Blockchain Applications

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It may seem obvious in 2023 that blockchain technology has a large amount of applications, but it wasn't until about 2014 that blockchain technology started to see mainstream attention with Vitalik Buterin's Ethereum framework. By 2017, the Hyperledger Fabric was up and running and enterprises were beginning to explore just how far ranging applications could reach for blockchain technology. This paper will assess how the fundamental aspects of voting, lotteries, certificate issuance, security auditing, and enterprise. While these applications may seem disparate and separate, they all can come together for a greater application. Voting is a novel use-case for blockchain, but such a radically new way of voting should not be approached without a serious understanding of what we as a society would be getting ourselves into, especially for political elections. Lotteries have the potential to be unregulated and susceptible to fraud, but not only can blockchains generally make the space more transparent, secure, and transglobal for a larger prize pool, we can also use the underlying concepts of the lottery to help bolster public school cohesion, especially in the inner-city. Certificate issuance on blockchains can be about more than just giving out diploma or achievements, as the certificates can simply signify that a digital transaction has value of some kind (i.e. it is authentic and useful for some greater transaction pool to measure an exposure or provide some extra context). Security auditing is not a new practice and it is only going to be become more important as new kinds of security problems come from a radically new server concept compared to the client-server model. Blockchain can enable news kinds of security audits to begin with, though, but since blockchain servers share so many assets, one auditing practice, such as a 51% or Sybil attack audit, should work for the entire network. The sheer number of new security audits that

blockchains could enable, such as environmental security auditing, should negate any worries one has about the new security audits the system requires. Enterprises in general will find benefit from blockchain technology through generally increasing positive cooperative efficacy.

Blockchain and Voting: Should We Really Be "Throwing The Baby Out With the Bathwater"?:

Park et al. (2020) take a pretty critical stance on thinking blockchain-based voting systems will be able to completely replace voting machines for political elections. The internet has been around for quite some time and various countries around the world, such as Belgium, Switzerland, and Estonia, have experimented with the concept of voting online with and without blockchains already. Even without blockchains, countries like Switzerland found no greater voter turnout. Estonia, which has experimented with blockchain-based elections, have only noticed a small percentage of affluent members of the population experimented with the concept to begin with - nothing enough to actually make an impact. Unfortunately, blockchain technology just isn't mature enough to be used for massive, public elections, since the security practices are potentially only good enough for financial applications. Fraud is actually allowed to some extent in the financial world and there are parties like the government or insurance companies that will actually help protect clients during a time of need.

Lottery Mechanisms - Leveraging the Benefits and Security of Blockchain for Better Public School Cohesion

Cryptocurrencies like Monero have shown that it is possible to provide a great deal of security to transactions in a blockchain through the use of elliptic curve cryptography as an underlying encryption mechanism**.** Caldarola et al. (2022) show that confidentially can be

achieved while providing security for a peer-to-peer lottery system. Their proposed novel consensus mechanism is similar to Delegated Proof-of-Stake, but they call it the Neutral Fairness Protocol, which has a unique structure to determine which nodes have the right to validate transactions. This makes it difficult to perform a 51% attack, since not all nodes are involved with consensus. The same nodes are not always involved with forming the consensus committee, which could help with network fairness. They go into quite a bit of detail about how a lottery mechanism might work in such a system and there is the potential for a scalable, secure, and decentralized lottery system. A conflict graph with neural networks helps deal with the issues present within unreliable networks.

While lotteries can normally be thought of as simply for gambling or winning a prize pool, in the United States, the lottery system is similarly applied to its school system, especially when children are given the option to attend a charter school (Gilmore, 2023). Charter schools are particularly common in the inner-city and since they operate with public funds while also not having to report much to the public (i.e. less accountability), they can be seen through a critical lens. While public schools are far from perfect, if public resources are being given to the inner-city, students who are unable to attend a school of their choice or are left with the under-funded public school offering could be left to fend for themselves. Also, Deming et al. (2014) have found that charter schools generally don't even help prepare students enough for college or the world beyond. Their cost may not actually be worth it in terms of helping inner-city people of color or other under-funded jurisdictions from having a healthy, public education system. Ashlagi & Shi (2014) try to fix the problem of community cohesion presented by the lottery system by implementing a correlated-lottery system. If such a lottery system as described by

these MIT researchers were to be implemented in a blockchain system, similar to Caldarola et al.'s idea, the lottery system for school choice could cease to be centralized and opaque, and benefits like cohesion could be achieved within neighborhoods.

The observant reader may have noticed that the lottery system within the united States makes use of votes. We can see an application here, now, where voting can be implemented in a lower-stakes setting than a political election. If someone were to test the waters of blockchain-based voting through a correlated-lottery education management application, it could bring together a number of concepts to more radically reform the education system within the United States, while also testing the waters for more powerful use-cases in the future. The education system is a great place for companies to try and test the waters for blockchain, since the risks for failing might not be all that high like for financial applications or political elections.

