Giving Thought discussion paper no. 4

Giving Unchained:

Philanthropy and the Blockchain

December 2015

CAF Charities Aid Foundation

1) Introduction

We explored in a previous CAF "Giving Thought" discussion paper the potential opportunities and risks for charities and donors associated with the rise of cryptocurrencies.[1] These are new forms of digital money that exist independently of governments and central banks, and are at the forefront of discussions about the future of money – to the extent that some people are even asking whether they could spell the end of traditional currencies.

There is a growing school of thought, however, that the most interesting thing about the current crop of cryptocurrencies is not actually the currencies themselves, but rather the mechanism that underpins them: the so-called "blockchain".[2] This is the shared public ledger which makes Bitcoin *et al* possible by providing a record of all transactions and determining who owns what at any given time. Its security is ensured by complex cryptographic processes which are performed by Bitcoin users in exchange for coins, via a process known as "mining".[3]

Although blockchain technology has, up to now, been seen primarily as part of the mechanism of making cryptocurrencies work, it can actually be applied in many other ways; some of which throw up intriguing possibilities. For instance in this paper we will ask:

- Can we use "**coloured coins**" to represent assets within the digital space, and thus open up the possibility of making **donations of intangible assets** such as intellectual property?
- Could self-governing "**smart contracts**" offer new opportunities for **businesses to embed philanthropy** at their core, and **new ways for charities to raise money** and **address social problems**?
- Can blockchain technology offer a form of "**radical transparency**" that can **overcome public scepticism** and lack of trust?
- Will an "**internet of things**", underpinned by blockchain technology, lead to a world in which smart machines emerge as a **new, hyper-rational donor class**?

[1] Davies, R. (2015) *Giving a Bit(Coin): Cryptocurrency and Philanthropy*. London: Charities Aid Foundation
[2] See, for example, Bradbury, D. (2015) As Bitcoin Slides, the Blockchain grows. *E & T Magazine*. London: The Institute of Engineering and Technology, 16th February.
[3] Coindesk (2015), *How Bitcoin Mining Works*.

The applications of blockchain technology are still very much in their infancy; hence relatively little thought has yet been given to their relevance in any field, let alone to the implications for philanthropy. As a result, the questions and ideas in this paper might well seem like science fiction to many readers. However, if the predictions of some commentators come true, blockchain technology is going to have a profound effect on the ways in which people and markets operate and interact in the future; and as a result there are likely to be profound implications for the nature of social action. Although this reality may still be far off, we would do well to think through some of the implications now.

2) What is the blockchain?

As mentioned above, the blockchain is best known as the mechanism at the heart of Bitcoin and other cryptocurrencies, where it acts as a public record of ownership and transactions between currency users. However the value of a decentralised, user-maintained public ledger is certainly not confined to the area of payments.

For example, one development from the field of cryptocurrency is the idea of using "coloured" digital coins to act as tokens which allow physical assets to be represented within the blockchain. And building even further on this is the idea of using the blockchain as a way of fully integrating the "internet of things". More immediately, there is a great deal of interest in the idea of "smart contracts". These are contracts between two or more parties which are underpinned by blockchain technology and which therefore, unlike traditional contracts, have no need for a third party to hold and enforce the contract terms. We will explore all of these possibilities in more detail later in this paper.

As with many of the developments in the field of crypto-currency and blockchain technology, the specifics of how the underlying mathematics and engineering works will neither be accessible nor relevant to the vast majority of people. What we need to understand is the key features of the technologies in terms of how they might change the way we do things.

Without going into too many details, the blockchain exists as a public ledger that records ownership at any given point in time. The ledger is not owned by a single party, but rather is owned and maintained by all users of the system, who contribute their own computer

processing power in order to perform the cryptographic calculations necessary to maintain the ledger and ensure its security.

Perhaps the best way to visualise what this means is to return to the name itself: "blockchain". Each "block" is a new iteration of the public ledger, containing all the information about who owns what and who owes who. Each time a successful cryptographic process is performed, a new block is produced which records all the information at a very slightly later point in time (currently about 10 minutes). Taken together, these blocks form a long sequence (the "chain") in which each block differs very slightly from the last.

The cryptographic calculations which generate new blocks also ensure that each new entry depends in a fairly fundamental way on the one that preceded it, and this helps to guarantee the security of the system because it means that anyone trying to fabricate a block would also have to fabricate copies of all blocks that follow it in the chain. Hence each block actually become more secure over time, as the number of subsequent blocks which depend on it grows. One way of thinking of this is to visualise the system not as a horizontal chain but as a vertical tower, in which new blocks are constantly being added to the top. In this picture it is obvious that removing or replacing an earlier block (i.e. one further down the tower) would be extremely difficult, due to what one might call "the Jenga Principle".

