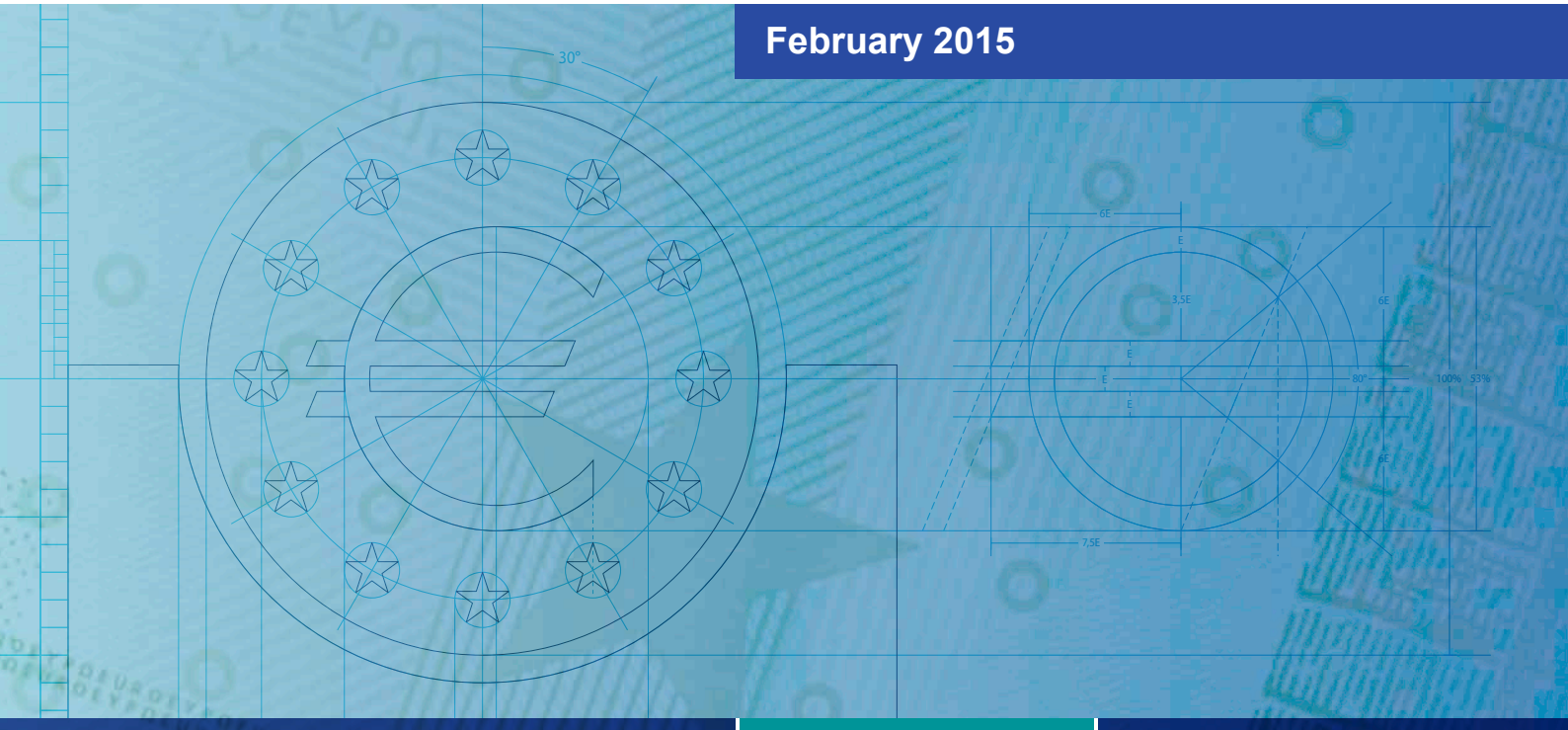
EUROPEAN CENTRAL BANK

EUROSYSTEM

Virtual currency schemes – a further analysis

February 2015



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EXECUTIVE SUMMARY

Virtual currency schemes (VCS) have experienced remarkable developments over the past two years. As announced in its October 2012 report, the ECB has been examining these developments, partly in order to understand their potential relevance for retail payments.

Although the term "virtual currency" is commonly used – indeed, it often appears in this report – the ECB does not regard virtual currencies, such as Bitcoin, as full forms of money as defined in economic literature. Virtual currency is also not money or currency from a legal perspective. For the purpose of this report, it is defined as a digital representation of value, not issued by a central bank, credit institution or e-money institution, which in some circumstances can be used as an alternative to money. The term "virtual currency scheme(s)" is used throughout this report to describe both the aspect of value and that of the inherent or in-built mechanisms ensuring that value can be transferred.

The VCS "ecosystem" consists mainly of specific, new categories of actors which were not present in the payments environment before. Moreover, emerging business models are built around obtaining, storing, accessing and transferring units of virtual currency. Many schemes have appeared and some have already disappeared again, but around 500 exist at the time of writing. This is in stark contrast to the situation of two years ago when it was only really Bitcoin that was known about. Some of these new VCS are designed with slightly different technical characteristics that could improve the functionality or some elements in the ecosystem. For many, however, it is unclear what their purpose is, as it seems that only a few are used, or are intended to be used, for payments. The acceptance of VCS for payments does not seem widespread, although some prominent e-commerce merchants did announce that they would start accepting payments with Bitcoin. Data concerning the usage of VCS as a payment method are not readily available. Bitcoin is used for around 69,000 transactions per day worldwide, compared with a total of 274 million non-cash retail payment transactions per day for the EU alone.

VCS present several drawbacks and disadvantages for users, i.e. lack of transparency, clarity and continuity; high dependency on IT and on networks; anonymity of the actors involved; and high volatility. In addition, users face payment system-like risks owing to their direct participation in the VCS, as well as risks associated with certain intrinsic characteristics of VCS, i.e. the counterparty risk associated with the anonymity of the payee, the exchange rate risk associated with high volatility and the risk of investment fraud associated, inter alia, with the lack of transparency. There are currently no safeguards to protect users against these risks.

Nevertheless, VCS present some advantages as perceived by users. They could pose a challenge to retail payment instruments and innovative payment solutions as regards costs, global reach, anonymity of the payer and speed of settlement. A new or improved VCS, if it overcame the current barriers to widespread use, might be more successful than the existing ones, specifically for payments within "virtual communities"/closed-loop environments (e.g. internet platforms) and for cross-border payments.

A number of international authorities have developed an interest in VCS, including the Financial Action Task Force (FATF), given the potential risks for the integrity of the international financial system. Several central banks and financial and supervisory authorities around the world have warned users of the risks related to holding and transacting virtual currencies, provided clarifications

on the legal status, started regulating certain activities or issued an outright ban. However, the responses vary, depending to some degree on the part of the world from which they originate and on the type of authority.

Based on a further analysis carried out by the central banks of the Eurosystem during 2014, this report adds perspective and detail, while reiterating and confirming the general consideration of the ECB's report on virtual currency schemes (2012) that, although VCS can have positive aspects in terms of financial innovation and the provision of additional payment alternatives for consumers, it is clear that they also entail risks. For the tasks of the ECB as regards monetary policy and price stability, financial stability, promoting the smooth operation of payment systems, and prudential supervision, the materialisation of these risks depends on the volume of VCS issued, their connection to the real economy – including through supervised institutions involved with VCS – their traded volume and user acceptance. For the moment, all these risk drivers have remained low, which implies that there is no material risk for any of the central bank's tasks as yet. Nevertheless, a major incident involving VCS and a subsequent loss of trust in them could also undermine users' confidence in electronic payment instruments, in e-money and/or in specific payment solutions, such as those in place for e-commerce. Therefore, the Eurosystem intends to continue to monitor payments-related developments in virtual currency schemes.

INTRODUCTION

In 2011 the ECB started analysing the emergence of virtual currency schemes, anticipating increasing media coverage and in response to requests from the public, press and public authorities. The analysis led to the publication in October 2012 of an ECB report on virtual currency schemes, which was one of the first comprehensive reports published on the topic.[1] The analysis placed the phenomenon in a historical review of money, i.e. as a tool created and marked by society's evolution, which has always exhibited a great capacity to evolve and adapt to the character of the time. It was seen as unsurprising that money had been affected by recent technological developments and especially by the widespread use of the internet. Within their user community, virtual currencies resemble money. In order to function, they necessarily also come with their own rules and processes enabling the transfer of value, as with payment systems. The term "virtual currency scheme(s)" (VCS) was therefore introduced in the report to describe both the aspect of value and the mechanisms which ensure the processing of transactions. The report proposed putting virtual currency schemes into three categories: 1) closed virtual currency schemes, which have almost no link to the real economy; 2) virtual currency schemes with unidirectional flows, in which units can be purchased using "real" currency at a specific exchange rate but cannot be exchanged back, and trading with other users is not allowed; and 3) virtual currency schemes with bi-directional flows, in which units can be bought and sold according to (floating) exchange rates. The report featured two case studies of VCS with bi-directional flows, the centrally issued and administered Second Life Linden Dollar and Bitcoin as decentralised VCS. It then examined the relevance for central bank tasks.

The general conclusion of the report was that, although VCS can have positive aspects in terms of financial innovation and the provision of additional payment alternatives for consumers, it is clear that they also entail risks. For the tasks of central banks, such as ensuring price stability and financial stability, the materialisation of these risks depends on the volume issued, the connection to the real economy, the volume traded and user acceptance. At the time, these risk drivers were all considered low. For users, however, participation in these schemes exposes them to risks. The report contained a recommendation to follow up by periodically re-examining developments in order to reassess the risks.

After publication of the ECB report in October 2012, media attention on VCS, and Bitcoin in particular, remained high and increased noticeably at the time of the Cyprus banking crisis (March-April 2013), in the run-up to Bitcoin's all-time high (USD 1,240 on 4 December 2013), as well as during phases of high volatility in its exchange rates, and yet again following the closing of Mt. Gox as the world's biggest exchange for Bitcoin (February 2014).

Perhaps because of the increased media attention, several financial authorities around the world, including some Eurosystem national central banks (NCBs), had by the end of 2013 warned users of the risks related to holding and transacting virtual currencies. Moreover, several authorities started to regulate certain aspects of VCS or issued an outright ban. Nonetheless, the VCS themselves remained largely out of the scope of the current regulatory framework, especially in the EU.

In stark contrast to the situation in 2012, there are a high and increasing number of decentralised, bi-directional VCS, also referred to as "crypto-currencies". However, Bitcoin still appears to be the most prominent of these VCS, as it accounts for more than 80% of the market capitalisation of

1 Virtual currency schemes, ECB, October 2012.

the around 500 known decentralised VCS.[2] Except for Bitcoin, little evidence could be found of any usage of virtual currencies for payments and some doubts have arisen regarding their intended purpose.

Two-and-a-half years after the previous report, and in the light of the main developments described above, this report analyses virtual currency schemes further, especially with regard to their relevance for retail payments.

1 PAYMENTS-RELATED ASPECTS OF VIRTUAL CURRENCY SCHEMES

1.1 KEY ACTORS AND THEIR ROLES

The "ecosystem" of virtual currency schemes consists mainly of specific, new categories of actors which were not present in the payments environment before. This list provides a description of the most relevant ones.

1) **Inventors** create a virtual currency and develop the technical part of its network. In some cases, these individuals or organisations are known, whereas in other cases their identity remains unknown (e.g. for Bitcoin and most other decentralised VCS). Following the launch, some remain involved in maintaining and improving the technical characteristics of the VCS, including – for decentralised VCS – the algorithm which is at the core of the VCS. This role could also be organised, to a greater or lesser extent, in foundations or societies.

2) **Issuers** are able to generate units of the virtual currency. Depending on the design of the VCS, the total issuance volume is predetermined or depends on demand. In centralised VCS, the issuer is often also the administrator of the VCS which establishes the rules for its usage and has the authority to withdraw units from circulation. Once units have been issued, they are normally delivered to users, either by selling them or by distributing them free of charge.[3] In decentralised VCS, new units can be created automatically as the result of the activities performed by "*miners*", who receive these units as a reward.

3) **Miners** are persons, sometimes working as a group, who voluntarily make computer processing available in order to validate a set of transactions (called a "block") made with a decentralised VCS and add this to the payment ledger (called a "blockchain"); without miners, the decentralised VCS would not run smoothly, since double-spent or false units could easily be introduced. As a reward for their work, miners normally receive a specific number of units.[4] The name is supposed to be an analogy to people spending time and energy on extracting a valuable mineral from the earth. The reward could be created via automatic decentralised new issuance or via a transfer from the issuer. Miners can also require a transaction fee from those who initiate a transaction.

2 See http://coinmarketcap.com/, last visited on 12 February 2015.

3 In some VCS, a percentage of the initial stock of coins is delivered freely so as to encourage mass adoption. It is also common to find that units of a virtual currency are launched to the market once its founders have significantly pre-mined a certain amount of coins (e.g. Auroracoin, Germanycoin, Isracoin). In those cases, allocation to the general public has been performed through a process called "airdrop distribution", which consists of giving a specified number of coins to each person on request.

