. The seller most likely withdraws the money as fiat currency to use in his business. When the seller collected the invoice, he deposits the amount to Populous and the buyer is rewarded with his initial investment and the interest.

On Populous all auctions are done using a custom token called “poken”. Pokens are custom stable coins, pegged to the value of fiat currency. Similar to tether, Populous allows to deposit and withdraw pokens in exchange for fiat currency. Pokens are implemented on the Ethereum blockchain and can be withdrawn from the Populous platform.

Populous has a second token, the Populous Platform Token (PPT). This token can be used to invest in invoices on the Populous platform. In the whitepaper there is no more information available on the PPT. In the business plan there is only a little more detail. PPT were issued following the pre-ICO fundraising-event.[233] The value of PPT is variable and determined at the

[232] Benet 2014
[233] Williams 2017a

time of exchange. There is a buyback mechanism to increase the value of the remaining PPT.[234] No specific details are revealed regarding the valuation or the buyback mechanism.

Our preliminary assumptions regarding the PPT token:

We assumed the PPT token is associated with Populous and implemented on the Ethereum blockchain. We assumed Populous is a peer-to-peer factoring platform and the token can in some way be used on this platform. We had no assumptions on the total supply of PPT tokens. We had no assumptions about the governance of Populous or any of the technical specifications of the factoring platform.

### 4.3.11 Pantos (PAN)

The entire chapter *5.2.11 Pantos (PAN)*, except for the preliminary assumptions, is based on the Pantos whitepaper.[235] Instances where information from other sources is included will be marked with a footnote.

Figure 18: Pantos logo

Pantos aims to be the first multi-blockchain token system. Pantos is a research project, started by team of the Austrian exchange Bitpanda. The goal is to improve the communication between the developers of various blockchain communities to create network effects. Having better communication and cooperation between all the developers and researchers in the blockchain field is expected to accelerate the overall development of the technology. A second goal of the multi-blockchain token system is to facilitate the movement of value between different blockchains. This way the value associated with the tokens shouldn't be stuck on a project that is not being further developed. The third motive for building a multi-blockchain token system is arbitrage. Arbitrage means taking advantage of different exchange rates for different currency pairs.

On the technical side, Pantos plans to utilize atomic swaps to move the tokens from one blockchain to another. Atomic swaps are a concept, that lets two parties trustlessly exchange tokens directly P2P at previously agreed upon conditions on different blockchains without an intermediary. The technology already exists today and test transactions have been made on different blockchains, however the concept is not very user friendly yet, and not ready for mass adoption by the markets. Atomic swaps utilize the existing features of multisignature and time locking. Atomic swaps are cryptographically build in a matter to ensure that if one party claims his tokens, it automatically allows the counterparty to claim the tokens on the other blockchain.

[234] Williams 2017a
[235] Bitpanda 2018

Should one party not cooperate, the parties can each reclaim their tokens after the time lock is released.

There are problems with atomic swaps today. For one, they are not really user friendly. Another problem is, to be able to perform an atomic swap, the two parties need to find each other and agree to terms. If they managed this part, there is the inconvenience of having to perform multiple transactions on both blockchains, resulting in higher transaction fees. Another issue with atomic swaps is privacy. Currently both parties need to know each other and see the transactions in order for them to be able to perform atomic swaps. Pantos wants to develop an open-source atomic swap protocol, which can become a standard for atomic swaps in any blockchain.

Combining atomic swap technology and lightning networks, Pantos imagines the possibility of a cross-chain lightning network. A lightning network makes microtransactions viable and allows near-instant transactions, without having to wait for confirmation of miners. A lightning network consists of multiple two-way payment channels. Payment channels utilize multisignature and time locking, same as atomic swaps. In a payment channel, both parties lock some currency up and can transfer this value among them off-chain, only sending signed messages to the other person. This works using decreasing time lock scripts, allowing for the recovery of the funds in case the other party doesn't cooperate. Payment channels and therefore also lightning networks dramatically reduce transaction costs, because only the opening and closing transactions are recorded into the blockchain and cause a fee.

Pantos hopes to advance the overall market-readiness of blockchain technology.

Pantos starts out as a centralized proof-of-concept on the Bitpanda exchange. The next stage will be an API that allows for automated trades, still using Bitpanda as a central entity. The final vision is for Pantos to be a truly decentral multi-blockchain system.

Pantos had an ICO, during which 40% of the created tokens were for sale, 50% were retained by the company, 9% were reserved for bounties and 1% was airdropped.

The ICO was capped at a contribution of 1.500 BTC, distributing 40% of all tokens proportionally to the contributors, meaning if there would be little contribution, these contributors would get more tokens than if the contributions were higher. The bounty tokens are given out to users and developers that notice and report bugs and unwanted behavior. The airdrop distributed a share of the tokens to users for free. All users that had an account on Bitpanda at the time of the airdrop automatically participated.

Our preliminary assumptions regarding the PAN token:

We assumed PAN is supposed to be a multi-blockchain token, meaning a token that can be transferred onto multiple blockchains. Further we assumed, that Pantos is being developed by the Bitpanda team. Also we had the assumption, that Pantos is only a concept at this point, because the ICO hadn't begun when we first read about Pantos. We had no specific assumptions regarding the governance or total supply of PAN tokens. We also had no assumptions regarding the technical implementation of PAN.

### 4.3.12 CryptoKitties

The entire chapter *5.2.12 CryptoKitties*, except for the preliminary assumptions, is based on the CryptoKitties whitepaper.[236] Instances where information from other sources is included will be marked with a footnote.

Figure 19: CryptoKitties logo

The overarching goal of the CryptoKitties project is to make the usually very technical and "esoteric" concepts of cryptocurrencies and the blockchain accessible to average customers.

CryptoKitties addresses a couple of problems. The first one being, that current blockchain projects usually only target early investors and cryptography experts, and even then oftentimes there is no concrete product. The second problem CryptoKitties wants to address is the current funding model for blockchain projects: ICOs. The concept of giving a project money, before there is any product requires that investors place immense trust in the product. If it turns out the ICO was conducted in bad faith or just completely overpromised on the product, this hurts the general perception of blockchain projects and the technology. The third problem CryptoKitties seeks to address are digital collectibles. Today they are not viable, because digital collectibles today depend on a central issuing authority and this authority could just produce more of the collectible at will, significantly reducing the value of the existing collectibles. Another difficulty of digital collectible is the dependence on the issuing authority. If the creator of the digital collectible e.g. goes bankrupt, the digital collectibles will just be gone with the creator. The third problem of digital collectibles is: they oftentimes don't have any functionality and customers lose interest in them.

The product the CryptoKitties team came up with is: "digital collectible cats on the Ethereum blockchain" Each cat has its own genes and visuals. The cats can be collected and they can be used to breed new cats.

This helps the average customer to gain a better understanding of cryptocurrency and blockchain technology through the concept of gamification. The user plays the game, and in the

[236] CryptoKitties 2017

process, learns about the technology, and how to use it. The design of cute cats was chosen deliberately to make the project appeal to customers and offer a different face for blockchain than the usual technical, business-to-business style applications. CryptoKitties did not have an ICO selling all the cats upfront. Rather the revenue model consists of two parts. On the one hand, CryptoKitties auctions of a total of 50.000 cats, one every 15 minutes. On the other hand, there is a marketplace where users can sell their cats to other users. CryptoKitties takes a 3.75% commission on every sale.

The sales on the marketplace, as well as the initial auction of the cats are conducted using a descending clock auction. In this sort of auction, a high starting point is set, as well as a minimum value and the duration of the auction. During the auction time, the price continually sinks until it reaches the minimum value. This concept is chosen to avoid fees associated with every transaction on Ethereum. The starting point for the 50.000 initial cats is determined by the average of the last 5 sales + 50%.

Besides making blockchain approachable and operating a sustainable revenue model, CryptoKitties also portrays a practical use of the ERC721 token standard for non-fungible tokens.

Our preliminary assumptions regarding CryptoKitties:

We assumed CryptoKitties are non-fungible, meaning each instance of CryptoKitties is unique and there is a difference in owning CryptoKitty A and CryptoKitty B. This differs from other tokens or fiat currency, where each instance is interchangeable and the owner doesn't care whether he owns e.g. Euro A or Euro B, since they have the same value. We assumed CryptoKitties is implemented on the Ethereum blockchain according to the ERC721 token standard. We had no assumptions regarding the governance or total supply of CryptoKitties.

### 4.4 Axial Coding

The next step in applying the GTM was the axial coding.[237] The goal of axial coding in general is to arrange individual codes around central topics, also called axes.[238] In the context of this study, this means identifying dimensions which can be used to describe token systems.