Despite the fact that Bitcoin remains the only real practical implementation of the blockchain so far, there is a lot of interest among developers in finding non-Bitcoin applications for blockchain technology. As the *Economist* points out, "*just as nobody forecast social networks, blogging or Netflix in the 1990s, the absence for now of any tangible applications other than bitcoin for the blockchain merely points to humankind's deficient imagination... All that is needed, blockchain boosters argue, is a "killer app" to find a use for the breakthrough, in the same way that web browsers made the internet useful. Some still think that a currency is the most promising application, but plenty of engineers are throwing other ideas against the wall to see what sticks.*"[4]

It may be, however, that the rise of blockchain technology does not have any single obvious impact. Some commentators have suggested that there will not be any "killer app" for the blockchain in the future, and that its value will only be felt in the large number of less radical

[4] *The Economist* (2015) Blockchain: the Next Big Thing. Or is it? 9th May.

applications to a wide range of areas. This is largely because those areas in which blockchain technology has the greatest potential to bring value have already been explored (many of which, it has to be acknowledged, involve criminal activities), and what is left is a "long tail" of applications where the additional value added by the blockchain is small in each individual case, but significant in total. As one blockchain expert puts it, *"the days of easy gains are over. Now is the time for a much harder, and longer, slog of looking into the real world, and seeing how the technologies that we have built can actually benefit the world. During this stage, we will likely discover that at some point we will hit an inflection point, where most instances of "blockchain for X" will be made not by blockchain enthusiasts looking for something useful to do, coming upon X, and trying to do it, but rather by X enthusiasts who look at blockchains and realize that they are a fairly useful tool for doing some part of X."*[5]

It has been pointed out that the relationship between Bitcoin and the blockchain is in many ways analogous to the early days of the internet, where much of the growth and technological development was driven by the market for pornography, and it was only later that many of the innovations were applied to more mainstream activities. Hence, "*in the same way pornography drove the early development of the Internet, these early adopters of Bitcoin – motivated by the promise of utilizing the nascent technology to satisfy their very specific needs – may end up creating markets and technologies that ultimately lay the foundation for more generalized uses... Of course, it remains to be seen if either Bitcoin or the Blockchain will prove to be durable solutions for anyone other than early adopters. However, if history is any indication — as Bitcoin markets and technologies continue to be developed — the Blockchain will become more understood, and vast numbers of new usages will emerge. In this manner, Bitcoin may truly do for the Blockchain what porn did for the Internet."*[6]

Even if the immediate impact of blockchain technology is not that dramatic, it is clear that there is a great deal of interest in how it could be applied to improve existing systems. A number of high-profile financial services firms, for instance, are exploring ways in which blockchain technology could be used to increase the security and efficiency of online transactions.[7] The Chief Executive of Nasdaq was quoted earlier this year as saying, "*We*

[5] Buterin, V. (2015) Visions, Part 1: The Value of Blockchain Technology, *Ethereum Blog*, 13th April.
[6] Howard, G. (2015a) Bitcoin Is To The Blockchain As Porn Was To The Internet. *Forbes*, 5th August.
[7] E.g. Stafford, P. (2015) Banks and Exchanges turn to Blockchain. *Financial Times*, 30th June; Smart, E. (2015) 9 Banking Superpowers Unite Behind Bitcoin's Blockchain Tech. *CoinTelegraph*, 16th September; and Wild, J., Arnold, M. and Stafford, P.

believe that blockchain technology holds great promise in allowing capital markets to operate more efficiently while simultaneously providing greater transparency and security, all of which are fundamental to the public interest."[8] And a former JP Morgan banker who now runs a blockchain start-up told a conference audience in October 2015 that they, "*should be taking this technology as seriously as you should have been taking the development of the Internet in the early 1990s... It's analogous to email for money.*"[9]

Further evidence of interest in the blockchain came in May 2015, when Richard Branson convened a meeting of technology experts and business leaders earlier this year on his private Caribbean island to "*lay out the framework for a world where the humankind is fully benefiting from the amazing technology behind the blockchain.*"[10] There have also been signs of interest from governments and public sector bodies: the US state of Vermont, for instance, is currently considering whether smart contracts and blockchain technology could be used to enable electronic validation of facts and records.[11]

Taking this idea one step further, people are starting to look at whether blockchain technology could even be used to replace traditional systems and structures of government. The start-up Bitnation,[12] for instance, has developed a model of decentralised governance that can offer citizenship services that would traditionally have been the domain of nation states.[13] Initially this is aimed at helping refugees to deal with the challenges they often face in terms of lacking documents of identification. However, people are already beginning to outline ambitious plans to extend these sorts of ideas to mainstream services.[14] And this may not be as far off as we think: November 2015, for instance, saw the world's first blockchain marriage.[15]

(2015) Technology: Banks seek the key to blockchain. *Financial Times*, 1st November. See also Barclays Corporate Banking, (2015) Blockchain: Understanding the Potential.

