An Introduction to Blockchain

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1. Introduction

Compared to digital natives, those old enough to recall how society functioned before personal computers arrived are all the more aware that a technological revolution has begun and is not slowing down. We have moved from fax machines, e-mail, and dial-up Internet to an explosion of social media services（SMS）that are transforming our world in ways too vast for the average person to adequately comprehend. This revolution has mainly involved the fields of communication, content creation and sharing, and commerce, and the digital environment users operate within has, for the most part, been centralized. Big corporations, institutions and government agencies are essentially at the helm, while users either acquiesce to dictates or opt out of a service. Recently, however, a new technology growing out of the open-source tradition has emerged that promises to help *de*-centralize the Internet and is in fact triggering a paradigm shift. Blockchain is poised to take us to stage two of the Information Technology（IT）Revolution that began in the previous century.

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The present centralized monetary system relies on government-issued fiat currency to act as the medium of value exchange. In other words, to engage in any kind of online transaction that involves a purchase or sale, "money" (i.e. dollars, yen, euros, yuan) is needed, and third-parties such as banks and credit card companies, have been necessary to ensure funds switch hands precisely and legally. Although these intermediaries are well known for their propensity to charge huge fees for their services, this process is much smoother than it was prior to the digital age where, for example, physical gold or silver was often shipped across land or sea to fulfill one side of a bargain. With advancements in the aforementioned technological revolution, we are, however, about to enter a world where the virtually instantaneous transfer of digital currencies utilizing blockchain, will replace these third parties.

The driving force of this blockchain revolution, or as some have put it, *The Internet 2.0,* therefore, lies in its potential to implement an incredibly efficient means of value transfer via the flow of decentralized digital funds. However, blockchain is not just about money. In one sense, this commercial function forms the backbone of blockchain, although in another, it is really just the tip of the iceberg. New applications in virtually any imaginable domain are employing blockchain and being developed at an amazing rate. This paper will explain what blockchain is, outline some of the key domains alluded to above, and then briefly present some of the ways it is likely to impact the field of education.

2. Blockchain Explained

The blockchain phenomenon arose in conjunction with Bitcoin, so it is

helpful to bring both into the discussion. A whitepaper was posted on the Internet a decade ago to explain the principle theory and mechanism by which Bitcoin operates（Nakamoto, 2008）. It is assumed that the document was penned by a team of experts who conceived of and developed the idea. An interesting caveat behind Bitcoin though, is that no one took credit for developing it. Only one person – a pseudonymous figure named *Satoshi Nakamoto* was named on the whitepaper. The software was designed in such a way that Bitcoins can be brought into existence and owned by individuals who configure computers with the blockchain network to solve complex mathematical problems. This process of birthing Bitcoins, called "mining," is the incentive used to keep the Bitcoin blockchain active as explained in the original whitepaper（Ibid, 2008）. Just as gold miners must work hard purchasing equipment, going into the hills and digging tunnels to tap into veins where precious metals are located, the mining of Bitcoin is only possible by managing computing systems specifically designed for the task, which requires the expenditure of time, money, and effort.

The entire process of mining Bitcoins and then using them in transactions with other parties is all recorded on the blockchain. Unlike records kept by corporate financial institutions, with Bitcoin there is no final authority that might unscrupulously add, delete, or adjust figures. It is thus 'decentralized,' which means the blockchain is a distributed ledger which every Bitcoin miner and owner downloads and can access from his or her own computer. Therefore, if an individual should try to edit the ledger, millions of others will immediately and automatically prevent it from happening. It is, in fact, impossible for any party to re-write what is on the blockchain. Everyone owns it and no one owns it.

Added to this formula is the algorithm of scarcity. According to how the Bitcoin creation protocol has been programmed, there will eventually be 21 million Bitcoins on earth and not one more. Every four years the Bitcoin mining reward gets cut in half. This partially explains why the value of Bitcoin continues to rise over time. At present (mid 2018), just over 17 million Bitcoins are in circulation. The remaining 4 million will not be completely mined until approximately the year 2140 (Redman, 2018).