The basis for axial coding are the codes gathered during the phase of open coding.[239] In this study we also take the keywords from open coding into account, since they were specifically added to facilitate the process of axial coding. To effectively work with the keywords, a condensed list of all keywords from all whitepapers was put together. This list noted the keyword,

[237] Walker/Myrick 2006, p. 553
[238] Walker/Myrick 2006, p. 553
[239] Walker/Myrick 2006, p. 553

the related whitepaper and the information which code the keyword belongs to. The following screenshot depicts a small excerpt of the list.

| | | | |
|---|---|---|---|
| 682 | blockchain | 46 | CryptoKitties |
| 683 | potential | 46 | CryptoKitties |
| 684 | public | 46 | CryptoKitties |
| 685 | practical | 47 | CryptoKitties |
| 686 | understanding | 47 | CryptoKitties |
| 687 | UX | 47 | CryptoKitties |
| 688 | digital collectibles | 48 | CryptoKitties |
| 689 | innovation | 48 | CryptoKitties |
| 690 | approachable | 49 | CryptoKitties |
| 691 | blockchain | 49 | CryptoKitties |
| 692 | consumer | 49 | CryptoKitties |
| 693 | Ethereum | 49 | CryptoKitties |
| 694 | game | 49 | CryptoKitties |
| 695 | API | 2 | DGX |
| 696 | asset | 2 | DGX |
| 697 | chain of custody | 2 | DGX |
| 698 | decentral | 2 | DGX |

Figure 20: Keyword list

Grouping is oftentimes a many-to-one relation and would mean assigning each keyword to the group it best fits into.[240] This approach was used as the first attempt for discovering dimensions. Each keyword was looked at one after another and subsequently either added to an existing class or a new class was created when the keyword didn't fit in any of the existing ones. Unfortunately, this process turned out to be only a mediocre fit for the data and keywords at hand. While there were some interesting classes and related insights, this process did not work for all keywords in the list. For one thing, there were many classes with merely one keyword in each class. The second, more sever issue with this approach were keywords which could be assigned to multiple groups. For example, the keyword *crypto-business* could be put in the group of *cryptoeconomics*, as well as the group *company*.

Because this first approach did not turn out as desired, a slightly different approach was taken. It turned out a many-to-many relation was a much better fit for the set of keywords at hand. There were specific keywords, which qualified for multiple groups. This is not a problem, since there was no exhaustive set of classes to comply with.[241] Rather the task was to come up with a way to describe tokens. The expectation was to identify multiple dimensions for describing

[240] Lund Research 2012
[241] Bryant/Charmaz 2007, p. 192

token systems. Multiple dimensions mean it's possible to look at the same object from different perspectives, so it has to be expected, that some aspects will be part of multiple dimensions.

The learnings about the token systems from open coding were kept in mind while looking for connections between keywords. This is very similar to the process described above with the difference that keywords can be reused multiple times. When a group of keywords related to a common theme was discovered, the common theme and the related keywords were noted down. The next step for this theme consisted in looking through the list of all keywords and looking for any other keywords that could fit the theme and adding them to the list.

To illustrate this process, consider the following example:
There was a common theme noticed among the keywords *hack, attack, cheat*. So the topic was noted as "*Threats*". Next the list of all keywords was checked and all remaining keywords related to "*Threats*" were identified and added to the list. The final list of keywords related to *Threats* was: *Hack, attack, cheat, abuse, collude, DDoS, fake, fraud, malicious, omit, scam, stolen, cheat*

This process of discovering a theme, naming it, and finding related keywords was repeated until theoretical saturation[242] was reached and no new themes were found in the data. In some cases a keyword did not relate to any other keywords. These isolated keywords were each very specific to only one token system and therefore not included as separate themes. The alphabetically sorted list of themes can be seen below.

| | | |
|---|---|---|
| Attack | Incentives | Token Distribution |
| Bug | Marketing | Token Implementation |
| Community | Mint / Destroy Tokens | Token Interactions |
| Creator | Organization / (Legal) Entity | Token Value |
| Developers | Regulations | Total Token Supply |
| Dividend | Smart Contracts | UI / UX |
| Openness | Strategy / Vision | Underlying Value |
| Fees | Supporters / Partners | Updates to Technology / Infrastructure |
| Governance | System Implementation | User Roles |

Table 6: Token Dimensions

[242] Bloor/Wood 2006

This cleaned list was the result of the axial coding. These themes can now be considered the dimensions for token systems. Some token systems did not provide information on all dimensions. For example, the EOS whitepaper was primarily focused on the specification of the EOS.IO software, that was not included in this study, and therefore there was no information on the ERC20 EOS or its ICO.[243] For the process of discovering the dimensions themselves, this was not a major problem. However, for describing the possible values for each of the dimensions a comprehensive view for each token and the characteristics of each of the dimensions was desirable. This description is done in chapter 5 *Results*. Secondary literature was needed in order to fill these knowledge-gaps. For the example of the ERC20 EOS token and ICO, the website eos.io presented the relevant information.[244]

### 4.5 Selective Coding

Generally, the goal of selective coding is to select one or a few of the axes from axial coding as the central axes which are central to the phenomenon of study.[245] In this study, the goal of selective coding was slightly different. As the overall goal of the study is to find a way for describing token systems, it was decided that a reduction is not the correct way to go about selective coding for this study. Instead this study focuses on the interactions of the individual dimensions and forms a model for token systems.

To accomplish this, the dimensions from axial coding presented the source material for finding relations and connections. To facilitate forming a model, all dimensions were revised and where it made sense, they were grouped together, e.g. the dimensions of *Attack, Bug, Updates to Technology / Infrastructure* were grouped under the topic of *Threats*.

After grouping the dimensions in this way, the next step was to search for relations between the various dimensions / groups of dimensions. For this purpose, the individual codes and the raw data behind the dimensions were revisited. The associated codes were identified by looking at the keywords that formed the dimension and then looking up the codes associated with the keywords. The individual codes and the according paragraphs in the whitepaper were reread and possible relations to other dimensions were noted. For example, the code from the Golem whitepaper "*GNT token is used for payments and other actions in Golem."* suggested there might be a connection between *Tokens* and the *Payment Structure*, as well as a connection of *Tokens* to *Functionality*. These relations were then validated by cross-checking them with the other codes. The example from before was validated by the code "*Use BNB token to pay for any fees on platform."* from Binance. When a significant amount of reinforcement was

[243] block.one 2017
[244] block.one 2018
[245] Walker/Myrick 2006, p. 556

added to a relationship through various codes, this relationship was accepted as valid and taken as a building block for the model of token systems.

The last step of selective coding consisted in putting together the model for token systems. This was done in an iterative fashion. The individual dimensions and relations were put together as a model. The model was then validated against the codes, to check if the model accurately represents the token systems. Discrepancies were noted, the model adapted, and checked again until the model was a good fit for each of the token systems. The results chapter will discuss the final version of the model as well as each of the dimensions in more detail.

# 5 Results

This chapter will discuss in detail each of the discovered dimensions and the model as a whole. In chapter 5.*1 Model for Describing Token Systems*, the model which was set up during selective coding will be discussed in more detail. The relationships between the dimensions will be explained and the reasoning for setting up the model the way it was set up will be laid out. In chapter *5.2 Dimensions for Describing Token Systems*, all the individual dimensions of the model will be presented. There will be a definition for each of the dimensions. Additionally there will be the description of the values and characteristics we discovered for the dimension while studying the twelve token systems.

## 5.1 Model for Describing Token Systems

As mentioned before, the primary result of this study is a model, depicting the individual parts that in sum constitute a token system. The following paragraphs will serve to describe this model and the important relationships between parts of the token system.

The model was created twice with varying levels of detail. This was done to give the model a wider range of applicability. The very detailed version will probably be “overkill” for most scenarios. The simple model is much easier to take in and understand. We advise everyone, even people who are interested in the detailed version, to start with the simple version to get a feel for the model.