[8] Quoted in Popper, N. (2015) Bitcoin Technology Piques Interest on Wall St.", *New York Times*, 28th August.

[9] Blythe Masters of Digital Asset Holdings, quoted in Wild, J., Arnold, M. and Stafford, P. (2015) Technology: Banks seek the key to blockchain. *Financial Times*, 1st November.

[10] http://www.blockchainsummit.io/#vision

[11] Cohen, B. (2015) Vermont Considering Blockchain Tech for State Records, Smart Contracts. *Coin Telegraph*, 5th August.

[12] https://bitnation.co/main/

[13] Allison, I. (2015) Decentralised government project Bitnation offers refugees blockchain IDs and bitcoin debit cards, *International Business Times*, 30th October

[14] Prisco, G. (2015) Estonian Government Partners with Bitnation to Offer Blockchain Notarization Services to e-Residents, *BitCoin Magazine*, 30th November

[15] Woods, T. (2015) This couple got married on the blockchain, *Technical.ly Brooklyn*, 11th November

A lot of the interest in the blockchain revolves around a handful of themes relating to its key features. Broadly these are:

1) **Transparency and openness**: The blockchain ledger is public and can be viewed by any user, so any system based on the blockchain is totally transparent as everyone can see all transactions.

2) **Reducing transaction costs**: The blockchain ledger is owned and maintained by users, with no need for a separate third party, which radically reduces many of the costs associated with transactions.

3) **Increasing trust**: The fact that blockchain technology removes the need for third parties and makes transactions open could have major benefits in terms of improving levels of trust.

4) **Integrating the digital and physical world**: Blockchain technology offers a means of representing almost any asset, be it tangible or intangible, in the digital world in such a way that its ownership status can be uniquely determined at any point in time and it is fully integrated with digital payment mechanisms

We will look in detail at each of these in this report. But we should also bear in mind our central question: what is the relevance for charities and philanthropy? In order to address this question, it is worth distinguishing three different ways in which blockchain technology might impact on the work of charities and their donors, and which can help us to frame our analysis:

1) **New ways to give**: Blockchain technology (and the cryptocurrencies that are based on it) offers new opportunities for donors to give and new ways for charities to raise funds for their existing work.

2) **New ways of addressing social problems**: The blockchain might enable charities to change the way they operate, by offering new ways of achieving their charitable missions based on blockchain technology.

3) **New social issues**: In the longer-term, if blockchain-based technologies become prevalent, this may in fact lead to new needs for charities to address. (The relevant precedent here is the way in which the ubiquity and importance of the internet has made lack of access to it a barrier to social mobility i.e. digital exclusion)

3) Trust

One of the major benefits of the blockchain may be its ability to guarantee higher levels of trust. This is down to two key features. The first is the decentralised nature of the system: as noted earlier, this means that there is no reliance on third parties when it comes to things like financial transactions or the execution of contractual terms. The upshot of this is that we no longer have to trust institutions such as banks or law firms in order to have faith in the system, because the system is owned and maintained by all of its users.

The costs of making transactions will be vastly reduced or even removed, which may bolster levels of trust. Even if one is not cynical enough to believe that existing third parties are actively malign in their intentions, when such a third party is willing to bear responsibility for managing transactions the cost is almost certainly going to be passed on to the user in some form. This may be a direct financial cost, or it may come in the form of loss of privacy when it comes to personal information, an agreement to be advertised to etc. Systems based on the blockchain may well elicit a greater degree of trust, as users would no longer need to question the motives of a range of third parties and try to identify costs that are sometimes carefully hidden.