The brilliance of the Bitcoin idea was recognized by computer programming and economics experts worldwide and in time new ventures began to appear which rely on the same model, wherein distributed ledger systems utilizing blockchain are used. These all fall under the category of "cryptocurrencies" – relatively synonymous with other terms such as: "cryptos," "altcoins," and "tokens." Thousands are presently in circulation and the number continues to grow on a daily basis. The cryptocurrency with the second highest market capital (roughly half that of Bitcoin) is "Ethereum." Ethereum fulfills a different purpose than Bitcoin; although it is also able to be used as a store of value and medium of exchange, it has gained prominence due to its functionality as a platform by which two parties may smoothly engage in "smart contracts" (Tapscott & Tapscott, 2016, p. 87). The Ethereum platform is sometimes referred to as the "Ethereum network" since more and more altcoins utilize its blockchain to run their own applications. After Ethereum, far too many cryptocurrencies to mention are listed on the 'go to' site for investors and market analysts alike, which is: coinmarketcap.com. Decentralized applications (DApps) of all kinds are being developed today at a feverish pitch. The ones that promise to fulfill a unique and/or vital function gradually rise to the top of the market

capital index, with the order changing constantly. It is indeed possible that a cryptocurrency not yet created may garner the highest market share in ten years' time, similar to the way Amazon, for example, moved in and found a niche on the Internet years after the dotcom phenomenon was in its heyday. All this is to say that at present we are in the very early stages of the adoption of blockchain applications; there is much anticipation about what the future might hold.

In summary, the IT Revolution Part II, which is driven by the distributed ledger technology offered by blockchain, involves much more than digital money（Bitcoin）. The old adage "the sky's the limit" would seem to apply here. The sections that follow explain how blockchain technology may one day impact our lives in a variety of spheres, which include legal contracts, healthcare, SMS, distribution/shipping, and education.

3. Blockchain Spheres of Influence

3.1 The Speed of Change

Thus far only two cryptocurrencies have been mentioned – Bitcoin and Ethereum, and it would be prudent not to name any more. The reason is simple. The entire crypto market is still speculative in nature and thus in a state of flux. For example, the price of one Bitcoin has risen by more than 10 times from the beginning of 2017 until the end of the same year, during which time most of the top twenty cryptos have been supplanted by new ones, some of which have increased in value by well over 100 times. Even

the most knowledgeable economic gurus can never accurately predict where just one year of crypto trading will take us. Books on blockchain that hit the press earlier than 2017, even for semi-knowledgeable followers of the technology, will quickly show their age if 'cutting-edge' cryptos from that era are discussed. The reality is some may stay with us and others might gradually lose their appeal. Whatever comes about, the cryptos in existence today or the cryptos of tomorrow will inevitably utilize blockchain to meet the broad spectrum of societal needs, whether on national, regional, or global planes.

3.2 Commerce

From major corporate business transactions to everyday purchases of candy bars, cryptocurrencies like Bitcoin are poised to replace the present monetary system that relies on centralized banking to oversee the entire process of acquiring goods and services. In the near future, wallet-apps on Smartphones, capable of instantly transferring digital funds between buyer and seller by scanning QR codes, will be commonplace.

For some, a world in which every single purchase is made with a Smartphone might feel too far-fetched. At present, technical glitches still abound; we have all probably been in a situation where just when the need for a perfectly functioning device is the greatest, a battery dies, software fails to load, wifi does not connect, and a password is inexplicably forgotten. In various situations, cash continues to be handy, reliable and anonymous, and will probably not go away quickly (Eveleth, 2015). Although it may be difficult to envision physical cash disappearing, at the same time, the functionality and convenience of cryptocurrencies in a rapidly advancing

modern world could achieve a state of such prominence that ample solutions to any and every problem would inevitably be found, born out of necessity. Digital blockchain currencies must overcome hurdles along the road in order to attain mass adoption but since the pros appear to outweigh the cons by a huge margin, it is safe to say that answers will come in time.