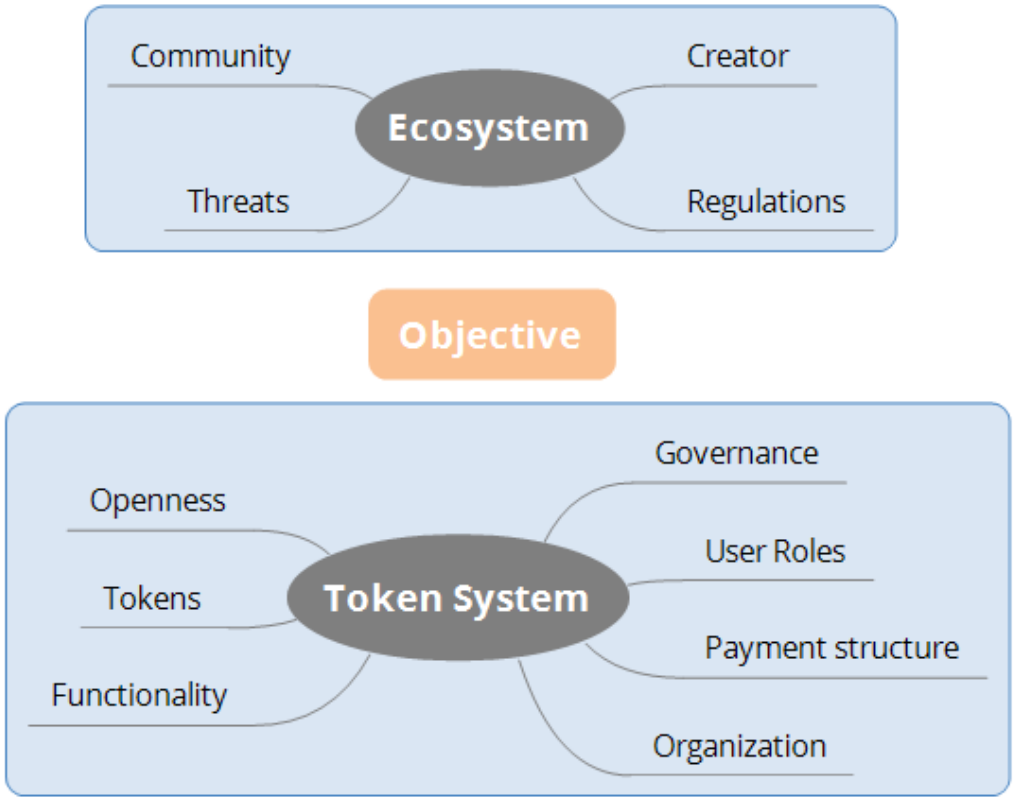


Figure 21: Token System - simple

On the first look, it can be noticed, that the model is divided into three general sections, the *Objective, Token System,* and *Ecosystem*. The Ecosystem and Token System should be understood the way they were defined in chapter *3.3 dApps & Token Systems* and *3.4 Ecosystem* respectively. The part of the *Objective* was already mentioned in the study as well. The *Objective* is the intention a creator had in mind when creating the token system. A list of each of the objectives of the studied token systems can be found in chapter *4.2 Open Coding*, on the pages 26 & 27. In chapter *3.3 dApps & Token Systems*, we defined a token system as a socioeconomic system and per definition a socioeconomic system consists of a system which is in interaction with its surroundings.[246] The model is arranged this way to represent this separation and interaction of the system with its surroundings. For further information about each of the dimensions refer to chapter *5.2 Dimensions for Describing Token Systems*. The whole model looks like this:

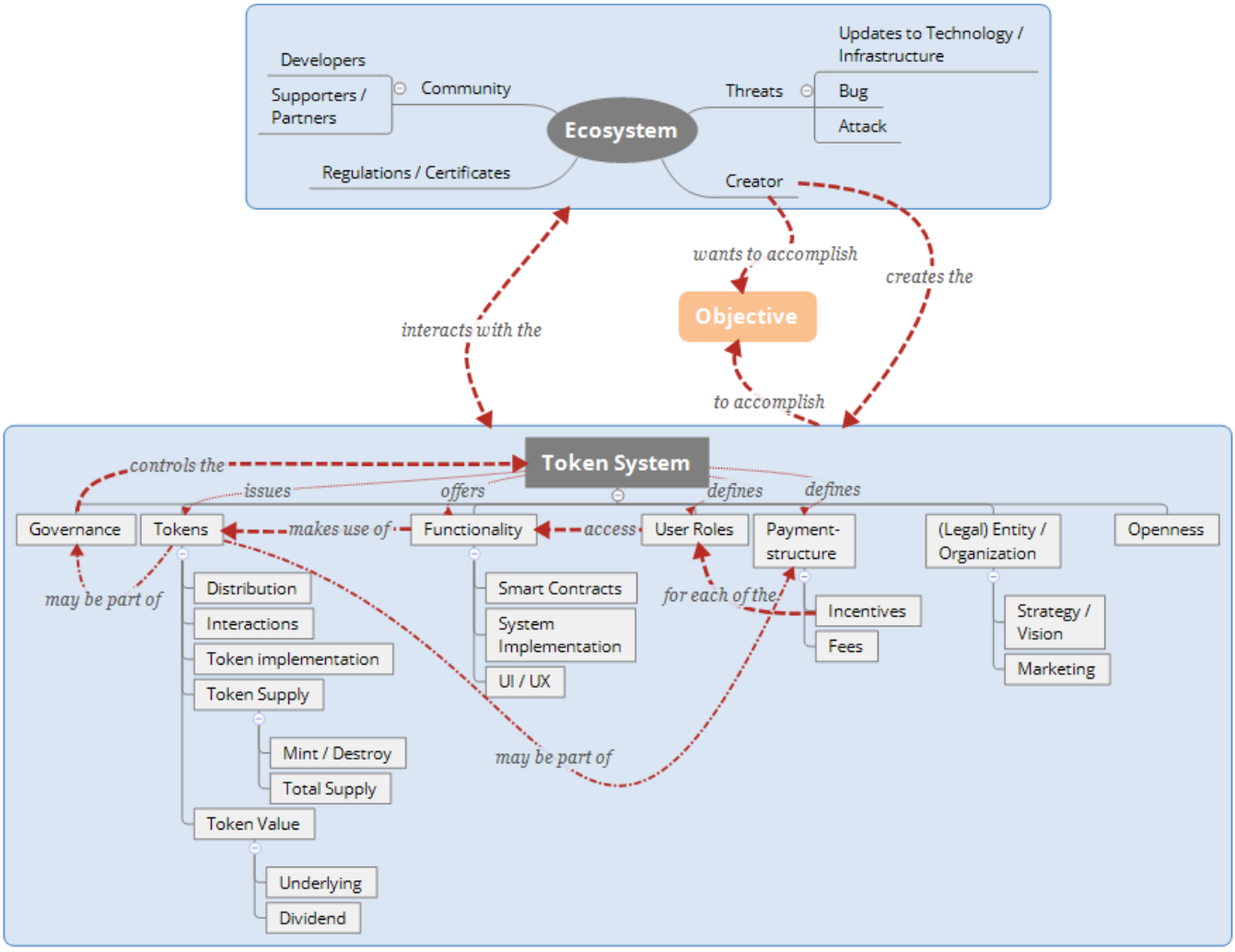


Figure 22: Token System - detailed

[246] Maurer 2018

Since this is much to take in at once, the model will be divided into its components and each section will be discussed separately, piecing the model together in the end. As a general note, the relationships should be read as {start} {action} {end}, e.g. {Tokens} {may be part of} {Governance}. Starting with the *Objective*, since the *Objective* has been the common theme all throughout this study.

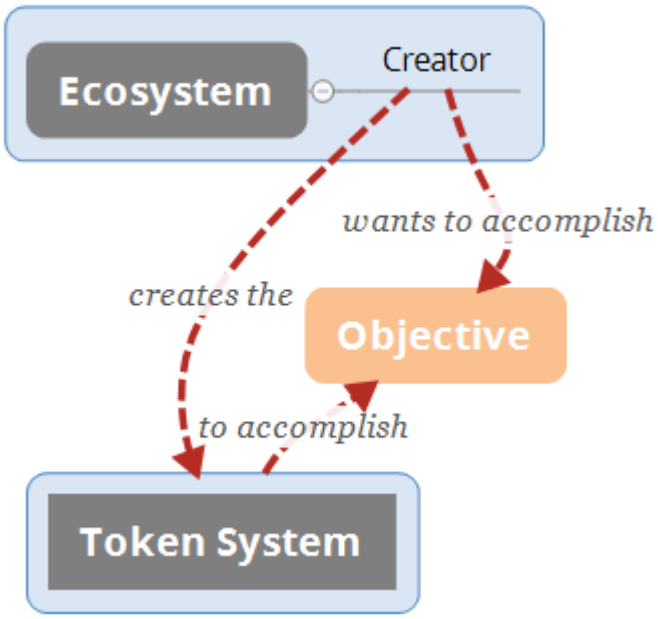


Figure 23: Model – Objective

Taking a closer look at the objective, it can be discovered that the Ecosystem, namely the creator of the token system, as well as the token system itself have some interaction with the objective. The *Creator* wants to accomplish the *Objective*. To accomplish this, he creates the *Token System*. In turn, this means that the *Token System* is created to accomplish the *Objective.*