4 For Bitcoin, the reward for the miner (or group of miners) successfully validating a block is currently 25 BTC, or about €5,000. By construction, in a competitive market for mining, the reward is expected to be only marginally more than the expenses for the computer hardware and, more profoundly, for the energy consumed.

4) **Processing service providers** facilitate the transfer of units from one user to another. In decentralised VCS, these services are part of the activity performed by the miners.

5) **Users** choose to obtain virtual currency for purchasing virtual or real goods and services from specific merchants, for making person-to-person payments (e.g. cross-border) or sending remittances, or for investment purposes, including speculation. There are five ways to obtain units: 1) purchase; 2) engage in activities that are rewarded with units of virtual currency (e.g. filling out a survey, participating in promotional activity); 3) self-generate units of the currency by acting as a miner ("mining"); 4) receive units as a payment; or 5) receive units as a donation/gift.

6) **Wallet providers** offer a digital wallet to users for storing their virtual currency cryptographic keys and transaction authentication codes, initiating transactions and providing an overview of their transaction history. There are basically two types of wallet, which differ as regards their immediate usability versus their safety from cyber crime: online wallets (hot storage) and offline wallets (cold storage). From a functional perspective, these services are offered for desktop PCs, mobile devices and as cloud-based applications. Nevertheless, users can also set up and maintain a wallet themselves without making use of a wallet provider.

7) **Exchanges** offer trading services to users by quoting the exchange rates by which the exchange will buy/sell virtual currency against the main currencies (US dollar, renmimbi, yen, euro) or against other virtual currencies.[5] These actors, most of them non-financial companies, can be either issuer-affiliated or a third party. They generally accept a wide range of payment options, including cash, credit transfers and payments with other virtual currencies. Moreover, some exchanges also provide statistics (e.g. volumes traded and volatility), act as wallet providers and offer (immediate) conversion services for merchants who accept VCS as an alternative payment method.

8) **Trading platforms** function as marketplaces, bringing together buyers and sellers of virtual currencies by providing them with a platform on which they can offer and bid among themselves. In contrast to exchanges, however, the trading platforms do not engage in the buying and selling themselves. Some trading platforms, such as www.localbitcoins.com, give their customers the option of locating potential customers nearby.

9) Various **other actors** are not specific to the VCS environment, e.g. merchants, payment facilitators (allowing merchants, mainly in e-commerce, to accept virtual currencies as a payment method), software developers (developing user interfaces for trading and storing), computer hardware manufacturers (building specific equipment for mining) and ATM manufacturers. From a financial investment perspective, there are also providers of investment vehicles and brokers which facilitate investment in start-up companies and design specific financial products, such as exchange-traded funds (ETFs) or derivatives. Other actors that have appeared are "tumblers", which provide a service for further increasing the anonymity of the payer by making it more difficult to find out where the virtual currency transaction came from.

5 This means that, in contrast to the roles assumed by regulated exchanges of traditional financial instruments, VCS exchanges also assume the role of dealers quoting two-way prices at which they are ready to act as buyers or sellers. Note that only the most relevant virtual currencies have a direct exchange rate against fiat currencies; the others are only referenced to Bitcoin.

1.2 THE DIVERSITY OF VIRTUAL CURRENCY SCHEMES

Just two years ago Bitcoin could be seen as a special sub-type in the full spectrum of virtual currency schemes (closed, unidirectional, and bi-directional VCS), namely as the only *decentralised* bi-directional VCS. There are currently around 500 such crypto-currencies, and the number has been rising steadily.[6] Offshoots of, and alternatives to, Bitcoin are commonly referred to as "altcoins", i.e. alternative coins. Given that Bitcoin is an open-source project, it is relatively simple to launch a new VCS based on its protocol. For this reason, many of the alternatives are technically identical to Bitcoin, but some are designed with slightly different technical characteristics that could improve the functionality or some elements in the ecosystem.

Possible reasons behind this massive launch of decentralised bi-directional VCS include:

1) improving some of Bitcoin's weaknesses (e.g. a higher speed of transaction validation, better energy efficiency and a more robust algorithm);

2) supplying mining alternatives to the existing network of miners (given that Bitcoin mining currently requires specialised computer hardware, suitable rooms to place such equipment in and considerable amounts of energy, including for cooling);

3) offering an alternative for storing value in case Bitcoin experiences some kind of problem, such as the (temporary) freezing of withdrawals from wallet providers;

4) profiting from the high attention on VCS in general by setting up a new VCS and obtaining a large number of units early on, including by pre-mining (i.e. self-generating the first units before publicly launching the VCS).

It is too early to tell what the future of these altcoins will be. A great many of them could be nothing more than "scamcoins", i.e. VCS that are created with the main objective of swindling naive buyers, either as consumers/payers or as investors.[7] Others, however, have a clearer objective to improve the Bitcoin model and it cannot be excluded that some of these VCS will develop into a fuller platform if additional services are provided, such as P2P (person-to-person) exchanges, payment solutions, transaction solutions for other assets, secure messaging or cryptographic key storage facilities.

Regarding the categorisation of different types of VCS, the most common approach is to distinguish between *centralised* (e.g. Second Life's Linden Dollar) and *decentralised* (Bitcoin, Litecoin, Peercoin and Namecoin, to name but a few), depending on the issuance and subsequent administration pattern. In some cases, where there is pre-mining activity, this distinction is not so clear, e.g. Mastercoin.[8]

6 Given the fact that the number of VCS is constantly changing, the current status of the range of decentralised VCS can be found at: http://coinmarketcap.com/all.html. For practical reasons, the focus was on those VCS which consistently ranked among the top ten positions as regards market capitalisation in April 2014: Bitcoin, Ripple, Litecoin, Peercoin, Namecoin, Dogecoin, Next and Mastercoin.

7 The rapid appearance, the absence of different functionality for most of them, the absence of indications that these are being used for payments and the anecdotal evidence found on some of the virtual currencies' websites and blogs all indicate that a majority of these altcoins can be placed in the category of profiteering (scamcoins).

8 For Mastercoin, although there is no central party that started out owning by default, the Mastercoin Foundation benefits from the issuing process and is entitled to extract a percentage from the market output in every transaction. For these reasons, there is an ongoing debate around classifying this VCS as a not truly decentralised one.

1.3 DIFFERENCES BETWEEN VARIOUS DECENTRALISED VIRTUAL CURRENCY SCHEMES

The focus of this section will be on decentralised bi-directional VCS, which now represent the vast majority of all VCS. The main technical and functional differences between the various decentralised VCS can be grouped into the following categories.

1) Different **validating systems**, i.e. the methods used for validating the transactions made and securing the network. The very first decentralised VCS (e.g. Bitcoin, Litecoin, Namecoin, Dogecoin) followed the *proof-of-work* (PoW) system, which depends entirely on computational power for validating transactions by means of hashing.[9] As an alternative to this model, the *proof-of-stake* (PoS) system was developed (e.g. Nextcoin). This takes into account the number of units of virtual currency owned by each user in the network. It thereby tries to eliminate some of the vulnerabilities of the PoW system, such as the possibility of manipulation through a (temporary) monopoly on mining (the 51% attack[10]) and the high energy consumption.[11] Instead of mining, these VCS carry out a process known as "forging", whereby all active users know beforehand the point in the network that will process the next transaction and add it to the record of all transactions, the so-called blockchain. Therefore, the network can work more efficiently than a network in which every transaction has to be sent to the entire network for validation.[12] Mechanisms can be put in place so as to temporarily penalise those users who are not actively participating in the network, as well as those with the largest holdings of virtual currencies. Some of the advantages of this PoS system are the higher speed of transaction validation (everybody in the network knows the point in the network to which their transaction will be sent) and higher energy efficiency, as it requires less computer processor power. Nevertheless, it is quite common to find VCS with a hybrid system, i.e. combining PoW and PoS (e.g. Peercoin, Blackcoin), which means that, in general, they work under a PoS model but that coins were pre-mined on a PoW basis at the beginning (e.g. up to the 10,000th block in Blackcoin, which has already been reached now).

2) Different **algorithms**, i.e. the mathematical procedure for calculating and processing data (it determines the speed at which the next "block" – set of transactions – is generated, how coins are released, etc.).[13] Despite being a very changeable attribute, two major algorithms can currently be identified: SHA-256 (e.g. Bitcoin, Peercoin, Namecoin, Mastercoin) and Scrypt (e.g. Litecoin, Dogecoin, Auroracoin), which could be described as an extension of the SHA-256 algorithm but requiring more physical memory. In contrast to the former, for which specialised equipment for "mining" was developed, deployed and therefore also needed to still be successful as "miner", the latter allowed "miners" to perform their activities with regular hardware. Currently, efforts are put into using the X11 algorithm for reasons of higher cryptographic security and lower processing costs, so it is quite possible that the algorithms mentioned above will be replaced shortly.

9 In cryptography, hashing is the application of a hash function to an input (i.e. a text message or a number) in order to receive a digest (output) which is encrypted and formatted in a predetermined way. The hash function basically converts a clear input into an encrypted output. Reversely, starting from the digest, it is nearly impossible to find the input, even when knowing the mechanics of the hash function or by trying to get the same digest using multiple random inputs in the hash function.

10 In a PoW system, people controlling 51% of the overall computational power in the network would be able to dictate the general functioning of the scheme, and manipulate transactions such as allowing double spending or blocking the validation of certain transactions. In a PoS system, someone would have to hold at least 51% of the total amount of units, which is likely to be much more expensive than controlling 51% of the computational power. The risk of a 51% attack is not theoretical. In June 2014 the latter reportedly has occurred for Bitcoin; see "Bitcoin security guarantee shattered by anonymous miner with 51% network power", http://arstechnica.com, 15 June 2014 and "Are 51% attacks a real threat to Bitcoin?", http://www.coindesk.com/51-attacks-real-threat-bitcoin/, 20 June 2014.

11 Social costs under PoW schemes could be high if energy consumption is compared with the return actually received.

12 In order to participate in the forging process, users should hold coins and leave their computers on (unlocked wallet). As a reward, they can obtain additional coins (a percentage of the fees) based on their "stake", which depends on the amount of coins already held and the "coin age", among other parameters.

13 This feature is very much connected to the validating system; PoS systems rarely have a SHA-256 algorithm.

3) Differences in the (total) **supply of coins**. Most of the VCS that have been analysed feature a fixed supply (e.g. Bitcoin, Litecoin, Namecoin, Dogecoin), but in other VCS the amount of coins is flexible (e.g. despite the limit of 2 billion units in Peercoin, the aim is to attain an annual inflation rate of 1% so units can be issued on demand; Dogecoin also has no amount limit).

4) Taking a **functional perspective**, a further way of differentiating between VCS are the extra features made available on the network. Nextcoin, for example, offers a P2P marketplace for goods and services and an asset exchange for decentralised trading, supports the use of so-called coloured coins, which function as records of transactions made in other items (e.g. property, commodities or securities), offers a messaging/chat service and a domain name system (DNS) service which maps alphanumeric text like VCS addresses to shorter names or account/e-mail addresses, phone numbers or codes.

There are also examples of VCS that are not competing with Bitcoin, but rather are complementing/improving that VCS by offering services that can be performed using the Bitcoin protocol (as such, these VCS do not have their own blockchain, as it is a modification on Bitcoin's protocol). Examples include Mastercoin, which allows users to transfer so-called smart properties[14] within the Bitcoin network[15]; Namecoin, which allows users to register arbitrary names to a coin, as well as attaching data to it, thus making it a shared decentralised database; and Zerocoin, which is projected as an integrated e-cash construction into the Bitcoin protocol so as to enforce anonymity.

1.4 EMERGING BUSINESS MODELS

This section tries to give an overview of business models of, or related to, centralised and decentralised bi-directional VCS. Ripple[16] will be taken as an example of a centralised VCS because of the role of the issuer and the way it organises trust within the network, despite the different views on whether it can be considered truly centralised, and Bitcoin will be analysed as an example of a decentralised VCS.