3.3 Legal Contracts

Smart contracts, which Ethereum has become popular for making practically available, were actually imagined in the pre-blockchain world – as early as 1994（Tapscott & Tapscott, 2016）. The thinking at that time was that computer programs could be relied upon to execute contracts by removing the variable of human error. We are still in the early stages of smart contract software development and forward-thinking legal professionals are in a position to begin putting every imaginable legal contract on the blockchain. As Tapscott and Tapscott remark: "Expertise in smart contracts could be a big opportunity for law firms that want to lead innovation in contract law"（2016, p. 103）. Properly designed smart contract software has the potential to assure clients of confidentiality, security, and the guarantee of agreements being fully legally binding. The present reality, however, is that firms receive huge sums for intermediation processes （paperwork）that well designed blockchain DApps would greatly eliminate. If indeed the blockchain revolution will not slow down, it is perfectly logical to assume that sowing reticence at this juncture will reap misfortune in years to come; another enterprising party will undoubtedly jump at the opportunity of engaging in the new field of smart contract development that anti-blockchain law firms refuse to take seriously. Opposing blockchain

would very likely be a losing battle in the business of law.

3.4 Social Media Services (SMS)

A current complaint about social media by users is the preponderance of unsolicited ads and commercials that clutter up web pages. Other issues of contention that arise due to these centralized systems include censorship and revenue generation. Huge SMS corporations can decide on a whim when and where they choose to censor material, and when revenue depends on factors related to visitor access rates, protests about 'number doctoring' are often voiced. It is not possible to confirm the veracity of data if a top-down, centralized authority opts to offer nothing more than just their 'good word.' Blockchain enters the equation again as a complete game changer. Depending on the software programs that have been developed or will be developed, ads can either be completely removed, or finely tuned by users. Censorship matters are addressed primarily by the community of users who have power to sort through content and make decisions in this regard. Although inadequately designed decentralized SMS rating systems can result in users suffering terrible abuse if snowball effect scenarios are allowed to occur (Alan & Domingue, 2017), the open competition to produce the best system there is, drives developers to most seriously deal with these and other issues.

A number of blockchain-based SMS options are currently in operation and more continue to join the space. These startups generally embrace the fact that blockchain, by definition, absolutely guarantees all numerical data are real. Tokens are naturally used to reward users who produce good content and/or evaluate content accurately. Unlike fiat currencies, the

tokens used on creditable SMS blockchain networks *do* fluctuate in value a great deal. However, also unlike fiat currencies, the value of the tokens does not decrease; instead, it greatly increases on average over the period of one year. Current leaders in the SMS industry can easily become yesterday's flavor if the blockchain factor is not given consideration and no evolution in thinking occurs.

3.5 Distribution / Shipping

Blockchain removes paperwork. This is a simple way to look at the effect it could have on many spheres of life. With regard to distribution and shipping, the impact blockchain will have is again, revolutionary. When every item shipped is time-stamped on the blockchain, questions of sending and receiving are eliminated. Such transactions are known as "trustless," which is not a negative term. It means trust in the person sending/receiving is no longer required since the blockchain record makes it a done deal.

Another term often used within blockchain discussions is the "Internet of Things" (IoT), which involves the idea of attaching coded identifiers to inanimate objects. The projected scenario for a future of seamless transportation that incorporates blockchain is one in which any good or commodity has a digitally attached IoT code that is immediately verifiable at checkpoints along the route. Ultimately the future of transport/shipping will include driverless vehicles, programmed to deliver parcels to their intended locations. Any item that lacks an IoT code is noticed and removed, while IoT-coded packages will be meticulously tracked by an exhaustive list of failsafe measures.

3.6 Healthcare

More and more DApps related to the healthcare industry are being introduced and tested. The notion of having medical records permanently stamped on the blockchain may be unnerving to some individuals if not for the fact that privacy features can easily be built into blockchain software. This means healthcare users would be able to select what records on their profile would be accessible to medical institutions, and which ones would be kept confidential. With blockchain, the focus shifts from a central authority making all the rules to the patient having full authority to protect his/her privacy.