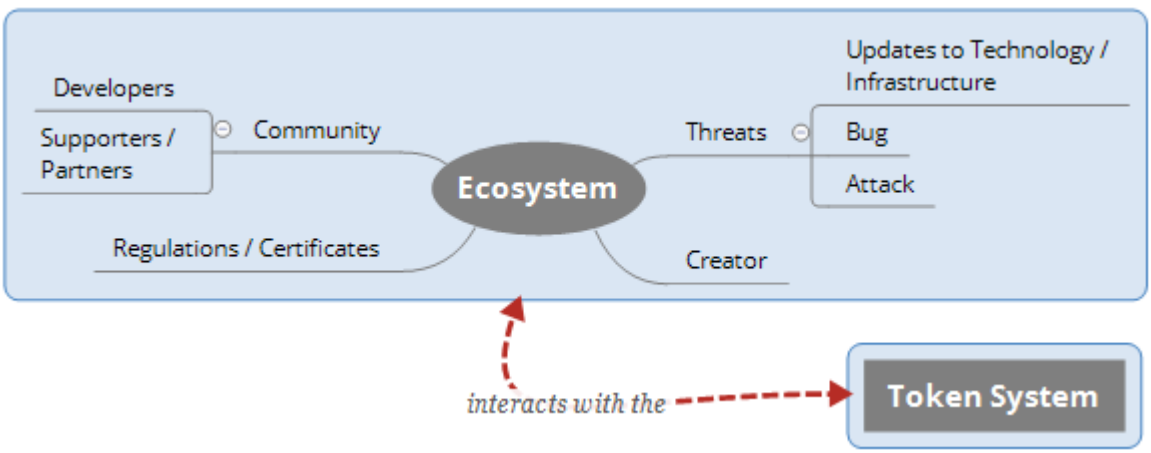


Figure 24: Model - Ecosystem

The *Ecosystem* in this version of the model is similar to the version in the simple model. The *Community* is split into *Developers* and *Supporters / Partners* and *Threats* are more specific with the variations of *Bug, Attack* and *Updates to Technology / Infrastructure*. There are no specific interactions within the *Ecosystem*. Neglecting the interactions of the *Creator* with the *Objective* and the *Token System*, the only meaningful relationship is between the *Ecosystem* and the *Token System*.

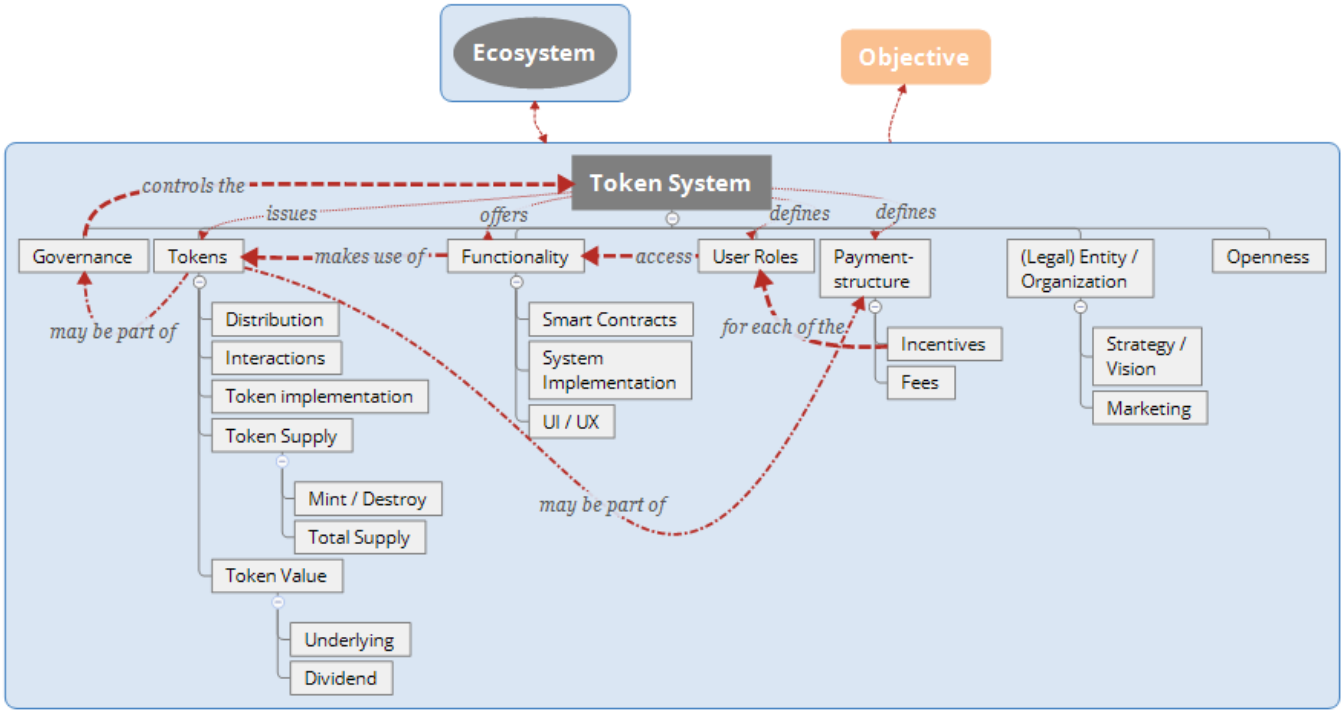


Figure 25: Model - Token System

Looking at the *Token System*, it is still appears rather loaded. Therefore each part of the Token System will again be looked at separately. Starting with the G*overnance* and the O*rganization* as the first aspect to be looked, followed by *Tokens*, *Functionality*, *User Roles* and finally the *Payment structure*. *Openness* will only be discussed in chapter *5.2* as it has no specific interactions with other aspects of the model.

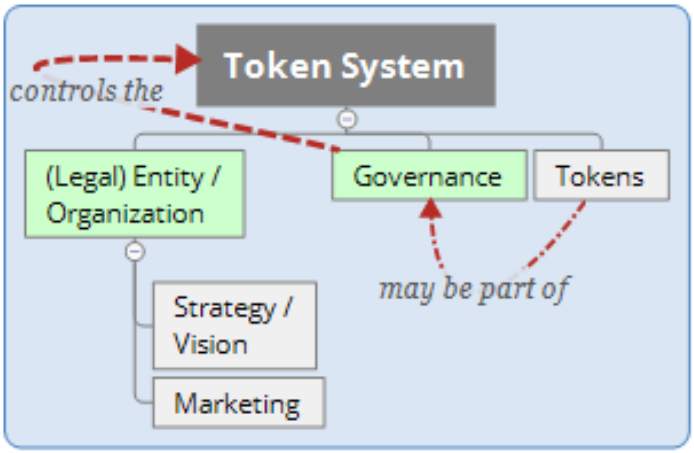


Figure 26: Model - Governance

This aspect is rather straight forward. Behind some *Token Systems* there is an *organization, a legal entity*. This *organization* oftentimes has a *vision* for the *Token System* and is responsible for *marketing* the *Token System*. For some token systems this may be a company, e.g. behind the PAY token stands the company TenX[247]. Other token systems are controlled via decentral *governance*, e.g. the 0x protocol.[248] In the case of decentralized *governance*, the distribution of *tokens* often determines the amount of control an individual has over the *Token System*. If there is a company behind the *Token System*, this company often times is also responsible for the *governance* of the *Token System*.