- **Business models based on obtaining units in centralised VCS**

In a centralised VCS, there is only one single institution which is able to issue units at its choice. In the case of Ripple, the central issuer – the Ripple Foundation – created 100 billion units (abbreviated as XRP) prior to the start of the network.[17] A small part was distributed daily to supporters of the World Community Grid.[18] Ripple Labs has kept the rest of the units to pay for the operation and maintenance of the system in the future. To prevent the ledger being overwhelmed by too many entries, Ripple aims to discourage small transactions on the Ripple network by setting a transaction fee and obliging users wishing to take part in Ripple to have a permanent minimum amount of units in their account (currently 20 XRP). To fund their wallet with the minimum amount, users need to receive XRP from an already known Ripple user or buy them at an exchange. In Ripple, besides the native XRP virtual currency, every currency and virtual currency can be transferred via an

14 Smart properties can be services, products, titles, deeds, virtual currencies or securities which are stored in the blockchain. That means that contracts or patents, for example, could be added to the blockchain to declare one's ownership (in the case of a patent) to the rest of the community.
15 Master Protocol addresses are the same as Bitcoin addresses and, as a result, a Bitcoin address can hold both Bitcoins and Mastercoins.
16 See https://ripple.com/. Ripple does have elements of a decentralised VCS, especially with regard to the validating system, which works on the basis of establishing consensus between the various points in the network. Moreover, Ripple Labs released the source code of its network in September 2013. See "Ripple is officially open source", Bitcoin magazine, 26 September 2013.
17 Of the total, 20 billion XRP were distributed to founders, developers and invested venture capital companies.
18 The idea of the World Community Grid is that people donate computing power to analyse aspects of scientific problems such as cancer, the human genome, climate change, etc. See: http://www.computingforgood.co.uk/p/wcg.html

IOU system.[19] Users also have the option of funding their wallet with IOUs in a specific currency. Entry points to the Ripple network (e.g. exchanges or trading platforms) are called "gateways". These gateways are persons or companies at which an amount of currency (e.g. euro, US dollar) or units of other VCS (e.g. Bitcoin, Litecoin) can be stored. As a quid pro quo, they provide the user with an IOU in the respective currency or virtual currency. Subsequently, the balance of the user will show that the gateway owes the stored amount. Gateways can therefore be seen as an interface between the outside world and the Ripple network.

- **Business models based on obtaining units in decentralised VCS**

Whereas no user is able to create new units in a centralised VCS, in decentralised VCS users are able to obtain new units by engaging in mining. So, besides running exchanges and trading platforms comparable to those in centralised systems, there are additional business opportunities related to the mining process.

Non-commercial mining

- Users can obtain units by mining and then sell them on exchanges or trading platforms, or spend them on purchases.

- Owing to the fact that mining activity is becoming more resource-intensive in many VCS (especially those with the SHA-256 algorithm), individual users collaborate in networks – so-called mining pools. This helps to avoid or reduce entrance barriers for miners. Here, individual users offer computational power to a mining pool and receive rewards according to their share of the pool.

Commercial mining

- Manufacturers produce specialised mining hardware[20] and sell it to private users and commercial customers.

- Cloud mining services run so-called server farms that are specialised in mining. They sell or rent out shares of their capacity to customers. When the server farm has successfully validated a set of transactions, the reward is distributed to shareholders after its own fees have been deducted.

- Bigger payment senders (and perhaps also receivers in future) could also be interested in mining on their own, as they could save on transaction fees.[21]

- The commercial miners could operate across multiple VCS.

- Different companies could also agree on forming a mining pool. Furthermore, companies could set up the infrastructure of a mining pool and then offer their services (e.g. offering mining hardware and software) to customers.

19 An "IOU" is an informal certificate of debt, whereby one person declares to another that he or she owes an amount, X, to the other.
20 This is primarily the case in schemes which are based on a proof-of-work approach (e.g. Bitcoin).
21 This could be interesting for large users for whom it might be cheaper to run servers for mining instead of paying transaction fees.

- **Business models based on storing units in centralised VCS**

Depending on the functioning of a VCS, units received can be stored on a device belonging to the user and/or in the cloud. In the case of Ripple, it is only possible to store units in the cloud, which is free of charge. Nevertheless, for other centralised VCS, other storage facilities could be developed and sold.

- **Business models based on access to a decentralised VCS wallet**

In general, it is important to recognise that users do not hold units of the currency in decentralised VCS. They actually hold keys which give access to a certain account balance, which is stored in the blockchain. These keys can be stored on any kind of data carrier, e.g. on a disk drive of a personal computer, as a paper print-out or in the cloud. In most cases, so-called wallets offer the option of storing keys – either on a personal device or in the cloud. It is important to keep in mind that the wallet also does not store any units of VCS in this case; it only provides access to the account balance stored in the blockchain.

The crux with the keys is always that the user has to trust the generator of them.[22] If the keys are generated by fraudulent software, the programmer of the software could get access to the keys and hence get access to the account balance to transfer the user's units of VCS. Therefore, companies could offer secure wallets – be it online in the cloud or offline on the computer – which could be accessed via mobile devices. In particular, companies that already offer high-security IT infrastructures could build up a business case in this field.

- **Business models based on transferring units in centralised VCS**

For a fully centralised VCS, it will be difficult to provide additional services given that the central issuer takes care of everything. The centralised system of Ripple is based on mutual trust amongst users. A Ripple user can make a money transfer in two ways:

- If the sender does not know the receiver directly or via another third person, they will use a gateway for processing the transaction on the general ledger.

- If the sender knows the receiver directly or indirectly, the sender, A, can make the currency transfer to another user, C, if there is a chain of trusted users between them. For example, B trusts C up to an amount of €50, whereas A trusts B up to an amount of €10. So C could send an IOU up to €50 to B, but only up to €10 to A (via B).

In most cases, gateways will probably operate as a link between two users who do not know each other (if both users are connected to the same gateway). If no connection can be found between two users, XRP can be used for the transfer, as it does not rely on the trust between two people but on the confidence that someone might change XRP back into currency again. Either way, if a transaction has been successful, it will be stored in the ledger.

That is where service providers could get access to the value chain, since they would be able to offer trusted gateway services to users. Recently a German bank announced that it had started using

22 Only programmers can make sure that the software generating the keys on their computer is free of fraudulent code. The same goes for keys generated and stored in the cloud.

the Ripple System for some parts of its payments. Consequently, users are able to send money via the Ripple network to other users.[23]

- **Business models based on transferring units in decentralised VCS**

As described above, units in decentralised VCS are not transferred in the sense of putting one precisely defined unit somewhere else, as it is actually subtracting a defined amount from one account balance and adding it to another account balance within the blockchain.

To initiate a payment, the sender sends a transfer instruction, signed with their private key and identifiable with the public key, to all users they are connected to.[24] Miners collect transactions, check whether the account is sufficiently funded and create a new block out of the transactions collected in the last ten minutes. This block is then spread to the network and becomes part of the blockchain.

The most common business case is probably mining, as described above. Furthermore, there are businesses offering an instant conversion service for Bitcoin so that merchants would be able to accept payments in Bitcoin without the exchange risk related to the high volatility.[25]

Another business model related to VCS can be seen in transferring remittances. A company could accept currency in one country, change it into units of VCS, transfer it via the VCS network, change it back into currency again in the receiving country and arrange the pay-out.[26]

To widen the acceptance of indirect payments in Bitcoin, there are also companies offering Bitcoin payment cards. In most cases, units of the VCS are stored in a company's digital wallet. The customer then receives a payment card, with which they can pay at the point of sale in local currency, whereas the company debits the equivalent in VCS units from the wallet.[27]

- **Other, complementary business models**

Besides offering the services of a gateway, every VCS allows financial institutions to build up financial instruments based on that VCS. So financial institutions could, for example, set up an exchange-traded fund (ETF) based on the development of the exchange rate and, in doing so, give more people the chance to invest indirectly in VCS by using common financial instruments.

1.5 DATA AND FIGURES ON VIRTUAL CURRENCY SCHEMES

Although quite a few websites collect data from available sources and present them, it is difficult to gather all the relevant information to appropriately examine developments connected to VCS.[28] Moreover, in contrast to comprehensive statistical information on Bitcoin that is publicly available, there are not enough data available on other VCS.[29] As a result, the data and figures that are

23 See http://www.coindesk.com/fidor-becomes-first-bank-to-use-ripple-payment-protocol/.
24 Further information on the functioning of a transaction can be found in the previous ECB report on virtual currencies.
25 Bitpay, for example, offers instant conversion of Bitcoin into USD to merchants for a fixed monthly fee (USD 30). See https://bitpay.com/.
26 The company zipzap inc. presented this business case for their future activity at the "inside bitcoin" conference in February 2014 in Berlin. In the Philippines, Coins.ph offers such a service; see http://www.coindesk.com/bitcoin-firm-enables-remittance-withdrawals-450-philippine-bank-atms/.
27 See http://www.coindesk.com/bitinvests-coincard-prepaid-mastercard-bitcoin-lovers/ or the Xapo Debit Card, which is now available for pre-order: https://in.xapo.com/campaign/debit/.
28 See http://coinmarketcap.com/all.html, http://www.coindesk.com/, http://www.coinometrics.com/bitcoin/tix, etc.
29 Although there is a comprehensive amount of publicly available statistical information on Bitcoin, only in a few cases do websites also publish the methodology and assumptions for presenting the data in an abstract manner.

presented are mainly on Bitcoin, accompanied by information on other crypto-currencies with the largest market capitalisation after Bitcoin.[30]

A further problem is that all of the existing and publicly available statistical information is gathered by VCS stakeholders or operators of web pages connected with them and is thus unverified. Independent gathering of information would therefore be useful, but also because the risks for central bank tasks depend mainly on the extent of the usage of VCS for payments. For gathering information on decentralised VCS, anyone can access the blockchain which is openly available. Moreover, the main exchanges and trading platforms could be invited to provide information on their transactions so as to differentiate between the use of VCS for payments and for investments. For gathering information on centralised VCS, their issuers could be invited to provide similar information. The information gathered could be compiled into indicators or statistics as regards the number and value of payment transactions.

At the time of writing, there are a large number of decentralised VCS, namely around 500 VCS with a total market capitalisation of about €3.3 billion.[31] The majority of VCS have insignificant market capitalisation, i.e. below €1 million. Only 21 VCS exceed this figure, and only the top eight are above €10 million. Given that there are constant fluctuations, only the largest VCS are presented in Table 1, which breaks down market capitalisation, price, available supply and volume traded over the course of 24 hours.

The significance of VCS could be estimated by comparing their market capitalisation with money supply (M1) for currencies as euro (€5,493,000,000,000), US dollar (€1,952,504,690,000), Australian dollar (€184,161,000,000) or even Bolivian boliviano (€5,286,504,000), which at the time of writing was closest to the market capitalisation of Bitcoin (see Chart 1). The ratio of market capitalisation to money supply is even smaller when using M3. Indeed, M3 might be a better reference, given that M1 as a definition of a country's money supply focuses on the role of money as a means of exchange, whereas virtual currencies are hardly used for payments at all.

According to bitcoincharts.com, only 9% of (Bitcoin) exchange transactions are against euro; most exchange transactions are against Chinese renminbi (31%) and US dollar (25%), while other currencies, including British pound sterling and Swedish krona, are traded to a much smaller extent.[32]

Table 1 Key figures on the largest VCS

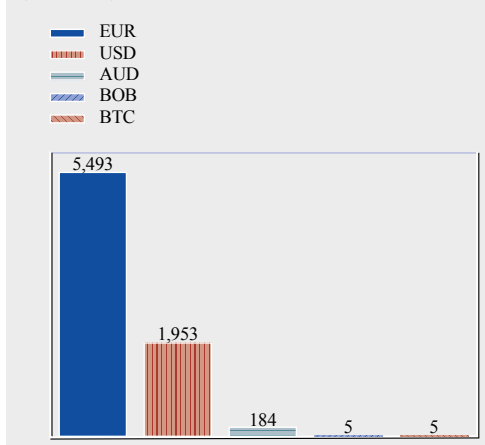
(as at 12 February 2015, 1.00 p.m. GMT)

Currency	Market capitalisation (EUR millions)	Price (EUR)	Available supply (number of units)	Volume traded in last 24 hours (EUR)
Bitcoin (BTC)	2,674	193.390000	13,828,700	12,702,120
Ripple (XRP)	392	0.012289	31,908,551,587	550,623
Litecoin (LTC)	56	1.530000	36,397,554	967,530

Source: http://coinmarketcap.com/all.html

30 The article "Sizing up Bitcoin" provides a good overview of Bitcoin; see http://thewhyforum.com/articles/sizing-up-bitcoin.
31 See http://coinmarketcap.com; last visited on 12 February 2015.
32 On 13 August 2014 with data over the past 30 days; source: https://bitcoincharts.com/charts/volumepie/

Chart 1 Market capitalisation of Bitcoin and money supply (M1) of EUR, USD, AUD and BOB; on 23 April 2014 for BTC and Q1 2014 for EUR, USD, AUD and BOB



Sources: http://thewhyforum.com/articles/sizing-up-bitcoin, http://coinmarketcap.com/all.html, and http://www.coinometrics.com/#!/bitcoin/mix

Chart 2 Price of Bitcoin (in USD)



Source: http://bitcoincharts.com/charts/

During 2013 and the first half of 2014, the Bitcoin daily transaction volume fluctuated in a range between €15 million and €30 million, and between 60,000 and 70,000 daily transactions worldwide on average.[33] When considering virtual currencies as a means of exchange, their price volatility should be taken into account. To illustrate the above, the price volatility of Bitcoin[34] is presented in Chart 2. Longer-term data on other VCS are scarce, but the change in exchange rates over 24 hours can easily exceed 10%, and can be over 100%.[35]

Despite the media hype, the acceptance of virtual currencies by "bricks-and-mortar" or online shops selling "real" goods and services does not seem widespread; a rough estimate would be three in every 10,000 businesses.[36] A majority of these shops sell computer hardware and software related to Bitcoin. However, others – mainly e-commerce merchants, including one of the world's largest online travel agencies – have started accepting payments in Bitcoin.[37]

Exact data concerning virtual currencies as a payment method are not available (not even on Bitcoin, on which the most information is obtainable). Bitcoin is used for around 69,000 transactions per

33 TheGenesisBlock.com, 2013; unverified data. http://blockchain.info/charts/n-transactions

34 The fact that 28.9% of Bitcoins are owned by 47 individuals and another 21.5% by 880 individuals (meaning that 927 individuals own half of all Bitcoins) initiated speculation of a cartel on Bitcoin prices. See the article at http://www.businessinsider.com/927-people-own-half-of-the-bitcoins-2013-12.