The US think tank the Brookings Institution has posited a number of scenarios in which the removal of the reliance on third parties could prove highly valuable.[16] They argue that "*while you may not be convinced that exchanging bitcoin is an invaluable service, there are many other examples of value transfer that are critical – and currently very slow and expensive.*" They suggest that exchange of property is an obvious example because "*numerous intermediaries are currently involved in this process, such as a third-party escrow service that works for both parties to ensure a smooth transfer*", and "*this escrow service, like other*

[16] Kausal, M. and Tyle, S. (2015) The Blockchain: What It Is and Why Does It Matter? *Brookings Institution Tech Tank Blog*, 13th Jan.

services built solely on trust and verification, collect fees that would be mitigated by performing the transaction on the Blockchain." Other examples suggested by Brookings include wire transfer fees, third party financial auditing and contract execution.

Those exploring the potential use of blockchain technology in creative industries have also highlighted the importance of reducing transaction costs. Phil Barry, an Oxford MBA student who landed the plum summer job of advising Radiohead's Thom Yorke on the digital launch of his second solo album has been quoted as saying that, "*just standing in the middle, collecting money, waiting a year, sending it on and taking 10 percent won't work anymore.*" Barry argues that, "*if anybody wants to build a new curation or streaming service, a negotiating service or other things that no one has imagined yet they can just build it on top of the blockchain. If it is a good model that benefits the creative community it will succeed, if not, it won't.*"[17]

The other feature of the blockchain which may enhance trust among its users is its level of security. Although some may be concerned that a system which exists entirely online is particularly vulnerable to attack from hackers, this is not necessarily a well-placed fear. For one thing, almost all existing institutions are now reliant on the internet in one way or another, so are theoretically open to attack. And blockchain-based systems in fact have an advantage because they are specifically designed for this context and thus have strong security features built into their very fabric.[18] The cryptographic protocols used to maintain the blockchain are extremely strong and, as pointed out above, the sequential nature of the chain means that transactions actually become more secure over time, as the number of subsequent blocks in the chain grows.

Trust is one of the most precious commodities for charities and not for profit organisations. Many already enjoy reasonably high levels of trust amongst their supporters and the general public; but maintaining and nurturing this trust is an ongoing process which takes time and effort.[19] Any tools that can provide new means of improving trust should therefore be of great interest. The use of blockchain technology could bring enhanced levels of transparency and accountability that would boost trust in a charity's work. Likewise, the availability of

[17] Quoted in Gottfried, G. (2015) How 'the Blockchain' Could Actually Change the Music Industry. *Billboard,* 5th August.
[18] Shin, L. (2014) Could Digital Currency Make Our Money More Secure? *Forbes,* 25th November.
[19] The 2015 edition of Edelmann's annual *Trust Barometer* showed a global decline in levels of trust in NGOs, Business and the Media. Trust in NGOs fell from 66 per cent in 2014 to 63 per cent in 2015.

blockchain-based options for things like financial transactions and contractual arrangements would radically reduce the transaction costs currently associated with the use of third parties, and charities would no longer have to absorb these costs or pass them on to donors. Given the oft-stated desire of many donors to ensure that their money goes directly to "the front line", reducing such costs so that more funding can be spent on the organisation's mission would be a real boon.

One area of the not-for-profit world where trust is a particular issue is in the international aid arena.[20] Many organisations operating in this arena are working in challenging locations such as conflict zones, where infrastructure is often poor or even non-existent and where levels of corruption are extremely high. We highlighted in a previous report the potential for cryptocurrencies to offer a way of circumventing the challenges of dealing with money in these locations, and the same is true of wider applications of blockchain technology. Smart contracts for instance (see below) could offer a significant advantage for charities operating in areas where trustworthy third parties are hard to come by.

4) Smart Contracts

Smart contracts are computer protocols underpinned by blockchain technology. Much like traditional contracts, they represent formalised agreements between two or more parties to provide specified goods or services in return for some form of consideration. But whilst traditional contracts require a third party to hold and manage the contract and execute contractual terms, smart contracts are designed to be independent and self-executing.

The decentralised, distributed nature of the blockchain means that a contract built on its infrastructure does not require a separate third party. And since smart contracts are essentially computer programmes, contractual terms can be translated into logical functions which trigger automatically when set conditions are met. This can include automatic payments via cryptocurrencies such as Bitcoin which are also based on the blockchain.

[20] See, for example, Perez, Y. (2015) Can Bitcoin Make a Difference in the Global Aid Sector?, *CoinDesk*, 9th September.

One potential advantage for charities, as outlined in the previous section, would be the vast reduction in transaction costs for contracts of this kind, which do not require expensive third parties. Another advantage would be the radically enhanced transparency that comes from basing contracts on a public ledger, where payments are open to be viewed by anyone.