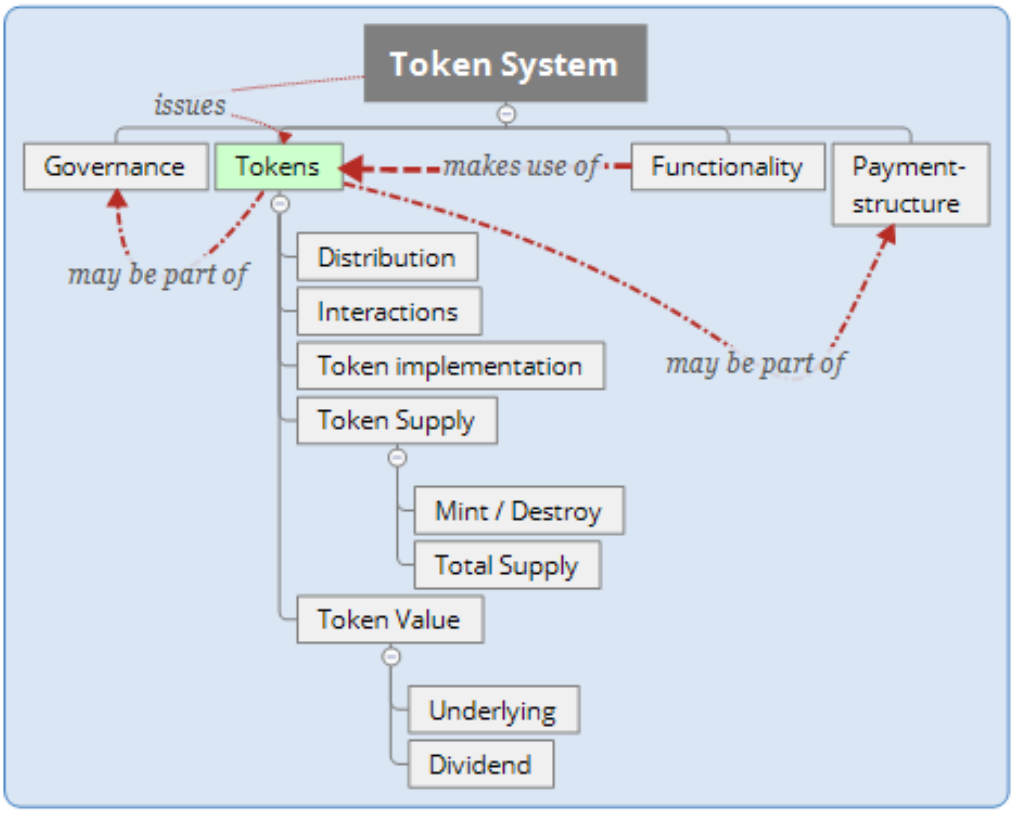


Figure 27: Model - Tokens

Looking at tokens, things get a little more complex. The token itself can be described in various ways. For one the value of the token, which might stem from some underlying value like gold in the case of DGX[249], or the value might come from some dividend that is paid to token holders like in e.g. the PAY tokens.[250] Each token has a certain supply. This supply might be fixed or

[247] TenX 2017
[248] Warren/Bandeali Amir 2017
[249] Eufemio/Chng/Djie 2016
[250] TenX 2017

it might be flexible and allow for the minting / destruction of tokens. E.g. BAT has a fixed supply[251] while DGX has a flexible supply.[252] Another characteristic of a token is its technical implementation. Many tokens are implemented as ERC20 tokens on Ethereum, but there are other options as well, for example, USDT which is based on the Omni Layer Protocol on the Bitcoin blockchain.[253] All the characteristics of the various dimensions can be found in chapter *5.2 Dimensions for Describing Token Systems*.

As stated in the section on governance, token holders might be eligible to participate in the governance of a token system by owning tokens, the way the 0x protocol handles this.[254] The tokens themselves are issued by the token system, often by publishing an ERC20 token smart contract. The core of the token system is often some functionality. Oftentimes this functionality makes use of the tokens. In turn, this means that token are a prerequisite to make use of the functionality of those token systems. For example, Golem can only be used with GNT.[255] The token might be part of the payment structure for the token system, meaning the token can be used to pay for fees (e.g. BNB[256]) or the token is used as a sort of incentive (e.g. the PAY token pays a dividend[257]).

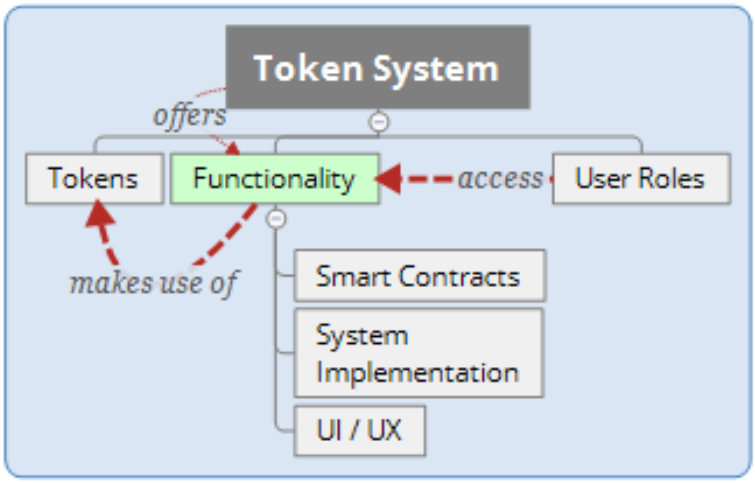


Figure 28: Model - Functionality

A token system usually offers some kind of functionality. This functionality oftentimes consist of a combination of smart contracts, a user interface and sometimes some other software. For example, Golem offers the functionality of renting computing power.[258] There might also be

[251] Basic Attention Token 2018
[252] Eufemio/Chng/Djie 2016
[253] tether 2016
[254] Warren/Bandeali Amir 2017
[255] The Golem Project 2016
[256] Binance 2017
[257] TenX 2017
[258] The Golem Project 2016

some additional systems integrated. For example, IPFS is used in Digix[259], Golem[260] and Populous[261]. The functionality is sometimes restricted to specific user roles, e.g. in Populous only the role of the administrator can access the functionality to approve a new seller.[262]

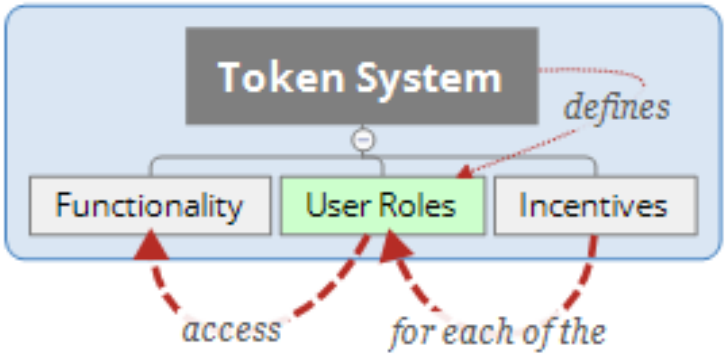


Figure 29: Model - User Roles

Within a Token System there are sometimes different User Roles. However not all Token Systems have distinct User Roles, for example, the Binance Coin does not know any User Roles[263], while Populous has a strict separation of user roles[264]. Each Token Holder of BNB can use the token in the same manner, namely to pay for transaction fees on the Binance exchange at a discount.[265] If there are User Roles, they each have a different set of Functionality accessible to them. So for example, in Golem there are requestors, providers and software developers.[266] Each of these User Roles has different actions they can perform, a software developer has access to tools for deploying and monetizing his software. A requestor won't use these tools but rather search the application registry to find a tool fitting his needs.[267]

There might also be cases where one person can act as different User Roles. Again looking at Golem as an example, in Golem a requestor can also be a provider, renting out his own computing power during idle times.[268]

[259] Eufemio/Chng/Djie 2016
[260] The Golem Project 2016
[261] Williams 2017b
[262] Williams 2017b
[263] Binance 2017
[264] Williams 2017b
[265] Binance 2017
[266] The Golem Project 2016
[267] The Golem Project 2016
[268] The Golem Project 2016

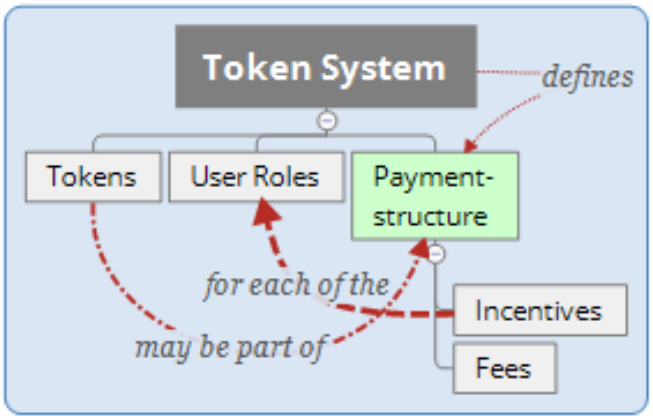


Figure 30: Model - Payment structure

Most Token Systems have a defined Payment structure. This payment structure encompasses fees and incentives. Fees often depict the monetization model of the company behind the token system and generates a continuous stream of revenue. Taking CryptoKitties as an example, they raise a fee of 3.75% on each sale of a CryptoKitty on the marketplace.[269] Most human decisions are based on some intention.[270] In order to stimulate intentions, Token Systems present incentives to each of the participating groups of people. In a regular production company the incentives are quite simple: the business owner gets the profit of the company, the employees get their wages, and customers get the product they want. In a similar fashion Token Systems need to incentivize the people it wants to interact with. BAT states the incentives for each of its User Roles (advertisers, publishers, users) very clearly. Advertisers can expect better conversion rates through more accurate targeting of users, while the price for advertising stays competitive. Publishers stand to get more revenue because there are fewer middlemen taking their cut of the pay. Users are expected to opt into the BAT ecosystem because their data is protected by better privacy than in the current advertising industry and very invasive ads are blocked.[271]

To depict the desired payment structure, oftentimes the tokens are utilized in some way. For example, TenX has a payback system for people using their debit card. This payback reward is paid in form of PAY tokens.[272]

[269] CryptoKitties 2017
[270] Ajzen 1991, p. 182
[271] Basic Attention Token 2018
[272] TenX 2017

Having an understanding of each of the individual parts and how they relate to each other allows looking at the model as a whole again and this time it should be clearer what the individual parts mean and how they compose the Token System.