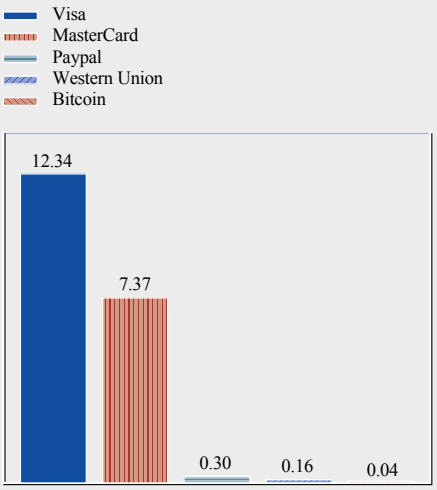
35 See http://coinmarketcap.com/all.html, last visted on 21 November 2014.

36 Bitpay, a Bitcoin payment processor subject to the laws and regulations of the United States, claims to be "trusted by over 30,000 businesses and organisations", https://bitpay.com/. This, however, needs to be seen against over 20 million businesses in the EU (European Commission, http://ec.europa.eu/enterprise/policies/sme/index_en.htm) and perhaps over 100 million businesses in the world. A much lower estimate would result when taking the information available on https://coinmap.org, which listed just over 6,000 places of acceptance for Bitcoin worldwide.

37 See "Is Bitcoin a real currency? An economic appraisal", David Yermack, 2014. Moreover, see "Expedia to accept Bitcoin payments for hotel bookings", http://www.bbc.com/news/technology-27810008.

Chart 3 Volume of global daily transactions with Bitcoin and with well-established payment solutions (Visa, MasterCard, PayPal and Western Union) on 10 August 2014

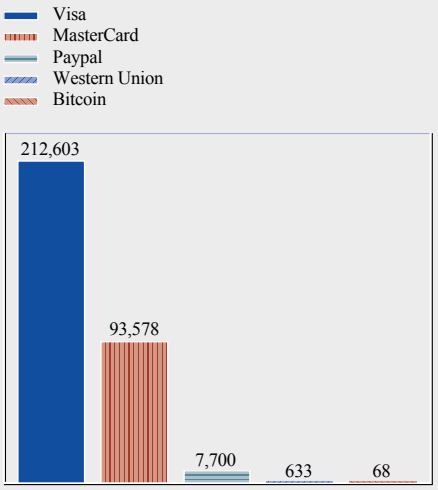
(EUR billions)



Source: http://www.coinometrics.com/#!/bitcoin/tix

Chart 4 Number of global daily transactions with Bitcoin and with well-established payment solutions (Visa, MasterCard, PayPal and Western Union) on 10 August 2014

(thousands)



Source: http://www.coinometrics.com/#!/bitcoin/tix

day worldwide (average for 2014)[38], which includes the transactions for buying or selling Bitcoins, compared with a total of 274 million non-cash retail payment transactions per day for the EU only.[39] Nevertheless, figures on the volume and number of daily transactions with Bitcoin compared with those with well-established payment solutions (Visa, MasterCard, PayPal and Western Union) show that Bitcoin as a payment method remains small. As mentioned above, the number of Bitcoin transactions compared with non-cash retail payment transactions in the EU is insignificant.

38 See http://blockchain.info/charts/n-transactions

39 In the EU, 100.0 billion "payment and terminal transactions" were made in the year 2013. Source: "Statistical Data Warehouse".

Box

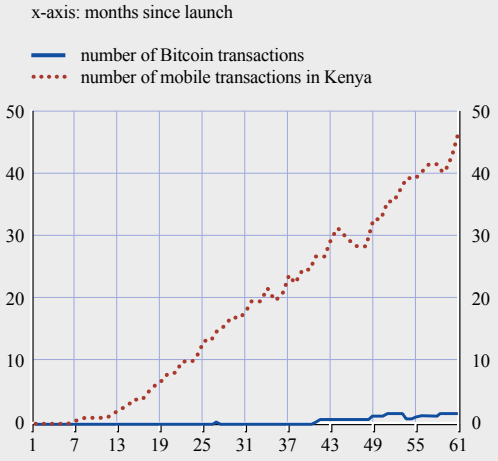
IS BITCOIN ESTABLISHING ITSELF AS A SUCCESSFUL PAYMENT METHOD?

In general, a buyer and a seller can agree on anything to be used as money (both regulated and unregulated payment methods) in a specific transaction. Consequently, virtual currencies may also be used as a payment method if both sides agree. The basic problem for every two-sided market is, however, that it needs "critical mass" on both sides for it to function. For payment cards and other payment instruments, reaching critical mass requires having enough merchants who accept the payment instrument and enough users who want to use the payment instrument so that it becomes attractive for other merchants and other users to join, thereby accelerating the network effects.

In the article "Bitcoin payments: igniting or not?", David S. Evans compared the number of daily Bitcoin transactions with the number of transactions on mPesa, a mobile payment solution which was launched in Kenya in 2007 and is now used by one third of its population.[1] As stated in the article, mPesa followed the classic path for a successful new payment method. Chart 5 shows that the number of transactions with mPesa increased, reaching an inflection point around the end of its first year, and grew explosively from then on (similar to Diners Club in 1950 and Discover Card in 1985), whereas the number of transactions with Bitcoin did grow at first but then levelled out. According to Evans, there is still no evidence of an inflection point for Bitcoin or an explosive growth phase even five years after its launch.

Chart 5 Number of daily transactions with Bitcoin (global) and with mPesa (mobile transactions in Kenya)

(millions)



Source: http://www.globaleconomicsgroup.com/financial-regulation/bitcoin-payments-igniting-or-not/

1 http://www.globaleconomicsgroup.com/financial-regulation/bitcoin-payments-igniting-or-not/

As regards academic research, there are also many examples of the interest that virtual currencies have been raising.[40] Moreover, major companies and banks such as Goldman Sachs[41] and UBS[42] have issued reports on Bitcoin.

1.6 THE USER'S PERSPECTIVE ON VIRTUAL CURRENCY SCHEMES

VCS could present some advantages for users, i.e. payer and payee, when making and receiving payments. An analysis of the risks for users is presented later in this section.

The **payer** might benefit from a relatively short time for the verification and settlement of the payment transaction. The length of these two processes may differ among the various VCS but it is usually less than one hour for decentralised VCS and instantaneous for centralised VCS. Furthermore, the speed of verification and settlement are not linked to the geographical location of the sender and receiver. In fact, the reach of each VCS is potentially global and almost every modern electronic communication device can access the internet and store a VCS wallet.

During the enrolment of a newly set-up wallet into the VCS network, the consumer is not usually requested to agree on a contract with the inventors or to pay them a participation fee. Moreover, the anonymity feature can be a relevant factor for certain users, and not only for the criminal user, but also for users concerned with protecting their privacy. That being said, several exchanges and trading platforms are adopting more serious know-your-customer measures as a result of higher

40 They include: "Some economics of private digital currency", Joshua S. Gans and Hanna Halaburda, Bank of Canada, Working Paper/ Document de travail 2013-38, November 2013; "Is Bitcoin a real currency? An economic appraisal", David Yermack, New York University Stern School of Business and National Bureau of Economic Research, April 2014.
41 "All about Bitcoin", Goldman Sachs, Global Macro Research, Top of Mind, Issue 21, 11 March 2014.
42 "Bitcoins and banks: problematic currency, interesting payment system", UBS, Global Research, 28 March 2014.

attention, increasing activities or new requirements by public authorities. A further potential advantage is that no personal or sensitive payment data are needed for making a payment. Unlike a card-not-present payment, for example – for which personal data and sensitive payment data need to be transmitted over the internet – the VCS payment cannot be linked to a payment instrument, payment account or person. Moreover, for the most prominent VCS, once the transaction is verified, no transaction information can be re-used to conduct a fraudulent payment.

The costs related to the usage of the VCS are usually considered low. Indeed, there are no account-holding fees when storing the cryptographic keys oneself, and the transaction fee for a single transaction has usually been absent, discretionary or low up to now.[43] It is important to note that when using VCS, as opposed to a currency that needs to be converted, there is no foreign exchange cost. Therefore, it could be cost-efficient to use this system, particularly for cross-border customer-to-business payments or for cross-border person-to-person payments (including money transfers/remittances). However, if payers do not wish to keep a certain amount of virtual currency for future usage, costs are usually incurred to obtain the amount of virtual currency needed for each of the intended payment transactions.

For the **payee**, the strongest advantage is the low cost for acceptance. In fact, the payee just needs to open a VCS account and wallet to be able to receive payments. As there is no payment service provider involved, there is usually no charge to be paid. Even if there is, the transaction fee is usually very low when compared with payment instruments, e.g. card payment. Moreover, the payee also benefits from the absence of direct foreign exchange costs. However, if they do decide to keep an amount of virtual currency for future usage, they are exposed to the exchange rate risk, which can be considerable given the instability of the exchange rates of some VCS that are actually used for payments such as Bitcoin. If payees do not wish to keep a certain amount of virtual currency for future usage, costs are usually incurred to change the amount of virtual currency received in the payment transaction.

The payee might also benefit from the reduced payment transaction verification and settlement time, which is especially valuable for those online sales with shipping after receipt of the payment. Moreover, no possibility of chargeback or refund is foreseen within the current VCS, which favours the payee's position.

In addition, VCS usually have a global scale and allow the payee to sell their products to payers located all over the world.

In addition to potential benefits for the payer and payee, VCS could present some advantages for the payment system at a general level. The most notable one in decentralised VCS is that the processing costs are distributed over multiple subjects, namely the miners. This characteristic allows the network to reach reasonable computing power without requiring any major single investment, and it grants the network a strong scalability, as long as enough miners are willing to participate. This also means that new and agile actors, mostly with a background in IT and knowledge of its possibilities, have been able to enter the world of payments. They are suggesting new payment solutions for the digital age.

43 The sustainability of the absence of transaction fees is questionable, since these largely derive from a type of subsidy given to miners in the form of new units of virtual currency, of which the supply might be limited (e.g. for Bitcoin).

Another, related advantage is the fact that further development of the software is taken care of by users on a voluntary basis (open source), thereby making it possible to go into directions that a single entity might not have thought of or would not have chosen. Releases of new software versions and other updates have taken place smoothly and with relative ease. On the other hand, problems in the software have surfaced once it has been released and installed by all users, with some major incidents occurring over time and no single entity being responsible for preventing or resolving such incidents.[44]

The advantages can thus be grouped into the areas of usage possibilities, speed, costs and development of alternative payment solutions. Thanks to these advantages, VCS could pose a challenge to retail payment instruments and innovative payment solutions as regards consumer fees, global reach, anonymity of the payer and speed of settlement. A new or improved VCS might be more successful in future, specifically for payments within virtual communities/closed-loop environments (e.g. internet platforms) and for cross-border payments.

For cross-border customer-to-business and person-to-person payments across the world, users may consider using VCS as an alternative. However, the technical infrastructure and knowledge needed for payments with VCS is a barrier. This certainly holds for most receivers of remittances, who would need to have the equipment to access the internet, as well as a way to change VCS units into the local currency. However, there is major room for improvement, especially in this field, and hence a VCS could have the potential to offer a better service than traditional providers (banks, money remitters and informal remittance systems).

In addition, a major internet company could decide to issue a centralised VCS to facilitate payments on its platform or "community". These could be payments for digital content, e.g. a newly released song, an exclusive video, a high-quality media article, a new level within a game, etc. Once a couple of hundred million users keep a small balance of VCS units, they could also start using these for payments for real goods and services or for person-to-person payments.[45] In the same vein, smaller commercial communities with a well-developed online presence and/or mobile app could achieve the same by hiring an external VCS processing provider, while informal online communities, such as a group of people sharing the same hobby and wishing to exchange goods or services informally, could decide to rely on a decentralised VCS.

The above-mentioned advantages, whether real or only perceived, have to be weighed against real disadvantages and even risks for users of VCS, either when acting as consumers, specifically as payers, or as (temporary) holders of virtual currency.[46] As there are currently no safeguards to protect users of VCS, they are exposed to all the risks. The most relevant risks are listed below and are specifically linked to the common characteristics of VCS.