Another application for charities could be the development of smart contracts which contain a charitable giving clause. For instance, philanthropically-minded business owners might build clauses into smart contracts which stipulate that a percentage of all payments, or all payments above a certain profit margin, go to charity. This would be similar in many ways to existing businesses that have built a philanthropic commitment into their corporate structure.[21]

A more speculative suggestion would be smart contracts which not only govern the decision to give, but actually govern the decisions about *how* to give. In the example of the philanthropically-minded business given above, the decision to give is triggered by conditions laid down in the smart contract being met, but one assumes that the recipients have been chosen by the company prior to setting up the contract. What if, though, no such decision had been taken, and the recipients of the donations were also decided by computer protocols built into a smart contract? This might involve analysing large amounts of data in order to assess the most pressing areas of need at that moment, identifying the organisations best-placed to deliver maximum impact in that area, and then distributing donations accordingly – all of which could be automated via a smart contract. Obviously this would have profound implications for charities in terms of collection and sharing of data and the measurement and reporting of impact collection. We will consider the idea of smart contracts for philanthropy further in section 6, in the context of the Internet of Things,

[21] Notable in this regard is Salesforce.com, whose "1-1-1 model" of giving advocates that companies should dedicate 1 per cent of profits, 1 per cent of product resources and 1 per cent of staff time to good causes. Other previous examples include The Children's Investment Fund, the hedge fund set up by Sir Christopher Hohn which originally had a commitment to donate to a linked foundation a percentage of all management fees and assets under management once set targets for returns to investors had been hit. Unfortunately, the subsequent high profile divorce between Sir Christopher and his wife Jamie Cooper-Hohn (who ran the foundation) has meant that this commitment has been revoked (although the hedge fund in fact continues to make large discretionary grants to the foundation).

5) Coin colouring and Digital Assets

One idea that bridges the divide between cryptocurrency and wider blockchain applications is the notion of "coloured coins".[22] These are units of cryptocurrency of negligible value (sometimes called "Bitcoin dust") which are given additional properties that mark them out for easy identification (so-called "colouring") and are then used as tokens to represent assets in digital form. This is a bit like a technologically-advanced version of taking penny coins and dipping them in paint so that they can be used as time tokens in something like a babysitting circle. This is a significant development, as it transforms the existing Bitcoin blockchain system from one that deals only with cash into one that can deal with all different kinds of assets.

Initially, coloured coins are most likely to be used to represent other quasi-financial assets such as shares or bonds, but the same technique could be applied to almost any asset. Some of these might be other intangible assets that lend themselves to the digital environment: there is interest in the music industry, for instance, in the possibility of using blockchain technology (possibly via coin colouring) to enable more effective attribution of intellectual property (IP).[23] An article in *Forbes* outlined one version of how this might work, explaining that, "*the original creator would not only be on record as the creator, but – utilizing smart contracts – also determine how/if/when/and at what price their works could be used by others, and be compensated – financially or via attribution – when such use took place.*"[24] The benefit of doing this via a platform that also supports cryptocurrencies is that it would make the large-scale distribution of micro-payments based on intellectual property rights possible, and thus might overcome thus overcome some of the challenges that have arisen from things like the growth in streaming music services.[25]

Coloured coins could also be used to represent physical assets, or part interests in them. For instance, time in a rental property or office space could be represented using coloured coins and then bought, sold and traded on the blockchain using cryptocurrencies to make payments. And, as we shall see in the next section, this can be taken one step further. If

[22] Bradbury, D. (2013) Colored Coins Paint Sophisticated Future for Bitcoin. *CoinDesk*, 14th June.
[23] Gottfried, G. (2015) How 'the Blockchain' Could Actually Change the Music Industry. *Billboard*, 5th August.
[24] Howard, G. (2015b) Blockchain Technology Is Our Chance To Rebuild The Internet In A Way That Benefits Creators. *Forbes*, 12th August.
[25] For more on this topic see: ReThink Music. (2015) *Fair Music: Transparency and Payment Flows in the Music Industry*.

objects are part of an "Internet of Things" which is underpinned by the blockchain, then we need not even involve human owners: those objects could instead start to interact with us and with each other in order to buy, sell or lease themselves.

Returning to our constant refrain: what does this mean for charities? Well, for one thing it opens up a whole new class of assets that can be donated. People would be able to give intangible assets such as IP, on the basis that the blockchain provides a way of uniquely recording ownership and thus makes a transfer of ownership via a donation meaningful. One might also be able to further divide coloured coins, so that partial shares of assets could be donated. In the case of IP, this would mean that a musician could donate a fraction of the IP for one of their songs to a charity, which could then benefit from a corresponding fraction of future royalty payments.