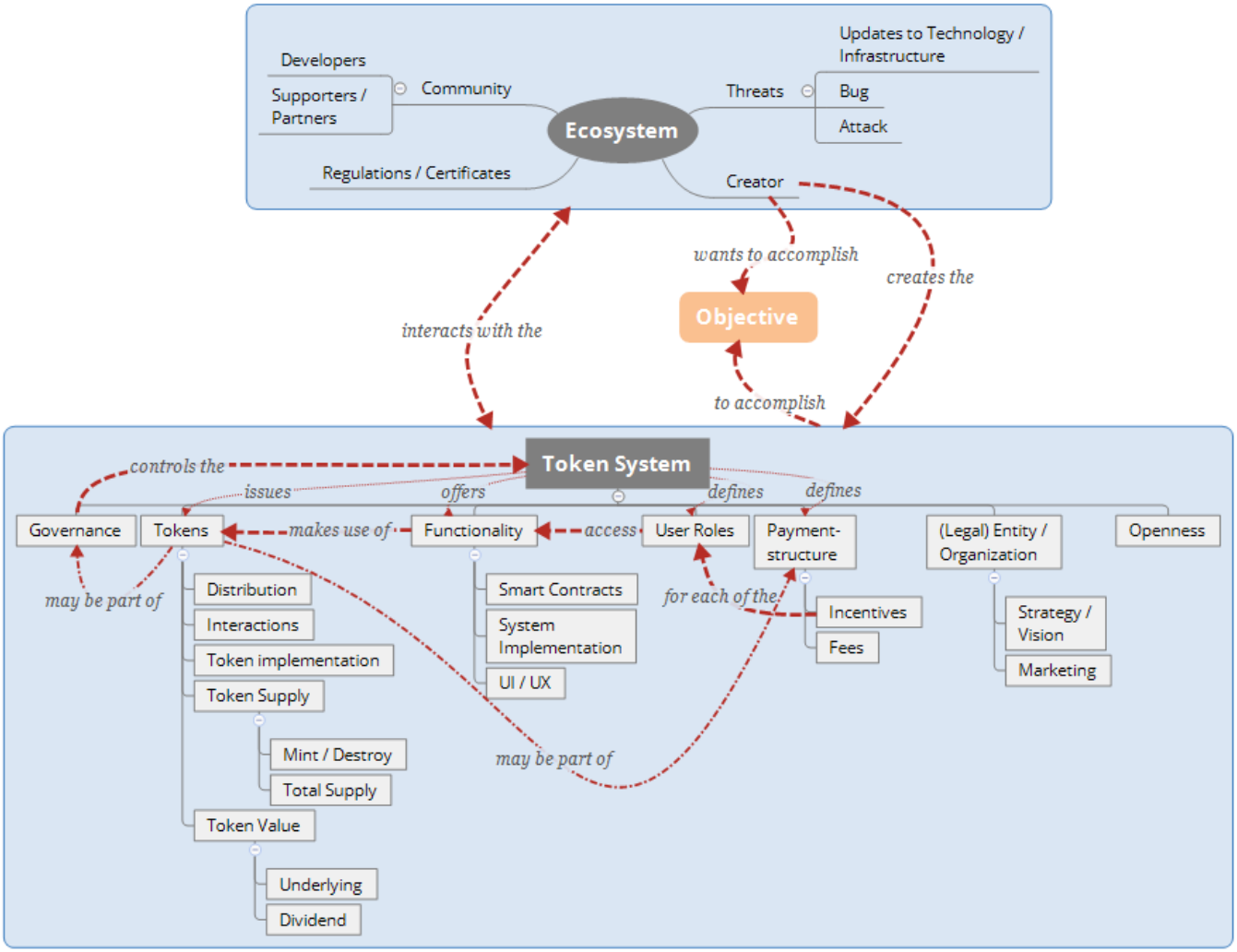


Figure 31: Token System – detailed

## 5.2 Dimensions for Describing Token Systems

The discovered dimensions were already shortly introduced in chapter *4.5 Selective Coding*. These dimension were then put together to form a model of token Systems as described in the previous chapter. This chapter will go into more detail about each of the dimensions.

**Objective** The objective is what the creator of the token system aimed to accomplish. This dimension differed for each of the token systems as can be seen in the list of all outcomes in chapter *4.2 Open Coding*. Most token system in this study have a business model they want

to make reality, there are some token models with different objectives, Pantos wants to drive research[273] and 0x offers a protocol for a decentral exchange.[274]

Next the dimensions within the token system itself will be discussed.

**Governance** determines who gets to control the token system. While looking at the token systems in this study it turned out that for governance there are varying stages of centralization / decentralization. It is close to a continuous scale. On the decentral end there is e.g. 0x protocol which offers a protocol free for anyone to use as they need it without conditions. The process of deciding on updates on 0x protocol is an example of active decentralized governance. The token holders get to democratically decide on updates.[275] More to the central end of the scale there is e.g. Populous which has administrators who can admit or deny people from using the platform.[276]

**Tokens** have multiple sub-dimensions, which in sum make up the token.

**Initial token distribution** describes the process of getting the tokens out to the actual users. There are a couple variations to this. The most common one being the ICO where people can buy tokens in exchange for other currency, as e.g. PAY did it.[277] In an ICO usually not all the tokens are sold, but the issuing company keeps some tokens for themselves and some tokens for bounties that include user acquisition or bug reporting / fixing. E.g. Pantos sold 40% of tokens through the ICO, kept 40% for the company, 10% were kept for the team and 9% were reserved for bounties.[278] The ICO is not the only alternative for the initial token distribution. Another option is the airdrop. In an airdrop users get tokens for free, e.g. Pantos did this with 1% of their tokens.[279] Yet other tokens don't have an initial token distribution at all, this is e.g. the case with USDT[280] and DGX[281], as they are backed by physical assets and the supply is adapted by the amount of collateral, which in the beginning is zero. CryptoKitties doesn't have an ICO, rather they auction off new cats in regular intervals.[282] This way the people get a working product and don't pay for something that still has to be developed.

**Token interactions,** each token has a set of possible interactions that is defined in the smart contract. The most basic version of the commonly used ERC20 token standard includes the

[273] Bitpanda 2018
[274] Warren/Bandeali Amir 2017
[275] Warren/Bandeali Amir 2017
[276] Williams 2017b
[277] TenX 2017
[278] Bitpanda 2018
[279] Bitpanda 2018
[280] tether 2016
[281] Eufemio/Chng/Djie 2016
[282] CryptoKitties 2017

interactions of checking someone's account balance, transferring tokens from one's own account to a destination account.[283] The full standard allows to set allowances for other accounts and therefore the option to spend tokens in the name of someone else. It also allows to burn tokens, reducing the total supply. There is also the option to include a mint function which allows the owner to create new tokens. ERC20 also makes it possible to freeze specific accounts and to set a buy / sell price for the token in ETH, automating the sale of tokens.[284] Not every token allows for every interaction. The PAN token additionally plans to offer an option to transfer the token to another blockchain.[285] CryptoKitties have the additional interaction of being able to breed two cats and receive a new one.[286]

**Token implementation** describe the technological layer of the token. Most tokens are implemented as ERC20 tokens on the Ethereum blockchain. Of the token systems in this study all but PAN, USDT and CryptoKitties are ERC20 tokens. USDT runs on the Bitcoin blockchain via the Omni Layer Protocol.[287] CryptoKitties is an ERC721 non-fungible token on the Ethereum blockchain.[288] At the moment Pantos only works through the Bitpanda exchange, in its final form it wants to be available on multiple blockchains.[289] While these are the only options for the tokens of this study, there are other smart contract platforms that offer the capability to run tokens on top of them, for example, Ontology is a token implemented on the NEO blockchain.[290]