- **Lack of transparency**

Even the basic functioning of VCS can be difficult to understand for a user. Most of the time, there is only limited information available, if any, especially for the smaller VCS. Furthermore, no transparency requirements apply. For decentralised VCS, it is not even clear who should provide

44 See http://bitcoinmagazine.com/3668/bitcoin-network-shaken-by-blockchain-fork/
45 Facebook experimented with a virtual currency, "Facebook Credits", between 2009 and 2012. Tencent saw that its "Q coins" were being used outside its instant messaging service. See the descriptions in the ECB report (2012).
46 Specific disadvantages and risks related to merchants, (professional) investors and other actors are not covered.

information to users. This could mislead users in evaluating the VCS risks and value, possibly inducing losses.

Lack of transparency can easily be exploited for fraudulent activities. Specific VCS can bear undisclosed features, putting users at a disadvantage.

Specifically, there is a risk that users invest in units of a VCS, or decide to make costs to earn from subsequent mining activity, in order to profit from price increases being unduly promised by inventors or issuers (investment fraud risk associated with the lack of transparency). It may be that a VCS is launched to the market only after its inventors have significantly pre-mined a substantial amount of units and that they subsequently abandon the VCS after selling these units.

- **Absence or unclarity of legal status/Unregulated activities**

Currently, if VCS have a legal status at all, it is unclear and the key actors are generally neither regulated nor supervised. Hence users do not benefit from legal protection such as redeemability or a deposit guaranty scheme, and are more exposed to the various risks that regulation usually mitigates.

Owing to the lack of information regarding legal obligations for each entity, users may be confronted with unexpected legal requirements that render contracts illegal or unenforceable. In most jurisdictions, the taxation regime is not yet clearly defined and might change unexpectedly, inducing additional costs for users.

Although VCS exchanges or trading platforms are registered in some countries (e.g. Germany), they are generally still unregulated. Users are exposed to losses resulting from fraud organised by such actors, from theft or from the bankruptcy of these entities. Such a situation has already materialised with the default of the exchange Mt. Gox in February 2014 leading to the actual loss of several thousands of units of Bitcoin held by users in their wallets at Mt. Gox. In January 2015 almost 19,000 Bitcoins were stolen from the hot wallet of the exchange Bitstamp.[47] And one month later, the company MyCoin came under the spotlight following allegations of fraud, apparently leaving its investors with a loss of €342 million.[48] Moreover, no compensation mechanisms are in place in case the counterparty does not meet its obligations (e.g. bankruptcy, fraud).

While financial institutions are subject to supervision by authorities, users might wrongly assume that the VCS and the key actors involved are also regulated or supervised. This confusion may in particular arise from the apparent similarity of VCS to certain forms of money or electronic retail payment instruments. Specifically, the apparent similarity to e-money may lead users to believe that a redemption obligation could also apply to VCS.

When using virtual currencies as a means of payment for goods and services, users are not protected by any refund rights offered for (unauthorised) transfers from a conventional payment account, as it is under EU law. In the case of unauthorised or faulty transactions (wrong beneficiary, wrong amount, etc.), there is no payment service provider to turn to nor will there be a central dispute resolution body. Moreover, in most VCS, transactions are hard to trace, as the beneficiary is known only by its VCS "address", and not by its name and postal address. Such transactions will consequently result in definitive losses for the user.

47 See http://www.zdnet.com/article/bitstamp-bitcoin-exchange-suspended-amid-hack-concerns-heres-what-we-know/
48 See http://www.zdnet.com/article/mycoin-closes-its-doors-387-million-in-investor-funds-vanishes/

Currently, most of the VCS key actors do not have to comply with minimum capital requirements or other safeguarding obligations aimed at ensuring the continuity of the VCS.

- **Lack of continuity and potential illiquidity**

For a number of reasons, continuity of the VCS is not guaranteed. Users face the risk that an abrupt stop in activities will leave them with valueless units. The activities of key actors may be discontinued, not only as a result of bankruptcy (as mentioned in the previous section), but also for any other reason (e.g. lack of profitability). Acceptance of a VCS by retailers is based on their free decision and can cease at any moment, again leaving users with valueless units. Such decisions can, for instance, be taken as a consequence of a loss of confidence in the particular VCS or of practical difficulties or drawbacks (e.g. possible losses due to exchange rate changes). For the same reason, the market can become illiquid; users are no longer willing to buy VCS units.

- **High IT and network dependency**

Like any highly IT and network-dependent mechanism, VCS are specifically subject to operational risks. These include a wide spectrum of risks, ranging from technical failures to hacking, without obligations to mitigate these risks as is the case for financial institutions and payment systems. Those failures or hacking attacks can occur at individual level (loss or theft of private cryptographic keys or user credentials) or on a wider scale (disruption to, or hacking of, the technical infrastructure of the key actors). The media reported on several thefts of units of Bitcoin, among them the Mt. Gox case and the recent Bitstamp case, leading to losses to users. In the case of decentralised VCS, which are currently the most used VCS, the operations fully depend on the network; there is no central body that can solve issues such as the loss of cryptographic keys (let alone the related reimbursement of the lost VCS units).

- **Anonymity ("pseudonymity")**

The transaction history of VCS is held in the blockchain, making it possible to find a trail of all the transactions of any user. However, the blockchain only identifies users by their VCS "addresses" which play the role of pseudonyms. As it is hardly possible to link the pseudonyms with the real persons or organisation behind it, fraudsters could take advantage of this, for instance by misleading users about the real beneficiary of the payments. As the real beneficiaries cannot be identified, such frauds are highly facilitated. In addition, the impossibility of reversing transactions increases the risk of such frauds and hence they are likely to increase with the growth in the use of VCS.

This anonymous character would also make it difficult to put in place a mechanism enabling erroneous or fraudulent transactions to be resolved.

There is a risk to each party of a contract that the counterparty will not live up to its contractual obligations (counterparty risk associated with the anonymity of the payee). This risk is particularly relevant to decentralised VCS, as the counterparty is not known other than by its VCS address. There are no arrangements in place in VCS to certify the counterparty, given the high level of anonymity and the consequent de facto inability to identify the counterparty of a transaction/operation involving VCS. In payment systems, this risk is mitigated by appropriate safeguards, i.e. access requirements and know-your-customer requirements.

- **High volatility**

Perhaps the most serious drawback for the user of VCS is their potentially high volatility, particularly in the case of VCS with bi-directional flow. The history of Bitcoin shows that this exchange rate of a virtual currency can be highly volatile.[49] Such volatility is a major concern for users as VCS holders because they will at some point either have to cash back their virtual currency holdings into currency or use them to buy goods, the price of which is usually quoted in currencies and therefore unstable in the case of payments in virtual currency.

There is a risk that the value of a business operation involving a VCS or of an investment in a VCS is affected by changes in exchange rates (exchange rate risk associated with the high volatility). Convertible VCS are, as experienced in reality, subject to wide fluctuations in their value against currencies. Users of VCS for business operations or investors in VCS are then exposed to this kind of risk.

Given the drawbacks, disadvantages and risks, many VCS appear to be more an investment or speculation vehicle, especially in the light of the high volatility, rather than a reliable payment method. However, VCS could present advantages in the areas of usage possibilities, speed, costs and the development of alternative payment solutions. In doing so, VCS could pose a challenge to retail payment instruments and innovative payment solutions. A new or improved VCS might be more successful in future, specifically for payments within virtual communities/closed-loop environments (e.g. internet platforms) and for cross-border payments. This warrants a closer look by central banks, given their tasks of ensuring price stability, financial stability and promoting the smooth operation of payment systems.

2 A CLOSER LOOK AT VIRTUAL CURRENCY SCHEMES FROM THE PERSPECTIVE OF A CENTRAL BANK

2.1 VIRTUAL CURRENCIES DO NOT FIT THE ECONOMIC OR LEGAL DEFINITION OF MONEY OR CURRENCY

Even if the terms "virtual currency" and "virtual currency schemes" are used in this report, Eurosystem central banks do not recognise that these concepts would belong to the world of money or currency as used in economic literature, nor is virtual currency money, currency or a currency from a legal perspective.

From an **economic perspective**, the virtual currencies currently known about do not fully meet all three functions of money defined in economic literature: i) medium of exchange (money is used as an intermediary in trade to avoid the inconveniences of a barter system); ii) store of value (money can be saved and retrieved in the future); and iii) unit of account (money acts as a standard numerical unit for the measurement of value and costs of goods, services, assets and liabilities). Indeed, certainly in the case of Bitcoin, the most popular and most commonly used VCS at the time of writing, virtual currencies have a limited function as a medium of exchange because they have a very low level of acceptance among the general public. In addition, the high volatility of their exchange rates to currencies – and therefore in terms of most goods and services – renders

49 Bitcoin's value has jumped and plummeted by more than 40% in a single day. Prices of the virtual currency soared to an all-time high of USD 1240 on 4 December 2013. It was trading at USD 100 in early October 2013. On 7 February 2014 Bitcoin slumped below USD 690 (€508) per coin, losing 20% of its value in a single day, primarily due to the suspension of withdrawals at Mt. Gox.

virtual currency useless as a store of value even for short-time purposes, let alone for the purpose of being a longer-term savings instrument. Finally, both the low level of acceptance and the high volatility of their exchange rates and thus purchasing power make them unsuitable as a unit of account. Therefore, although it cannot be excluded that more stable virtual currencies will emerge and be used by a much wider group of users, VCS such as Bitcoin cannot be regarded as full forms of money at the moment.

From a **legal perspective**, money is anything that is used widely to exchange value in transactions. The term currency is used for "minted" forms of money; nowadays usually taking the form of coins and banknotes. In a more conceptual sense, a (particular) currency refers to the specific form of money that is in general use within a country. Given that VCS are not used widely to exchange value, they are not legally money, and – in the absence of minted versions – they are not currency either, and no virtual currency is a currency.

When further exploring the legal nature of virtual currency and VCS, the following concepts and notions are important as well. For the acceptance of money for payments, only euro banknotes and coins are legal tender[50/51] in the countries of the euro area and therefore, *by law*, must be accepted as payment for a debt within those countries.[52] Scriptural money[53], or bank money, in euro and electronic money[54] (e-money) in euro are not legal tender. Nevertheless, these forms of money are widely accepted for all kinds of payments *by choice*. The euro as a currency may therefore take the form of banknotes, coins, scriptural money and electronic money.[55]

This is not the case for virtual currencies. VCS, such as Bitcoin, use their own denomination (e.g. Bitcoin). VCS are not scriptural, electronic, digital or virtual forms of a particular currency. They are something else, different from known currencies. No virtual currency has so far been declared the official currency of a state, nor do any physical formats, backed by law, have a legal tender capacity. Therefore, no creditor is obliged to accept payment with it to discharge a debtor of its debt. This means that virtual currencies can be used only as contractual money, when there is an agreement between buyer and seller in order to accept a given virtual currency as a means of payment. In the EU, virtual currency is not currently regulated and cannot be regarded as being subject to the (current) PSD or the EMD. As the phenomenon is still relatively new and also moving into different areas, it would be too early to try making new, tailor-made legislation. This would also give more importance to the phenomenon than currently warranted by its low usage. For the

50 See http://www.ecb.europa.eu/euro/intro/html/index.en.html. See Council Regulation (EC) No 974/98 of 3 May 1998 on the introduction of the euro.

51 Up to a limited amount: Article 11 of Council Regulation (EC) No 974/98 of 3 May 1998 on the introduction of the euro defines that: "Except for the issuing authority and for those persons specifically designated by the national legislation of the issuing Member State, no party shall be obliged to accept more than 50 coins in any single payment".

52 Limits to the use of cash in payment transactions, e.g. payments above €1000, exist in some Member States in order to fight tax evasion by merchants and companies.

53 Scriptural money are funds held in demand deposit accounts in commercial banks. These account balances are considered money and can be transferred from person to person by way of payment transactions, such as credit transfers, direct debits or card payments.

54 Electronic money, or e-money, as defined in the E-money Directive (EMD), means electronically, including magnetically, stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions and which is accepted by a natural or legal person other than the electronic money issuer. See Article 2.e of Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions, amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC.

55 Banknotes and coins, scriptural money and electronic money are "funds" as defined under Article 4.15 of Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market amending Directives 97/7/EC, 2002/65/EC, 2005/60/EC and 2006/48/EC and repealing Directive 97/5/EC (PSD). Virtual currencies cannot be regarded as funds and are not as such subject to the PSD. This does not mean, however, that certain services connected to virtual currency schemes might not be deemed to be covered by national laws on payment services. See the recent decisions of the French courts concerning the service of converting virtual currencies (Commercial Court of Créteil, 6 December 2011, and Court of Appeal of Paris, 26 September 2013).

execution of its tasks in the field of payment systems, the ECB does not see the need to amend or expand the current EU legal framework. It is, however, desirable that legal clarity is established by the relevant authorities, explaining how the current legal framework applies to virtual currency and related aspects.

As a result, analysis from the economic and legal perspectives leads to the conclusion that virtual currencies should not be bundled into the generic words of money or currency, even though their technical appearance takes a form which has some similarities to scriptural money and/or electronic money.