6) *The Internet of Things and the End of Ownership?*

So far, we have considered the way in which coloured coins could be used to represent assets digitally within the blockchain and smart contracts could be used to govern their behaviour. But what if we took this one step further, and assumed that objects in the physical world were internet-enabled and could thus interact directly with the blockchain?

The concept of the "Internet of Things"[26] (or "internet of everything") has been around for some time. The basic idea is that internet technology is used to create a vast network of "smart" machines and appliances, which are able to interact directly with us and with each other. This might range from smart metering systems, of the sort many of us already have in our homes, or smart appliances, such as fridges that are able to notify users when items need replacing, right up to entire smart cities in which services such as rubbish collection, traffic management and public transport are delivered by networks of internet-enabled appliances and vehicles.[27]

[26] Kobie, N. (2015) What is the Internet of Things? *The Guardian*, 6th May.
[27] The U.S. government announced in September 2015 that it would be investing $160 million in a new "Smart Cities Initiative", designed in part to "*create test beds for "Internet of Things" applications*" in cities around the country.

The internet of things is already with us in a small-scale and patchy way: there are numerous examples of initiatives which are harnessing the power of smart objects to improve services and products.[28] However, these all currently rely on the existing infrastructure of the internet, which means that there are inevitably gaps. The blockchain could potentially bridge these gaps and make a truly universal Internet of Things a reality. It provides a mechanism that would allow physical objects to connect seamlessly to one another and to users in a digital space, and which also links to infrastructure for payment and other transactions. Furthermore, as an IBM report explains, the potential ability of the blockchain to overcome issues with trust could be crucial, because "*the greatest challenge... is not in simply building a decentralized Internet of Things (IoT), but one that can scale universally while maintaining private, secure and trustless transactions. In other words, the IoT represents a case of billions of players, not all of which can be trusted – some even malicious – with a need for some form of validation and consensus. And for this, the "blockchain" offers a very elegant solution.*"[29]

What does a full-blown Internet of Things based on blockchain technology actually mean in practice? Well, in some ways the implications are hard to get your head around (and this is where things begin to sound like science fiction), because they are so broad-ranging and potentially transformative.[30] At the simplest level, in our previous example of the smart fridge, it would mean that not only would the fridge be able to notify users when items need replacing, but it might actually be able to order replacements itself and thus be "self-stocking".[31] Similarly, a smart washing machine or dishwasher would be able to analyse its own performance and identify when it required servicing or replacement parts and order them itself, with no requirement for the user to get involved.[32] At the more complex end, a smart city could become an autonomous system in which the appliances and objects that make up the system constantly adapted to the changing needs of citizens without the necessity for human administrators.

[28] For examples, see http://mashable.com/category/smart-appliance/
[29] IBM Institute for Business Value. (2015) *Device Democracy: Saving the future of the Internet of Things*.
[30] Burrus, D. (2014) The Internet of Things is far bigger than anyone realizes. *wired.com*, November.
[31] Poole, J. (2014) Why the 'Internet of Things' will be run on the blockchain. *James C Poole Blog*, 13th December.
[32] For more on the idea of smart objects as autonomous economic agents within the Internet of Things, see Brown, R. (2013) On the Blockchain, Nobody Knows You're a Fridge. *Richard Gendal Brown Blog*, 23 October.

In the Internet of Things, spare capacity becomes a highly valuable commodity. Smart objects might be able to manage their own usage and thus minimise redundancy by ensuring that they match supply with demand as effectively as possible. As IBM explains, "*by identifying and matching supply and demand for physical assets and services in real-time, the IoT will create new marketplaces. These complex, real-time digital marketplaces will build upon the foundation established by mobile devices and social networks to expand the reach of this transformation very quickly. They will enable new peer-to-peer economic models and foster sharing economies. Devices will be able to compete in real-time, be reviewed and recommended by consensus, and trade on their own, resulting in highly efficient digital marketplaces.*"[33]

Partly this is about spare processing capacity, as this is required in order to perform the cryptographic calculations required to maintain the blockchain itself. In the current Bitcoin system (which remains the primary example of blockchain technology to date), users offer up their own processing capacity in return for new coins through a process known as "mining". A similar approach might be taken in the internet of things, but this time spare processing capacity within smart objects could be identified by the objects themselves and offered up for the maintenance of the blockchain. This might eventually be done with no expectation of reward, as everyone comes to realise the collective shared interest in maintaining the system, but in the short term it is more likely to stick to the current model in which those offering processing power are remunerated.