**Token supply** specifies the amount of tokens in existence. This number can be fixed or flexible and is determined by two factors, the initial total supply and the effects of minting / destroying tokens. E.g. for Tether the token supply is flexible, because there are constantly new tokens being minted and old tokens being destroyed, therefore changing the total supply.[291] Other coins for example, BNB have an initial total token supply, but over time they burn tokens, reducing the total supply.[292] The most common variation among the token in the study was a fixed initial amount of tokens and no planned minting or destruction of tokens, the way BAT handles it.[293]

**Token value** describes what value a token holds, either in general or at a given point in time, depending on the token. The most common variation among the tokens in the study was a value, purely based on the perceived network value of the token and regulated by supply and

[283] Ethereum Foundation 2018d
[284] Ethereum Foundation 2018d
[285] Bitpanda 2018
[286] CryptoKitties 2017
[287] tether 2016
[288] CryptoKitties 2017
[289] Bitpanda 2018
[290] CoinMarketCap 2018d
[291] tether 2016
[292] Binance 2017
[293] Basic Attention Token 2018

demand. USDT and DGX have per design a specified value, being worth 1 USD[294] and 1 g gold[295] respectively. Another way tokens can increase their value is through monetary dividends like the PAY token offers.[296]

**Functionality** is usually the core of the token system. Functionality describes what users can do with the token system. In this aspect there was a lot of variety among the individual token systems, each doing something else. It turned out, that for each token system, the functionality directly aimed at accomplishing the objective, which makes sense. Most but not all token systems had additional smart contracts besides the token contract. All of the token systems that already have a live product also have a user interface, like the TenX wallet app.[297] Some token systems integrate with other systems, these could be technical systems like IPFS in the case of DGX[298] or they could be other companies or non-smart contract services like the auditors in DGX[299] or the process tether uses to map bank transfers to the minting of new USDT.[300]

**User roles** are defined in some of the token systems. However most of the token systems in this study don't know multiple user roles. For example, anyone who own a BNB token can use it for the same things.[301] Some token systems name user roles, without actually restricting the functionality to any specific user group. The reason for these user roles is to create incentives for each of the user roles. Golem does this by stating they need providers and requestors and naming the incentives for both user groups, however they also state that a requestor can also be a provider.[302] Other token systems have user roles and the functionality of each role is limited, however not by a central authority. This is the case in Augur's future markets, where the designated reporter has functionality available, which is not available to anyone else.[303] A last form of user roles are roles with restricted functionality and assigned by a central authority. This is the case with Populous. There is an admin who decides whether a user may participate or not.[304]

**Payment structure** describes all flow of money or tokens. Most tokens are freely transferable, the exceptions are tokens that are locked for a certain time after the ICO. For example, Binance keeps BNB tokens as an incentive for the team[305]. As another example the EOS tokens will become locked after the ICO is complete.[306] On the platforms, namely BAT, Augur, Golem and

294 tether 2016
295 Eufemio/Chng/Djie 2016
296 TenX 2017
297 TenX 2018
298 Eufemio/Chng/Djie 2016
299 Eufemio/Chng/Djie 2016
300 tether 2016
301 Binance 2017
302 The Golem Project 2016
303 Peterson et al 2018
304 Williams 2017b
305 Binance 2017
306 block.one 2017

Populous, there are payments going from A to B in return for something (advertising[307] / chance to win[308] / computing power[309] / invoice[310]). One token system with additional payments is PAY as a payment provider. TenX processes card payments made with the TenX cards.[311] Two special types of payments that appeared rather often among the token systems in the study were **fees** and **incentives**. Some fees are paid to the owner of the token system and generate an income stream for the owner, like the fee of 3.75% CryptoKitties raises on every sale of a CryptoKitty.[312] Other fees are paid to other parties to compensate them for their service, for example, DGX has fees which are used to pay for the storage of the physical gold and for auditors to verify the existence of the gold.[313] Incentives in this context are financial incentives. This can be in the form of a discount, the way BNB is giving a discount on fees on Binance[314], or in the form of some bonus. This bonus can be winnings (e.g. Augur[315]), interest (e.g. Populous[316]), or dividends (e.g. TenX[317]).

**Organization** describes the organizational structure of the token system. This can be a legal entity, like a business anywhere in the world, e.g. TenX sits in Singapore[318], EOS sits on the Cayman Islands[319] etc. The other form of organizational structure is a decentral organization. This sort of organization is governed democratically by the token holders and the 0x protocol is an example of this kind of decentral organization.[320]

**Openness** has multiple aspects itself. For one openness is shaped by entry barriers to the usage of a token system. E.g. Golem talks about their plans for lowering entry barriers to attract more requestors.[321] CryptoKitties talks about entry barriers in a similar fashion, they reprimand that the entry barriers to using token systems are rather high and take it as one of their primary goals to reduce these barriers.[322] Availability of information turned out to be another part of openness. This means predominantly whether the source code for the application is open-source or closed-source. E.g. the code for the Tether web-wallet and the proofs for the wallet are closed source.[323] Other systems have a mix of open and closed-source code. E.g. CryptoKitties is mostly open-source, however the gene-algorithm which determines the future value

[307] Basic Attention Token 2018
[308] Peterson et al 2018
[309] The Golem Project 2016
[310] Williams 2017b
[311] TenX 2017
[312] CryptoKitties 2017
[313] Eufemio/Chng/Djie 2016
[314] Binance 2017
[315] Peterson et al 2018
[316] Williams 2017b
[317] TenX 2017
[318] TenX 2017
[319] block.one 2018
[320] Warren/Bandeali Amir 2017
[321] The Golem Project 2016, p.12
[322] CryptoKitties 2017, p.2
[323] tether 2016, p.10

of the cat is closed-source.[324] Yet other systems are completely open-source as, for example, the 0x protocol.[325]

In the ecosystem there are also relevant factors that have some influence on a token system. Usually these factors are a lot more static and can't be chosen freely like the internal factors of the token system. The factors in the ecosystem just exist and the token systems interacts with them.

**Community** The community describes the people around the token system who interact with it. This can be customers, partners, investors, and developers. Customers are using the services offered by the token system. An example of customers are the people using the TenX card to make payments.[326] Token systems sometimes have, for example, external service providers, these would be considered partners of the token system. An example for such a partner is the auditing service DGX uses to verify the existence of the physical gold.[327] Another example of a partner is the Technical University of Vienna, which collaborates with the Bitpanda team in researching cross-chain tokens.[328] Investors hold some sort of stake in the token system. Usually this shows in the ownership of tokens. An example of investors are the token holders of PAY. They don't have an active function but they hold stake in the system and hope to receive a dividend in return.[329] Developers push the token system forward. Every token system has developers, some are internal to the organization and some are external and just pitch in without getting anything in return. Sometimes developers are a key part of the token system, as e.g. in Golem where the value of the Golem network rises with more and more applications published by developers on the Golem platform.[330]

**Threats** include all sorts of threats and attacks that might hurt the token system. During the study multiple kinds of threats were discovered, namely bugs, updates and direct attacks. EOS addresses bugs in their whitepaper. While bugs were addressed as part of the EOS.IO software which was not part of the study[331], bugs are still interesting to look at, because they can happen in any of the token systems. Bugs are therefore connected to updates, which are necessary to fix the bug. Updates are a threat, because new software is used and there are multiple aspects that might go wrong. The update itself might introduce new bugs or the update causes the existing system to stop working properly. For this reason the 0x protocol addresses

[324] Duffy 2017
[325] 0x protocol 2017
[326] TenX 2017
[327] Eufemio/Chng/Djie 2016
[328] Bitpanda 2018
[329] TenX 2017
[330] The Golem Project 2016
[331] block.one 2017

this issue and decided to have decentralized governance to oversee updates.[332] Traditionally fraud is also a problem. In the whitepapers fraud was only mentioned in the context of blockchain preventing fraud.

**Regulations** are set and are part of the legal structure of the country in which the company behind a token system is registered. Today in a lot of places, there are not very clear regulations about how to treat token systems and how they are to be taxed. This is changing at the moment as e.g. Switzerland proposed some regulations for tokens and ICOs[333] and other countries are doing the same. This means depending on the geolocation of the token system company the regulatory framework is more or less set. It can't be directly influenced by the token system, however what they can do is provide evidence that they are in compliance with the regulatory framework. Having a legal or disclaimer section in the whitepaper is a good hint that the token system considered legal aspects. Nevertheless the contents of this legal section have to be checked closely whether it actually is in compliance with the legal framework or not. TenX and EOS had disclaimer sections in their respective whitepapers.[334] [335] It has to be added, that both are merely disclaimers, limiting the liability of the company and don't provide proactive hints about the legal compliance of the token system for the specific country.