However, it cannot be excluded that safer, more efficient and more reliable VCS will be developed in the future, which will be more usable as form of money.

2.2 A NEW DEFINITION FROM THE PERSPECTIVE OF A CENTRAL BANK

For various regulatory and other purposes, it is important to define or classify virtual currencies, but the definition tends to vary depending on the context, e.g. taxation, the registration and licensing of market participants or anti-money laundering.[56] However, these other definition needs fall outside the scope of this analysis. This report addresses VCS mainly in the context of payments.

It was considered necessary to amend the definition of virtual currency used in 2012 on several aspects.[57] First, it should no longer contain the word "money", since it has become clear that, even today, virtual currencies do not have the nature of a highly liquid asset and have not reached the level of acceptance commonly associated with money.

Moreover, the word "unregulated" should be deleted from the definition used in 2012, given that, in some jurisdictions, legislation and regulation has caught up with this innovation and addresses some of its aspects and/or aspects of related services. Finally, to avoid misunderstandings as regards any theoretical limits to the acceptance of a virtual currency "used and accepted among the members of a specific virtual community" is also deleted, even though peer-to-peer networks and internet platforms can be described as a virtual community.

For the purpose of this report, and based on the characteristics currently observed, **virtual currency** can therefore be defined as **a digital representation of value, not issued by a central bank, credit institution or e-money institution, which, in some circumstances, can be used as an alternative to money.**

The term **"virtual currency scheme(s)" (VCS)** is used throughout this report **to describe both the aspect of value and that of the inherent or in-built mechanisms ensuring that value can be transferred**.

56 "(…) the digital currency does not comfortably fit any existing classification or legal definition. It is not a foreign currency, nor a traditional commodity, nor is it simply a payments network", Jerry Brito, in "Beyond Silk Road: potential risks, threats and promises of virtual currencies", written testimony to the US Senate, in http://mercatus.org/sites/default/files/Brito_BeyondSilkRoadBitcoin_testimony_111313.pdf.

57 Definition in ECB report (2012): "A virtual currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community".

2.3 IMPACT ON THE TASKS OF THE ECB/EUROSYSTEM

The ECB's report in 2012 considered the extent to which virtual currency schemes might affect a central bank's tasks in the areas of price stability, financial stability and payment system stability.

- **Price stability**

In theory, VCS could have an impact on monetary policy and price stability. However, it was concluded that VCS did not pose a risk for price stability in practice, provided that the issuance volume of virtual currency continued to be stable and their usage low.

As explained in Section 1.5, the ratio of VCS market capitalisation to the money supply of the major currencies is still very low, despite the increases of the VCS issued volume over the past few years. However, Eurosystem central banks will keep monitoring the developments of VCS, particularly as regards their issued volumes and their interactions with the real world.

- **Financial stability**

Conceptually, VCS could jeopardise financial stability. However, it was considered that they were inherently unstable, but did not jeopardise financial stability given their limited connection to the real economy (i.e. the exchange rates and the exchange markets), the low volumes traded and the lack of wide user acceptance.

The developments of Bitcoin, specifically, confirmed that VCS are inherently unstable. From around USD 12 in October 2012, Bitcoin's exchange rate peaked first in April 2013 at USD 266 and reached its all-time high at USD 1240 (€914) in early December 2013. In April 2014 the exchange rate dropped briefly to approximately €245 or USD 339. Having recovered to €490 in June 2014, the exchange rate has gradually fallen below €200 in February 2015.[58] Another development has been the involvement of the traditional financial system over the past two years, including the issuing of Bitcoin-related securities.[59]

The build-up of financial stability risks from VCS would be likely under the following conditions: (i) VCS become more widely used in regular payments; (ii) greater links to the real economy develop, including through the presence of financial institutions participating in VCS; and (iii) no structural developments are envisaged that would make VCS inherently more stable. As and when these conditions are met to a larger extent, more direct regulatory responses might be required from a financial stability perspective. Moreover, regulatory responses are likely to be more effective if they are internationally coordinated. A patchwork of inconsistent national-level regulatory responses to financial stability concerns may not address risks – as the activity of agents in this market may be international.

An increase in the usage of VCS is conceivable and thus surveillance of the take-up of VCS is important from a financial stability perspective. Transparency as regards the number, structure and scope of VCS appears key for monitoring such developments.

58 Data on usage provided in the section on data and figures show the high volatility of the exchange rates. Source: http://bitcoincharts.com/charts/ (using "mtgoxUSD" for data up to February 2013, and "bitstampUSD" thereafter). Own calculations for currency conversions.

59 As an example, several exchange-traded funds (ETFs) are being prepared for launch and are pending approval by the US Securities Exchange Commission – see http://www.bloomberg.com/news/2014-07-10/bitcoin-by-bitcoin-the-winklevii-etf-inches-closer-to-reality.html

Therefore, the Eurosystem intends to continue monitoring the volumes traded and exchange rate dynamics of the most important VCS, as well as their links with the "traditional" financial sector.

- **Payment system stability**

One of the ECB/Eurosystem's tasks is to promote the smooth operation of payment systems.[60] VCS are a combination of a virtual currency and rules and procedures enabling transfers, similar to a (retail) payment system. For traditional payments, payment service providers participate in payment systems to be able to offer various payment services to users. However, with VCS, users participate directly in the system and hence face payment system-like risks (e.g. credit risk, liquidity risk, operational risk and legal risk) as described in the 2012 report.[61] With VCS, some aspects of these risks are very difficult to avoid or to mitigate, as these aspects are inherent to the VCS concept. In addition, the systems are not currently subject to oversight by a central bank.

As in 2012, again because of their small size, VCS do not pose a threat to payment system stability. However, the overall situation as regards payment system stability might change if: i) large financial sector players interconnected to the global banking system started offering services related to VCS; and/or, ii) a significant increase in users and the volume of transactions took place (for example due to the acceptance of virtual currencies by large e-commerce merchants). In other words, if VCS became part of the regular financial system and/or were used on a large scale. If this did happen, a major incident involving large amounts of virtual currencies in one point of the VCS environment might theoretically trigger payment disruptions elsewhere in the VCS environment or even transmit shocks to traditional payment systems through financial institutions participating in VCS and in traditional payment systems. It cannot be excluded that a major incident with a VCS would not only trigger a loss of trust in VCS but would also undermine users' confidence in electronic payment instruments, in e-money and/or in specific payment solutions (such as those in place for e-commerce).

As concluded in 2012, it can reasonably be expected that the growth of VCS will most likely continue. However, as analysed in this report in more detail, the potential for them to be used more commonly for payments in the future depends on whether a new generation of VCS improve on their current consumer unfriendliness and technical weaknesses, as well as becoming less volatile vis-à-vis currencies. Furthermore, some elements of the technological set-up of VCS could perhaps serve as the inspiration or even basis for traditional PSPs to offer innovative payment solutions.

As concluded in 2012, VCS fall within the statutory task of the ECB/Eurosystem to promote the smooth operation of payment systems owing to their payment system-like characteristics. The ECB and other central banks of the Eurosystem will continue to monitor developments as regards the use of VCS for payments and their role as an alternative to traditional payment systems.

- **Prudential supervision**

The 2012 report did not cover the prudential supervision of credit institutions, as this was not yet an integral part of the tasks of the ECB. However, it is noted that many Eurosystem central banks

60 The ECB/Eurosystem has a catalyst and oversight role. Oversight can apply on payment systems or on payment instruments. As regards systems, oversight would normally focus on systemically (or prominently) important payment systems. Moreover, for the ECB/Eurosystem, oversight is often defined in relation to the confidence in the euro as its currency.

61 The report was based on the CPSS core principles for systemically important payment systems. These were replaced by the principles for financial market infrastructures adopted in April 2012, which add "general business risk" and "custody and investment risks" to the key risks, CPSS-IOSCO, 2012.

did have tasks in this area, and continue to do so, and some also have specific market conduct and consumer protection tasks. Hence, some central banks – taking their tasks in banking supervision as the legal basis – have decided to issue warnings or to take regulatory measures related to VCS. Moreover, the European Banking Authority issued a Warning to consumers on virtual currencies (December 2013), followed by an Opinion on virtual currencies (July 2014) addressed to the national competent authorities and to the European Commission, the Council of the European Union and the European Parliament. Even if the banking supervision mandate of the ECB (as from November 2014) does not cover financial conduct supervision or consumer protection aspects[62], it does cover prudential supervision as regards operational and other risks. Hence, the ECB, in its supervisory role, is in a position to monitor the extent to which the financial institutions it supervises are involved with VCS, and in these cases assess the risks that these activities entail for them.

- **Preserving the integrity of the financial system**

Since the publication of the 2012 report, there have been developments with regard to preserving financial system integrity, i.e. to ensure that VCS are not used for illegal purposes (terrorist financing and money laundering). Those VCS that are convertible into currencies are potentially vulnerable to illicit use, since they have global reach, are accessible through internet and allow greater anonymity than traditional payment methods, and thus may facilitate anonymous funding and anonymous payments.

Risks related to money laundering and the financing of terrorism are enhanced in VCS by the following factors.

1) Owing to the decentralised nature of many or most VCS (like Bitcoin), there is no single entity to be held accountable for the integrity of the VCS and/or to enforce the rules of functioning (other than those enforced by the protocol/algorithm itself). For example, the Bitcoin protocol does not require or provide any identification or verification of the users, nor does it generate historical records of transactions that are necessarily associable with persons in the real world.

2) Difficulties of applying and enforcing anti-money laundering laws and regulations, as well as those countering the financing of terrorism (AML/CFT), in the presence of complex infrastructures to transfer funds or execute payments involving several (not always identifiable) entities which are often spread across several countries.

3) VCS issuers or their related service providers (e.g. wallet providers, exchanges) can be located in jurisdictions that do not have effective AML/CFT controls in place.

The development of this function is not in the remit of the Eurosystem, but other authorities (see Chapter 3 below) are carefully studying these aspects.

- **Wrap-up**

Owing to their payment system-like characteristics, VCS fall within the statutory task of the ECB/Eurosystem to promote the smooth operation of payment systems. The usage for payment transactions and the shared characteristics with payment systems were the main reasons for

62 The consumer financial products and services and consumer protection are relevant issues for the national competent authorities and for the European Banking Authority, as well as for the European Securities and Markets Authority.

analysing the phenomenon from a payment systems perspective, while the money or currency aspect was more important for the other central bank tasks. Although VCS units are not denominated in euro, they do have the potential to have an impact on monetary policy and price stability, financial stability and the smooth operation of payment systems in the euro area. No negative impact has yet materialised, but that could change if VCS were to become more widely used in the euro area and noticeably affect the role of the euro as a medium of exchange, unit of account or store of value. The Eurosystem will continue to monitor payments-related developments in VCS, as they are comparable to payment systems, can be and are being used for payments, and have the potential to develop wider user acceptance in the future.

3 LEGISLATIVE AND REGULATORY RESPONSES TO VIRTUAL CURRENCY SCHEMES

3.1 THE INTEREST AND INVOLVEMENT OF OTHER EUROPEAN AND INTERNATIONAL AUTHORITIES

A number of international authorities have developed an interest in virtual currencies and are currently dealing with the subject. Some of their activities are described in this chapter.

The World Bank organised a conference entitled "Virtual currencies: the legal and regulatory challenges" (June 2013), where legal and regulatory challenges associated with virtual currencies were discussed. A further conference was organised entitled "Virtual currencies: legal, regulatory and policy implications" (May 2014). In December 2013 the World Bank and the CPSS organised a retail payment forum dedicated almost entirely to VCS.

In December 2013 the European Banking Authority issued a warning to consumers on a series of risks deriving from buying, holding or trading virtual currencies such as Bitcoin.[63] Moreover, the EBA published an Opinion in July 2014 in which it stated that regulated financial institutions should be made aware of the risks and discouraged from buying, holding or selling VCS.[64] European legislators, however, did not follow the EBA's recommendation that exchanges become "obliged entities" in the Anti-Money Laundering Directive (AMLD4). The European Securities and Markets Authority (ESMA) is monitoring the breadth of the virtual currency market and the investment products/services providing exposure to virtual currencies.

The Financial Action Task Force (FATF) has published the report "Virtual currencies: key definitions and potential AML/CFT risks" (June 2014), which focuses specifically on decentralised, maths-based, convertible virtual currencies like Bitcoin.[65] The report suggests "a conceptual framework for understanding and addressing the anti-money laundering/countering the financing of terrorism (AML/CFT) risks associated with one kind of internet-based payment system: virtual currencies". The report also establishes a common set of definitions that apply to virtual currencies.