This could lead to a situation in which smart objects are able to make money by selling their own spare processing capacity. As an *Economist* article noted, "*The next step is for robots to go into business for themselves, for example a computer server renting out processing capacity, and using the profits to upgrade itself.*"[34] The premium on processing capacity, and the rapidly decreasing cost of computer processing hardware, may even mean that smart technology is embedded in extremely mundane items, simply as a way of creating additional mining power. For example, earlier this year developers showcased a prototype "smart light bulb", which can mine for bitcoins whilst illuminating a room.[35] One can speculate that a smart building with many such appliances would be a potent source of processing capacity.

[33] IBM Institute for Business Value. (2015) *Device Democracy: Saving the future of the Internet of Things*.
[34] *The Economist,* (2015 Blockchain: the Next Big Thing. Or is it? 9th May.
[35] Rizzo, P. (2015) BitFury to Release Light Bulbs that Mine Bitcoin in 2015. *CoinDesk*, 2nd June.

Spare physical capacity is also likely to be a valuable and tradeable commodity within the internet of things. For example, a network of smart office buildings could be constructed, offering flexible workspace and hot-desking facilities that were managed by the buildings themselves, which could communicate and allocate resources accordingly. One consequence of this might be the eventual slow death of ownership: a senior internet analyst at Goldman Sachs has argued that, "*it's hard to see a world where that blockchain technology doesn't end up changing the way we think about asset ownership.*"[36]

Currently ownership of physical property is defined simply by keeping those physical objects in a particular place, and backed up by a system of proofs of purchase. There is a huge amount of redundancy in this system, as many objects that we own sit idle for long periods of time until we have need of them. In a world where we have an internet of things underpinned by the blockchain, however, it is possible for users to define their relationship with objects via blockchain contracts which need not be permanent. For instance, you could "own" a car simply when you were in proximity with it, and your usage of it and the cost associated would be linked to your identity on the blockchain (and hence, to your cryptocurrency wallet) for the duration of your "ownership". An article on *wired.com* outlines a version of this scenario, explaining that, "*the physical car is connected to the internet and can read the Block Chain. Therefore it can keep track of the status of the digital asset representing it. As the digital asset is transferred from one address to another, the physical car can see this status update in the Block Chain and take necessary actions, i.e. change its owner.*"[37]

This would represent a radical expansion of the idea of the "sharing economy" that we already see in car-sharing services like ZipCar, in new methods of public transport like Uber and in property-sharing initiatives like AirBnB. The blockchain would make such sharing far more streamlined, and thus potentially overcome the inertia of those who currently cling to traditional ideas of ownership.[38]

So, for the final time we raise our central question: what does all this mean for philanthropy and charities? There are a number of fascinating possibilities:

[36] Quoted in Popper, N. (2015) Bitcoin Technology Piques Interest on Wall St. *New York Times*, 28th August.
[37] Bheemaiah, K. (2015) Blockchain 2.0: The Renaissance of Money. *wired.com*, January.
[38] We are already beginning to see this idea turned into a reality by start-ups like Slock.it, which has recently been launched to enable device sharing using blockchain technology

1) Death of the Charity Shop: If the growth of a blockchain-enabled internet of things really does mean a fundamental change to our notion of ownership there will be far fewer unwanted assets in the future, and therefore fewer things to donate. However, as we have alluded to above, this may be counteracted by entirely new forms of giving spare capacity in "shared" objects.

2) New Solutions to Old Problems? Donations of spare physical capacity, managed by smart objects themselves, could provide new ways of addressing major social problems. For example, smart buildings could be used to create new systems for effectively identifying and allocating unused accommodation, and could thus be used to help address the challenge of rough sleeping.

3) Your Toaster: the Donor of the Future? As outlined above, spare capacity will be a valuable commodity in the internet of things, and it is possible that smart objects will be able to generate their own income by selling spare processing or physical capacity. Assuming that what is done with this money is governed by smart contracts, could a philanthropic element be built into them? i.e. Functions within the computer protocols making up the contract might specify that a certain portion is given away to good causes. Hence smart buildings and appliances might effectively become significant sources of charitable money, albeit governed by smart contracts imposed by human users.