Needless to say, with healthcare, similar to that of transportation and other spheres of business and industry in society, all assets, records, inventory and commercial records would naturally be digitized and added to the blockchain, which would ensure smooth operations and an overall better customer service. Both medical institutions and their patrons would therefore benefit greatly from blockchain.

4. Blockchain in Education

4.1 Overview

As educators, the promise of blockchain bringing about tremendous change in our field is real, as the number of applications continues to increase. At present there is still only a minute amount of blockchain adoption, but within the space of a decade, we should expect to see a variety of innovative applications according to Clark's analysis (2016). These could be said to fall under the two major categories explained below.

4.2 Institutional Record-keeping

Every piece of data institutions gather on teachers, staff, and students could easily be added to a decentralized education blockchain DApp. As noted above, personal settings for the release of various fields of data would be up to each individual. To begin with, teachers in the process of changing jobs would be able to submit a resume that is "blockchain-verified." In other words, transcripts, degrees, and qualifications properly tagged by accredited participating institutions would not be questioned by hiring bodies（Matthews, 2017）. At present, without blockchain, an online c.v. could be padded with various unconfirmed items that might slip through during the application and hiring process. Sony corporation has taken notice of these and other issues, announcing in August 2017 its plans to develop blockchain technology for digitizing educational records（Russell, 2017）. Although non-teaching staff may profit somewhat from such blockchain software, it is envisaged to be much more advantageous for students by maintaining true records of all their grades and scholastic achievements – to be used primarily when searching for jobs or seeking admission to graduate school programs. The common chore of ordering and having official transcripts signed, sealed, and sent in when applying for entrance to higher education programs will one day be a thing of the past.

4.3 Autonomous Frameworks for Self-learning and Assessment

Blockchain is in essence, all about record-keeping; it is, after all a distributed ledger system. Since it is primarily related to maintaining permanent facts and figures, there are obviously limitations as to its effectiveness in the subjective realm of classroom education. However,

one method by which blockchain is being implemented in a more practical sense is through Massive Open Online Courses (MOOCs). Such course objectives and materials may be set up by just one or a number of partnering institutions, with students opting to join courses that are appealing to them. Blockchain can be used from start to finish, recording all pertinent information about students who enroll. The key purpose, from the perspective of students, is to finally receive an official record on the blockchain to confirm their completion of the course. Research conducted by the European Commission on blockchain in education (Grech & Camilleri, 2017), reveals that MOOCs have become a hot area of study, particularly with regard to the goal of implementing a means by which courses might one day be fully accredited. This would only be possible if blockchain technology could assure institutions that individuals have indeed completed all requirements satisfactorily (Ibid, 2017). Professor John Domingue, of the Open University in the UK, claims, in an interview by Matthews (2017), that ultimately the traditional concept of the university will begin to fade away due to the influence of blockchain and online courses such as MOOCs. Competition will also drive costs down as the number of MOOCs that are readily available to the masses grows. Once trust can be appropriated in such a system, the future of education, according to Domingue, will be one in which universities begin to merge into one (Ibid, 2017).

5. Conclusion

The blockchain revolution started with the whitepaper by Satoshi Nakamoto in 2008; it is real, but has yet to achieve critical mass. Most people cannot sense it, but it will affect every aspect of our lives in time if current

trends are allowed to proceed unhindered. Educators too will eventually see blockchain technology moving into the classroom, just as the Internet was introduced in the 1990s, and as we now automatically assume, will never retreat. Blockchain promises to improve education in the area of permanent, trustless record-keeping, and by providing students anywhere with the opportunity to study online, developing skills and knowledge through the completion of MOOCs.

　　This paper has provided a brief and simple overview of the revolutionary, new technology known as blockchain. It is expected to play an incredibly advantageous role in all aspects of society including education. Future challenges, dilemmas and obstacles will inevitably come as theory becomes fused with practice little by little, from one stage of development to the next.

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