Virtual currencies have become an issue at the level of the European institutions. The European Parliament has been requested by one of its members to adopt a resolution on Bitcoin pursuant to Rule 120 of the Rules of Procedure[66], by means of which he calls on the Commission to keep a close eye on Bitcoin and its spread, as well as looking into the positive and negative implications of

63 See http://www.eba.europa.eu/-/eba-warns-consumers-on-virtual-currencies
64 See the EBA Opinion on virtual currencies, 4 July 2014.
65 See http://www.fatf-gafi.org/media/fatf/documents/reports/Virtual-currency-key-definitions-and-potential-aml-cft-risks.pdf
66 See http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+MOTION+B7-2014-0168+0+DOC+PDF+V0//EN.

the spread of Bitcoin and the market distortions to which it could give rise. Virtual currencies have been addressed by the European Commission in discussions with market experts.

Furthermore, concerns have been raised about the use of VCS, especially crypto-currencies, for criminal activities. This is why EUROPOL, the EU's law enforcement agency, has called for police to be given greater powers to identify criminals using crypto-currencies to launder money on the internet.[67] Moreover, a future orientation on possible scenarios for the evolution of the role of virtual currencies in society, and in criminal finance in particular, has demonstrated that it is desirable from the perspective of preventing and combating serious forms of crime that an explicit stance is taken at policy level in regard to the conditions for the recognition and acceptance of VCS in the regular economy. As such, the political guidance can be perceived as an incentive for VCS developers. According to EUROPOL, this policy position should at least specify the conditions and limitations for the acceptance of anonymity in payments and include the possibility for (financial) authorities to monitor financial flows and for law enforcement authorities to analyse transactions, intervene and seize assets in accordance with domestic legislation in the event that there are clear indications that payments are associated with crime and/or the laundering of the proceeds thereof.

3.2 NATIONAL RESPONSES TO VIRTUAL CURRENCY SCHEMES

A number of central banks, supervisory authorities and other government agencies around the world have communicated publicly on virtual currency schemes. Notably, the Chair of the Board of Governors of the Federal Reserve System, Janet Yellen, said at a US Senate banking committee hearing in February 2014: "It's important to understand that this is a payment innovation that's happening outside the banking industry. [...] The Federal Reserve simply does not have the authority to regulate Bitcoin in any way."[68]

The responses can be sorted into four broad categories: warnings, statements and clarifications on the legal status, (future) actions in licensing and/or supervision, and issuing bans.[69]

Several central banks and supervisory authorities **warned about risks** associated with Bitcoin and/or virtual currency schemes in general. For example, the German Federal Financial Supervisory Authority (BaFin)[70], the Banque de France[71] and the Dutch[72] and Belgian central bank and supervisor[73] have published warnings about the possible use of Bitcoin in money laundering and financing terrorism, the lack of supervision, price fluctuations and security risks. The Deutsche Bundesbank has given such warnings in interviews. Outside Europe, the People's Bank of China[74], the Reserve Bank of India[75], the Monetary Authority of Singapore[76] and Bank Indonesia[77] are among those warning of the risks of Bitcoin.

A number of authorities specifically pointed out that, **legally, Bitcoin is not a currency, does not have the status of legal tender and/or does not meet the definition of a financial instrument.**

67 See http://www.itpro.co.uk/public-sector/21903/europol-calls-for-greater-bitcoin-policing-powers.
68 See http://fortune.com/2014/02/27/janet-yellen-fed-will-steer-clear-of-bitcoin/.
69 A detailed overview for EU countries is provided in Annex 1.
70 http://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/fa_bj_1401_bitcoins.html
71 http://www.banque-france.fr/fileadmin/user_upload/banque_de_france/publications/Focus-10-stabilite-financiere.pdf
72 http://www.dnb.nl/en/news/news-and-archive/nieuws-2013/dnb300672.jsp
73 http://www.nbb.be/pub/01_00_00_00_00/01_06_00_00_00/01_06_01_00_00/20140115_FSMA_NBB.htm?l=nl
74 http://www.theguardian.com/technology/2013/dec/05/bitcoin-price-tumbles-chinese-central-bank-warning and http://www.theguardian.com/technology/2013/dec/18/bitcoin-plummets-china-payment-processors-digital-cryptocurrency
75 See press release of 24 December 2013; http://rbi.org.in/scripts/BS_PressReleaseDisplay.aspx
76 http://business.asiaone.com/news/bitcoin-users-beware-mas
77 http://www.coindesk.com/indonesia-central-bank-warns-bitcoin-use/

In Finland, the central bank has stated that Bitcoin does not fulfil the criteria for a currency or a payment instrument.[78] In Sweden too, Bitcoin does not meet the definition of a currency and is taxed as an asset. It does not meet the Swedish definition of a currency, as currencies are tied to a central bank or a geographic area.[79] The German Ministry of Finance has stated that it regards Bitcoin as a unit of account; the financial supervisor added that units of account (such as Bitcoin, IMF special drawing rights, regional currencies, etc.) that are not legal tender do qualify as financial instruments.[80] Outside Europe, Bank Negara Malaysia has clarified that Bitcoin is not legal tender in Malaysia[81] and Bank Indonesia has stated that only the rupiah is legal tender.[82]

A number of countries are considering the possible **licensing and supervision of certain Bitcoin-related services.** In Sweden, VCS exchanges have had to register with the financial supervisor since 2012, as Bitcoin was being used as a means of payment.[83] In Germany, BaFin has stated that the use, sale and purchase, and mining of units of Bitcoin do not in themselves require an authorisation, although additional services may be subject to authorisation.[84] In view of the legal complexity, BaFin recommends that potential providers allow it to assess their activities at an early stage. In Denmark, Bitcoin service providers are not currently required to have authorisation.[85] The French prudential supervisor ACPR has announced that it regards the activity of receiving funds denominated in a currency with legal tender status from a Bitcoin purchaser and transferring those funds to a Bitcoin seller as offering a type of payment service that requires authorisation as a payment services provider.[86] Outside Europe, Hong Kong has stated that it wants to expand its e-money directive to cover Bitcoin as a medium of exchange.[87] The State of New York is planning to issue licenses for businesses that use virtual currencies, and intends to provide regulations.[88]

In some countries, **certain activities related to virtual currencies are banned.** The People's Bank of China warned financial institutions in early December 2013 that they are not to trade in Bitcoin.[89] This warning was later extended to payment service providers, which had to end Bitcoin trading by 31 January 2014. A Thai Bitcoin exchange applied for a licence but was informed by the Bank of Thailand that all trade in, and sale, purchase and use of, units of Bitcoin was currently illegal.[90] However, the Bank of Thailand does not itself have the ability to impose a prohibition. Bank Indonesia has stated that the use of Bitcoin contravenes various Indonesian laws.[91] It does not, however, have a policy or regulations to prevent the use of Bitcoin. In Russia, the prosecutor general's office stated that systems for anonymous payments and cyber-currency with a large

78 http://www.suomenpankki.fi/en/suomen_pankki/ajankohtaista/muut_uutiset/Pages/uutinen_140114.aspx and http://www.bloomberg.com/news/2014-01-19/bitcoin-becomes-commodity-in-finland-after-failing-currency-test.html
79 http://www.bloomberg.com/news/2014-01-21/bitcoin-becomes-art-as-swedish-taxman-rejects-creative-currency.html
80 http://www.theguardian.com/technology/2013/aug/19/bitcoin-unit-of-account-germany
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82 http://www.coindesk.com/indonesia-central-bank-warns-bitcoin-use/
83 http://www.riksbank.se/Documents/Rapporter/Riksbanksstudie/2013/ rap_riksbanksstudie_The_Swedish_retailpayment_market_ 130605_eng.pdf and http://www.bitcoin.se/2012/12/04/finansinspektionen-klassar-bitcoin-som-betalningsmedel/
84 http://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/ fa_bj_1401_bitcoins.html
85 http://rt.com/news/bitcoin-denmark-regulator-unsafe-395/
86 http://acpr.banque-france.fr/fileadmin/user_upload/acp/Communication/Communiques%20de%20presse/20140129-Communique-ACPR-position-bitcoin.pdf
87 CPSS-World Bank Forum Report on Retail payments.
88 http://www.reuters.com/article/2014/02/11/usa-bitcoin-idUSL2N0LG1P520140211?feedType=RSS&feedName=financialsSector
89 http://www.theguardian.com/technology/2013/dec/05/bitcoin-price-tumbles-chinese-central-bank-warning and http://www.theguardian.com/technology/2013/dec/18/bitcoin-plummets-china-payment-processors-digital-cryptocurrency
90 http://www.theguardian.com/technology/2013/jul/31/thai-bitcoin-exchange-suspend-trading and http://qz.com/110164/thailands-infamous-bitcoin-crackdown-is-not-quite-what-it-seems
91 http://www.coindesk.com/indonesia-central-bank-warns-bitcoin-use/

circulation (including Bitcoin) are "substitute money" and are therefore forbidden in Russia.[92] The Russian central bank had previously announced that providing Bitcoin services would be regarded as possible involvement in dubious transactions.[93]

From the above, it becomes clear that the national responses differ, partly depending on the part of the world they originate from and on the type of authority. Moreover, in many cases, these responses may still change over time. To address the lack of clarity surrounding VCS, the ECB would welcome clarification by the respective authorities at national, European and global level as to how the relevant legislative, regulatory and supervisory frameworks currently in place apply to virtual currency schemes, to their usage and – especially – to the related services on offer, such as exchanges, and the amendment of these frameworks if needed. In this context, the ECB welcomes the clarification provided by the EBA in its opinion. With regard to its own tasks in the field of payment systems, price stability and financial stability, the ECB does not see a need to amend or expand the current EU legal framework related to these tasks.

4 CONCLUSIONS

Virtual currency schemes, such as Bitcoin, are not full forms of money as usually defined in economic literature, nor are virtual currencies money or currency from a legal perspective. Nevertheless, VCS can/may substitute banknotes and coins, scriptural money and e-money in certain payment situations.

The general consideration of the ECB's report on virtual currency schemes (2012) was that, although VCS can have positive aspects in terms of financial innovation and the provision of additional payment alternatives for consumers, it is clear that they also entail risks. The current report, while reiterating and reconfirming this consideration, adds perspective and detail, based on a further analysis carried out by the central banks of the Eurosystem during 2014. For the tasks of central banks, such as those regarding monetary policy and price stability, financial stability, prudential supervision and promoting the smooth operation of payment systems, the materialisation of these risks depends on the volume issued for the respective virtual currency schemes, their connection to the real economy, including through supervised institutions involved with VCS, their traded volume and on user acceptance.

With around 500 decentralised VCS now, the number has dramatically increased. Most of the new ones are copies of Bitcoin with only minor modifications. Participation in VCS exposes users not only to key payment system-like risks but also to a range of other risks emanating from the characteristics of VCS. In particular, users are exposed to exchange rate risk related to high volatility, to counterparty risk related to the anonymity of the payee and to investment fraud risk related to the lack of transparency. In short, there are both general and specific ways in which users could lose their entire virtual currency holdings. Some aspects of these risks are inherent to the VCS concept and the risks mostly remain unmitigated by legislation, regulation or supervision. The reactions from national authorities to the phenomenon vary, partly depending on the part of the world these originate from and on the type of authority. Responses range from warnings about risks, statements and clarifications on the legal status, licensing and supervision of VCS-related activities, or the banning of those. In order to establish clarity on virtual currency and related aspects, the ECB

92 http://www.reuters.com/article/2014/02/09/us-russia-bitcoin-idUSBREA1806620140209
93 Press release from the Russian Central Bank, 27 January 2014.

would welcome clarification by each respective authority as to how the relevant legislative, regulatory and supervisory frameworks apply to virtual currency schemes, and amendment of these frameworks if needed. For its own tasks in the field of payment systems, the ECB does not see the need to amend or expand the current EU legal framework related to these tasks.

The usage of VCS for payments remains limited for now, which implies that there is not yet a material risk for any central bank tasks, including promoting the smooth operation of payment systems. However, a major incident with VCS and a subsequent loss of trust in VCS could also undermine users' confidence in electronic payment instruments, in e-money and/or in specific payment solutions. The ECB recognises that, besides their drawbacks and disadvantages, VCS could also have some advantages over traditional payment solutions and specifically for payments within virtual communities/closed-loop environments and for cross-border payments. As such, it is not excluded that a new or improved VCS may be more successful in future. Therefore, the Eurosystem will continue monitoring developments, notably for payments-related aspects of VCS.

GLOSSARY

Blockchain is the ledger (book of records) of all transactions, grouped in blocks, made with a (decentralised) virtual currency scheme.

Currency is now minted money; it usually takes the form of coins and banknotes. When referring to **a (particular) currency**, such as the euro or the US dollar, the meaning becomes more conceptual, i.e. the representation of value that is backed by a law and/or government (see also fiat currency).

Fiat currency is established by governments to centre an economy onto one kind of transaction medium (e.g. euro, US dollar and yen).

Fiduciary currency is a currency without intrinsic value; it derives its worth from the trust users have in the issuer of the currency.

Mining is the validation of a set of transactions (called a "block") made with a decentralised VCS and adding this block to the ledger of all transactions (called a "blockchain"). The name is supposed to be an analogy to people spending time and energy to extract a valuable mineral from the earth.