4) Do Androids Give to Electric Donkey Sanctuaries?[39] We can take the situation outlined above one step further by assuming that not only is the decision about whether to give governed by a smart contract but that the decision about *what to give to* is also dependent on a smart contract. In many ways this would make sense, as in a highly connected system populated by smart objects and artificial intelligences, it would seem peculiarly luddite to incorporate a charitable element but to base that solely on one-off stipulations to given to particular organisations. Rather, would the decision about where to give not also become something governed by a smart contract? The ability to process vast sources of quantitative information might enable data-led algorithms and decision procedures which mean that smart objects

[39] With thanks (and profound apologies) to the memory of Philip K. Dick.

themselves can "decide" where to give money. And once emotion is stripped from the system, it would surely place a far higher emphasis on notions of "rational" giving and the ability to measure outcomes and impact etc. Does an idea like Effective Altruism[40] (which critics might argue could be caricatured as philanthropy for robots anyway) thus come into its own?

This scenario, were it to come true, would present huge challenges for charities. These might be analogous to the challenges currently facing the financial sector, where automated trading by AIs using "black-box" algorithms has become so complex and so prevalent, and takes place at such a speed, that humans are no longer able to understand what is actually going on and thus markets are sometimes subject to inexplicable and potentially damaging AI trading behaviour.[41] Could the same happen in a world where there was widespread use of "philanthropic smart contracts"? i.e. would we no longer be able to understand and control the flow of philanthropic capital governed by increasingly complex algorithms and computer protocols?

7) Conclusion

It is probably fair to say that the ideas in this paper are 'forward-looking', and largely for discussion at this point. Some may even feel that they stray perilously close to the realms of science fiction at times. However, although we have extrapolated quite far in order to try and think through the consequences, most of the technologies mentioned in this paper already exist. Whilst very few charities or donors may at this stage even be aware of the blockchain, it seems almost certain that the technology is, in one form or another, going to play an increasingly important role in the years to come. Those who want to prosper in this new environment would thus do well to think through the implications now.

So what are these implications? Once again, we don't pretend to have all the answers, but the ideas explored in this paper point to a number of key things that charities and donors should bear in mind when planning for the future:

[40] http://www.effectivealtruism.org/about-ea
[41] See, for example, Baumann, N. (2013) Too Fast to Fail: How High-Speed Trading Fuels Wall Street Disasters. *Mother Jones*, Jan/Feb.

1) Radical transparency:

The public nature of the blockchain has significant implications for openness and transparency in any system based on it. As we highlighted in our previous report on cryptocurrency and philanthropy, this may open the financial dealings of charities and philanthropists up to unprecedented levels of scrutiny. This may offer benefits in terms of increasing levels of trust, but it will also present real challenges.

2) Low or Zero Transaction Costs:

By removing the need for third parties to manage transactions and record-keeping, the blockchain can massively reduce or even remove transaction costs. This may be a compelling reason for charities to consider ways in which they can harness blockchain technology, as it could potentially boost their financial efficiency, thus saving large amounts of money and enhancing trust and confidence amongst donors and supporters.

3) New types of assets:

Blockchain technology will open up the possibility of transactions in all sorts of assets where this was previously impossible of impractical. This includes donations. Whilst charities may struggle with the challenges of early adoption, there are potentially huge advantages to finding ways to harness this new technology and accept donations of digital assets.

4) Sharing Replaces Ownership:

The "sharing economy" is already a widespread idea, but the use of blockchain technology could lead to an exponential growth in this area by making the attribution and transfer of ownership fast, cheap and easy. This may have an impact on traditional donations, particularly those of non-cash assets, if sharing rather than ownership becomes the norm, as the concept of "unwanted goods" owned by an individual will become redundant. However, it may also open up new avenues for philanthropic action, as unused capacity replaces outright ownership as the relevant transferable commodity.

5) Smart Contracts with Philanthropy Clauses:

The development of smart contracts holds huge potential for philanthropy. At the most basic level, it would be possible to include clauses in smart contracts which stipulate that donations are made if certain trigger conditions are met. For example, a company might set up smart contracts which specify that a percentage of profits above a certain threshold go to charity, or a smart electricity meter might be configured so that a percentage of any financial savings made through energy saving measures are given to charity. There is an obvious opportunity for charities to promote this as a way of giving, and to partner with companies that could enable such contracts.

6) Philanthropic Smart Contracts:

In the future, smart contracts could also be used to govern the distribution of philanthropic money. This would rely on the analysis of large amounts of data about needs, and assessments about the effectiveness of interventions based on measurable impact, which would then be used to determine the "best" donations that could be made at a given time. This obviously represents a hyper-rational version of philanthropy in which the element of emotional connection is absent, and thus may be an unappealing prospect for many donors. However, in a world with a full-blown Internet of Things, philanthropic smart contracts may come into their own as a way of enabling smart objects to act philanthropically without the need for constant human involvement.

If you have any thoughts or feedback on this discussion paper, or would like more information, please contact the author:

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