**Creator** is the person or group who had the idea for the token system and took the initiative of making it come to reality. The creator is usually closely associated with the Organization (in the case of there being one) and with the developers. The creator(s) often present themselves in the whitepaper under the section team, like in the Golem whitepaper.[336]

[332] Warren/Bandeali Amir 2017
[333] Lux/Mathys 2018
[334] TenX 2017
[335] block.one 2017
[336] The Golem Project 2016 p. 25

# 6 Critical Reflection

## 6.1 Limitations

This study serves as an initial exploration of the field of blockchain-based token systems. However, there are some notable limitations and aspects about the study that could have improved the validity of the result. First, while it was discussed in chapter *2 Introduction* and chapter *4 Grounding Theory* that GTM is capable of achieving the desired outcome of creating a model and discovering dimensions, alternatives were not considered and some other method might have been a better fit. Second, the selection of token systems for the study was not completely transparent. There were conditions for the structured selection, but the choice of token systems is not deterministic, meaning another researcher might choose different token systems for the same criteria. Another limitation of the study is the quality of the sources. This includes on the one hand, the sources for the theoretical background and on the other hand the selected data for the GTM. The theoretical sources were not discussed as much as they could have been and were rarely triangulated to increase the validity of statements. The limitation regarding the data for GTM is that only whitepapers were coded. While they certainly should be considered and they give a nice overview of the token system, they should not be relied on as the sole source of information on the token system. Whitepapers most likely have alternative intentions besides objectively informing the reader about the specifications of the token system, namely convincing the reader to get involved with the token system.

These limitations mostly emerged due to resource constraints.

## 6.2 Unexpected Results

Some aspects of the study were rather surprising. For one the characteristics of EOS were surprising. It was not expected to encounter a case where it is unclear whether the subject should be considered a blockchain native coin or a secondary token on the blockchain. Further it was a surprise to learn about the success of EOS, as it is clearly stated that obtaining ERC20 EOS does not entitle the owner to anything. Billions of USD worth of EOS were sold on the mere hope that future blockchains utilizing the EOS.IO software will follow the suggestion of EOS and take the EOS balances as the starting balances for that blockchain.

Another unexpected discovery was presented in the Digix and Populous whitepapers. For both of these token systems there are tokens with significant market capitalization at the point of writing (DGD, PPT). These tokens are associated with the mentioned token systems, yet there is little to no information about these tokens and their role in the respective whitepapers. Digix describes the DGX token which is backed by gold and was just launched on April 8th 2018[337],

[337] CryptoNinjas 2018

but does not mention the DGD token. Similarly Populous only peripherally mentions the PPT token and mostly talks about the Poken and its use on the platform.

Another unexpected result was the token supply of the PAY token. The values given in the whitepaper did not add up to the actual token supply. This is odd and raised questions about where the surplus of tokens came from.

### 6.3 Future directions

There are multiple research opportunities building on this study. For one the study should be validated by repeating the study in a similar fashion with different token systems. A validation study resulting in similar conclusions would greatly increase the credibility of this model for token systems. Another option is to go into more detail about one aspect or a selected group of aspects of the model. This extends the model, making it more accurate for that specific section.

Further it would be interesting to take a closer look at the use cases for token systems. While this study looked at the outcome for a token system in a general way, it would be interesting to look at the outcomes / use cases in more detail and checking their validity and potential.

A more practical study could be a design science approach. As part of a study, a token system could be build according to this model. The study would then discuss problems it encountered with the model and in that fashion validate or falsify the model and make it more specific.

A last idea for an interesting study related to this one would be to compare token systems and blockchains at a conceptual level. This study distinguished between blockchain native coins and blockchain-based tokens. A study could compare the model for token systems with a model for blockchains or more generically DLTs.

# 7 Conclusion

In the introduction to this study, the research question chosen as:

***Which dimensions are useful for describing blockchain-based token systems and how do these dimensions relate to each other?***

The goal was to answer this question by setting up a model for token systems. This model was supposed to include dimensions for describing tokens systems and some guidance to common relations between the dimensions.

In order to answer this research question, the study conducted GTM. The data for performing the GTM was mostly comprised of the whitepapers for token systems. Token systems for the study were chosen through a methodical selection process to avoid researcher bias. In total 13 token systems were chosen of which 12 were included in the actual study. The whitepapers of each token system were codified in open coding, resulting in 872 codes and 2980 keywords.[338] These codes were connected to form dimensions which, in turn, make up the model.

The model consists of three major constructs, the Token System, the Ecosystem and the Intention behind the Token System.

On a high level the token system includes a token, smart contracts to interact with the token and other factors directly related to the token system. This includes software acting as a user interface to allow people to interact with the token and smart contracts. The token system also includes a company or other legal entity that might exist for some token systems.

Besides the token system itself, the model includes an outcome and the ecosystem. Every token system has an outcome, it describes the intention behind the creation of the token system. The ecosystem is comprised of the surrounding factors of a token system, which cannot be arbitrarily changed by the token system. The token system is in frequent to constant interaction with its ecosystem.

This model satisfies the research question of the study. The model lists dimensions which describe token systems and also includes the relations among these dimensions. While the model is not validated yet, it provides a starting point for looking into token systems. Further research is needed to confirm the findings of this study and researchers might deem it worthwhile to explore certain parts of the model in more detail than this study allowed.

[338] A concept introduced as a proxy between open coding and axial coding in chapter 5.1 Open Coding

**Attachments**



**Attachment 1: Finding existing models which describe tokens**

Top 15 results „token class“ on medium.com

1 The Token Classification Framework

2 AppCoins: The von Neumann App Economy

3 Primalbase Token and Ways to Gain Profit

4 Sending contributions using Ethereum Classic (ETC)

5 The Ether Review #66—Gnosis, Martin Köppelmann

6 The Discount Token model

7 Episode 30: To Bee or Not to Bee

8 The Birth of A New Asset Class: Blockchain Tokens & The Decentralized Web

9 Why I like the term, “Cryptoassets”

10 How we change our ICO to comply with regulations

11 StockTwits Adds Streams and Symbology for 100+ Cryptocurrencies and Tokens

12 I Am So Honored That You Have Chosen to Follow Me Welcome to me Chandigarh [Redacted] Girl Portal

13 I Am So Honored That You Have Chosen to Follow Me Welcome to me Chandigarh [Redacted] Girl Portal

14 Traditional Asset Tokenization

15 Why Are We Called SPiCE

Reasons for dismissal:

Single coin: 2, 3, 4, 5, 7, 10, 15

Tokes generally: 8, 9, 11

No blockchain-relevance: 12, 13

Relevant articles for token classes:

1 The Token Classification Framework

6 The Discount Token model

14 Traditional Asset Tokenization

**Attachment 2: Introduction to NEO (GAS)**

Figure 32: NEO Logo

We chose to look at GAS because it coinmarketcap.com listed it as a token on a smart contract platform other than Ethereum, NEO to be specific. As it quickly turned as we looked at the GAS whitepaper, which interestingly enough was the same whitepaper as the one about NEO, it turned out that the NEO blockchain has two native currencies: NEO and GAS. NEO is used to govern the NEO blockchain and make decisions, GAS is used to pay for transactions, similar to ether for Ethereum. The NEO token holders receive newly generated GAS as incentive. At this point we had to revise our assessment of GAS being a token and put it in the category coin, which made it uninteresting for us and we did not investigate it as part of this study any further.

Our preliminary assumptions regarding the GAS token:

We assumed GAS is somehow connected to the NEO blockchain, because they have the same logo. We assumed GAS is a secondary token running on the NEO blockchain, because coinmarketcap.com listed NEO as a token and not a coin[339]. We had no specific assumptions as to the functionality provided by the GAS token. Regarding the technical implementation we had no assumptions past the fact, that it is a token on the NEO blockchain. We had no assumptions regarding the governance of the GAS token, or the total amount of GAS tokens.

[339] Coinmarketcap follows the same definitions for coins and tokens we use

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## Declaration of Authorship

I hereby declare that the Bachelor thesis submitted is my own unaided work. All direct or indirect sourced used are acknowledged as references. Further I assure, that the electronic version is equal to the printed version.

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