Money is anything that is widely used to exchange value in transactions. It functions as a medium of exchange, storage of value and unit of account.

Virtual currency is a digital representation of value, not issued by a central bank, credit institution or e-money institution, which, in some circumstances, can be used as an alternative to money.

Virtual currency scheme(s) is used to describe both the aspect of value (i.e. virtual currency) and that of the inherent or in-built mechanisms ensuring that value can be transferred.

ANNEX – NATIONAL RESPONSES TO VIRTUAL CURRENCY SCHEMES IN THE EU

	Status of Bitcoin/virtual currency	Warning	Supervision	Prohibition
Belgium	Not legal tender or electronic money.[1]	Yes[2]	Virtual currencies are not supervised.[3]	
Bulgaria				
Czech Republic	Bitcoins are not banknotes, coins, scriptural or electronic money.[4]	Yes (reference to EBA warning)[5]	No licence is required for selling or buying Bitcoins, and these activities are not supervised. Licence might be needed for trading derivatives with Bitcoin as underlying, managing a fund investing in Bitcoins or transferring funds between buyers and sellers of Bitcoins by the operator of an exchange platform.[6]	
Denmark	Bitcoin is not a currency. "Bitcoin does not have any real trading value compared to gold and silver, and thus is more similar to glass beads."[7]	Yes[8]	Bitcoin service providers do not need a licence. The Danish have stated that regulation of Bitcoin should be organised at European or even global level.[9]	
Germany	Unit of account,[10] not legal tender but a financial instrument.	Yes[11]	According to BaFin, the usage, buying, selling and mining of Bitcoin does not require a licence. Additional services might require a licence, though, so Bitcoin start-ups are advised to check this with BaFin on a case-by-case basis.[12]	
Estonia	The central bank, the FSA and the Ministry of Finance have stated that Bitcoin is not legal tender, but "an alternative means of payment".[13]	All three institutions have warned consumers and stressed the potential threats. Head of the Eesti Pank payment and settlement systems department cautioned against VCS.[14]		The Ministry of Finance has stated that selling and buying Bitcoins is not illegal. Selling and buying as a professional activity is considered an event of provision of services of alternative means of payment [§ 6 (4) of MLTFPA].
Ireland		Yes (reference to EBA warning)[15]	No[16]	
Greece		Yes (reference to EBA warning)[17]		

1 http://www.nbb.be/doc/ts/Enterprise/Press/2014/cp140114En.pdf
2 http://www.nbb.be/pub/01_00_00_00_00/01_06_00_00_00/01_06_01_00_00/20140115_FSMA_NBB.htm?l=en
3 http://www.nbb.be/doc/ts/Enterprise/Press/2014/cp140114En.pdf
4 http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/faq/obchodovani_s_bitcoiny.pdf
5 http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/dohled_financni_trh/novinky/download/EBA_2013_varovani_bitcoin.pdf
6 http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/faq/obchodovani_s_bitcoiny.pdf
7 http://www.nationalbanken.dk/da/presse/Documents/2014/03/PH_bitcoin.pdf#search=Bitcoin
8 http://www.finanstilsynet.dk/da/Nyhedscenter/Pressemeddelelser/Arkiv-PM/Presse-2013/Advarsel-mod-virtuelle-valutaer-bitcom-mfl-2013.aspx
9 http://www.bloomberg.com/news/2013-12-17/bitcoin-rules-drafted-in-denmark-as-regulator-warns-against-use.html#disqus_thread
10 http://www.theguardian.com/technology/2013/aug/19/bitcoin-unit-of-account-germany
11 http://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/fa_bj_1401_bitcoins.html and http://www.wiwo.de/politik/konjunktur/jens-weidmann-der-geldwert-ist-stabil-seite-all/9257044-all.html
12 www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/fa_bj_1401_bitcoins.html
13 http://www.bloomberg.com/news/2014-01-30/bitcoin-ponzi-scheme-worry-sparks-estonia-central-bank-caution.html, http://www.loc.gov/lawweb/servlet/lloc_news?disp3_l205403934_text
14 http://www.bloomberg.com/news/2014-01-30/bitcoin-ponzi-scheme-worry-sparks-estonia-central-bank-caution.html
15 http://www.centralbank.ie/publicinformation/Documents/EBA%20Warning%20on%20Virtual%20Currencies.pdf
16 oireachtasdebates.oireachtas.ie/debates%20authoring/debateswebpack.nsf/ takes/dail2013121000054?opendocument
17 www.bankofgreece.gr/Pages/el/Bank/News/Announcements/DispItem.aspx?Item_ID=4517&List_ID=1af869f3-57fb-4de6-b9ae-bdfd83c66c95&Filter_by=AN

	Status of Bitcoin/virtual currency	Warning	Supervision	Prohibition
Spain	Virtual currencies are not considered legal currency, since they are not issued by the government's monetary authority.[18]	No, but informative note published[19]	Virtual currencies are not currently supervised.	
France		Yes[20]	Supervisor ACPR regards Bitcoin exchanges as a form of financial service provision for which a PSP licence is required.[21] The French Banking Federation indicates that wiring revenue from the sale of virtual currency to a personal bank account may require the bank to file a declaration with the French anti-money laundering agency.[22]	
Italy	Virtual currencies are not considered legal tender.	Yes, a warning has been issued by the Bank of Italy on the use of so-called virtual currencies.[23] A communication has also been issued by the Italian Financial Intelligence Unit on the anomalous use of virtual currencies and on the detection of suspicious money laundering or terrorist financing transactions by obliged entities.[24]	A communication has been issued by the Bank of Italy's Supervisory Directorate (included in Supervisory Bulletin n.1, 2015) which endorses the EBA "Opinion on 'virtual currencies'" – this discourages banks and other supervised financial intermediaries from buying, holding or selling virtual currencies.[25]	
Croatia	Not legal tender, electronic money or foreign currency		No	
Cyprus		Yes[26]	No[27]	No[28]
Latvia		Yes[29]		
Lithuania		Yes[30]	Bitcoin is not supervised.[31]	

18 http://www.loc.gov/law/help/bitcoin-survey/#_ftnref121
19 http://www.bde.es/clientebanca/noticias/Nota%20informativa%20Bitcoin%20_enero%202014%20(corregidas%20erratas)_.pdf
20 https://www.banque-france.fr/fileadmin/user_upload/banque_de_france/publications/Focus10-the_dangers_linked_to_the_emergence_of_virtual_currencies_the_example_of_bitcoins-GB.pdf
21 http://acpr.banque-france.fr/fileadmin/user_upload/acp/Communication/Communiques%20de%20presse/20140129-Communique-ACPR-position-bitcoin.pdf
22 http://www.coindesk.com/france-bitcoin-revenues-must-declared-tax-authorities/
23 http://www.bancaditalia.it/compiti/vigilanza/avvisi-pub/index.html
24 http://uif.bancaditalia.it/normativa/norm-indicatori-anomalia/Comunicazione_UIF_su_VV.pdf
25 http://www.bancaditalia.it/pubblicazioni/bollettino-vigilanza/2015-01/20150130_II15.pdf
26 http://www.centralbank.gov.cy/nqcontent.cfm?a_id=13239
27 http://cyprus-mail.com/2014/02/26/central-bank-says-bitcoin-is-not-illegal/
28 http://cyprus-mail.com/2014/02/26/central-bank-says-bitcoin-is-not-illegal/
29 Latvijas Banka and the Latvian Financial and Capital Market Commission both issued recommendations cautioning citizens on the use of virtual currencies: http://fktk.lv/en/publications/press_releases/2014-02-18_fcmc_opinion_on_the_legal_framework_for_bitcoin_and_similar_instruments/ and http://www.bank.lv/presei/komentari-un-raksti/par-bitcoin (only in Latvian).
30 http://www.lb.lt/lietuvos_bankas_perspeja_del_virtualiu_valiutu_naudojimo
31 http://www.lb.lt/lietuvos_bankas_perspeja_del_virtualiu_valiutu_naudojimo

	Status of Bitcoin/virtual currency	Warning	Supervision	Prohibition
Luxembourg	Virtual currencies are not legal tender	Yes	Companies that want to carry out activities in the financial sector (including the provision of payment services using VCS or establishing a trade platform) are required to request authorisation by the Minister of Finance and to subject themselves to CSSF (financial sector supervisor) supervision.[32]	
Hungary		Yes[33]	No[34]	
Malta	Virtual currencies are not considered to be legal tender	Yes issued by MFSA (reference to EBA warning)	Bitcoin is not supervised.	
Netherlands		Yes[35]	Bitcoin falls outside the scope of the Dutch Financial Supervision Act. Consequently, De Nederlandsche Bank (DNB) does not supervise virtual currencies or enterprises trading in them.[36] In June 2014 DNB warned banks and payment institutions of the derived integrity risks related to virtual currencies. According to DNB, they are unaware, or not sufficiently aware, of the identity of the parties buying and selling virtual currencies. Integrity risk management must include effective measures in respect of client acceptance and the monitoring of new, innovative providers. DNB qualifies existing virtual currencies (Bitcoin and other altcoins) as products with an extremely high risk profile.[37]	
Austria		Yes	No, although business models based around Bitcoins may require compulsory licensing in accordance with statutory provisions, the enforcement of which falls within the remit of the FMA.[38]	
Poland	Not legal tender[39]			The representative of the Minister of Finance declared at a conference that Bitcoin is *not* illegal.[40]
Portugal		Yes[41]	No[42]	

32 www.cssf.lu/fileadmin/files/Publications/Communiques/Communiques_2014/Communique__virtual_currencies_140214.pdf
33 www.mnb.hu/Sajtoszoba/mnbhu_pressreleases/mnbhu_pressreleases_2014/mnbhu_sajtokozlemeny_20140219
34 www.mnb.hu/Sajtoszoba/mnbhu_pressreleases/mnbhu_pressreleases_2014/mnbhu_sajtokozlemeny_20140219
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37 http://www.dnb.nl/en/publications/dnb-publications/newsletters/nieuwsbrief-banken/nieuwsbrief-banken-juni-2014/dnb308035.jsp
38 http://www.fma.gv.at/en/special-topics/bitcoin.html
39 http://www.coindesk.com/polish-official-bitcoin-not-illegal/
40 http://www.pb.pl/3485125,94998,minfin-bitcoin-nie-jest-nielegalny
41 http://www.bportugal.pt/pt-PT/OBancoeoEurosistema/Esclarecimentospublicos/Paginas/meiosdepagamento.aspx
42 http://www.bportugal.pt/pt-PT/OBancoeoEurosistema/Esclarecimentospublicos/Paginas/meiosdepagamento.aspx

	Status of Bitcoin/virtual currency	Warning	Supervision	Prohibition
Romania				
Slovenia	Not currency and not a payment instrument[43] Bitcoins could fall within the scope of the Prevention of Money Laundering and Terrorist Financing Act[44]	Yes (reference to EBA warning)[45]		
Slovakia		Yes[46]	Bitcoin is not supervised.[47]	
Finland	Not a currency and not a payment instrument.[48]	Yes[49]	Bitcoin is not supervised.[50] FIN-FSA has made reference to EBA Warning.	
Sweden	Asset (not a currency)[51]	Yes[52]	Virtual currency exchanges have to register with the Finansinspektionen (the financial supervisor).[53]	
United Kingdom	Act as money only to a limited extent and only for relatively few people.[54]	Yes (reference to EBA warning)[55]		

43 http://www.coindesk.com/slovenia-clarifies-position-cryptocurrency-tax/, http://www.durs.gov.si/si/davki_predpisi_in_pojasnila/dohodnina_pojasnila/dohodek_iz_kapitala/dobicek_iz_kapitala/vrednostni_papirji_in_delezi_v_gospodarskih_druzbah_zadrugah_in_drugih_oblikah_organiziranja_ter_investicijski_kuponi/davcna_obravnava_poslovanja_z_virtualno_valuto_po_zdoh_2_in_zddpo_2/
44 Notice on Bitcoin treatment of Office of Republic of Slovenia for money laundering prevention: http://www.uppd.gov.si/fileadmin/uppd.gov.si/pageuploads/dokumenti/Bitcoin_obvestilo.pdf (available only in Slovene).
45 http://www.bsi.si/informacije-za-potrosnike.asp?MapaId=1562&VsebinaId=16324&Pisava=1
46 http://www.nbs.sk/sk/informacie-pre-media/tlacove-spravy/spravy-vseobecne/detail-tlacovej-spravy/_upozornenie-nbs-bitcoin
47 http://www.nbs.sk/sk/informacie-pre-media/tlacove-spravy/spravy-vseobecne/detail-tlacovej-spravy/_upozornenie-nbs-bitcoin
48 http://www.suomenpankki.fi/en/suomen_pankki/ajankohtaista/muut_uutiset/Pages/uutinen_140114.aspx
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50 http://www.bloomberg.com/news/2014-01-19/bitcoin-becomes-commodity-in-finland-after-failing-currency-test.html
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55 http://www.fca.org.uk/news/european-warning-virtual-currencies