Certificate Authorities and Trust

Capece et al. (2020) discuss the literal concept of digital certificates, as in actual university certificate on the blockchain. The general concept of the certificate authority on the blockchain actually simply means the usage of a digital signature to validate a digital transaction as having some kind of value. The digital diploma really exemplifies this idea, since a blockchain-based university certificate easily showcases the benefits of an easily verifiable, tamper-proof, permanent, convenient, secure, and legitimate digital asset. As many graduates from universities in the United States may know, there is a centralized provider for most college diplomas in the United States. Many schools, like my own alma mater the University of Michigan, require their students to communicate with the the third-party company Michal Sutter in order to receive their diplomas. Capece et al. try to bring the concept of certificate issuance

back to the schools while also reducing the likelihood of corruption and fraud through blockchain databases. Having a school act as a certificate authority in a network of notaries is a novel concept and could help bring greater autonomy to school systems, especially if exposures and funding are managed through decentralized capital markets as well. The certificate authorities can help provide some level of security and network performance by lending their compute resources to the network, and novel consensus mechanisms can help speed up the overall settlement times.

Capece et al. seems to agree that education is a one of the most promising sectors for blockchain innovation. It's structure makes it relatively easy to map as a blockchain system and the ability to communicate this data more easily to recruitment systems for employment purposes, capital markets for better debt market consolidation of the education system, learning management systems for risk management, and other sub-systems can make a fantastic end-to-end financial product.

Improving Cohesion in the Enterprise World

Blockchains can do more than just improve cohesion within actors of a single organization. In the past and up until today, the public-goods argument has held that due to the limitations of volunteerism, government provision in the form of taxes and regulation is a necessary evil in order to solve the free-rider problem (Nair & Sutter, 2018). However, government bring with them so many imperfections and many non-profit organizations mean well and genuinely make improvements to the communities they serve, so there has to be some proper accountability framework in place to make sure both the government and non-profits are doing the right thing. Many social scientists have already studied the concept of cooperative

efficacy, which is a measure of the willingness of the public to voluntarily contribute to the public good. Nair & Sutter claim that blockchain has the potential to increase cooperative efficacy significantly and also reduce the size and scope of the expensive and inefficient government, which struggles to improve public schools and uses inefficient methods like charter schools to fill in the gaps of the shattered education system.

In its very definitions, cooperative efficacy refers to joint effectiveness of volunteerism. It's a way of measuring how much a community is working together to overcome the free-rider problem and help maintain core functions of maintaining a civilized society like enforcing property rights or keeping their communities safe. While the government is supposed to keep charge of these things, many times we cannot rely on our governments for support for one reason or another. Blockchain has the ability to strengthen the private sector and help bring better balance between the imperious relationship often found between public and private sector. This is a complicated topic that deserves its own paper, since bolstering volunteerism and proving its efficacy via blockchain servers could force us to reassess the tasks assigned to the government for public-good.

Security Auditing

A security audit is a comprehensive assessment of any organization's information systems - from the data to the underlying infrastructure. It is fairly comprehensive and can view the problem from just the perspective of protecting from distributed denial of service attacks, Sybil attacks, 51% attacks, or ensuring that data itself is compliant with certain standards**.** While blockchain systems introduce a new set of challenges in terms of being such a radically new server model, the plus side is that since the blockchain is supposed to be used by so many parties

at once, one audit might be larger in size, but it would cover many different companies at once. Auditing firms would not have to hop to as many companies to perform infrastructure audits. Data audits might be more complex, since each company would have to be checked for compliance, but the range of new auditing practices the blockchain enables could even help make the data auditing process easier.

Blockchain can enable more kinds of audits than previously imagined. Yashin et al. (2019) describes how the blockchain can enable a range of auditing features such as environmental audits to ensure that workplace safety. The biggest benefit to auditing blockchain systems is that since the blockchain encourages interconnectedness more between areas such as industrial, financial, or compliance activities, the range of possible data audits increases. The ability to create and manage novel measures is not something to dismiss, since measures aimed at reducing production risk, for example, can become common place. The sheer number of measures you can create when you have so much interconnected economic data in "one place" is staggering and could change the audit industry for good.

Conclusion

Surprisingly, voting and lottery systems in the blockchain are closely related, potentially even relying on each other to thrive, while certificate authorities and security audits are also closely coupled concepts. Blockchain-based voting systems for public elections might be too risky for now, but leveraging these systems for managing the education system might be a good first step to test the waters more before going all-in with blockchain-based political election systems. The principles of the lottery are not just used for gambling, as the American education system also uses a lottery system to provide school choice to students living in the inner city.

Emulating lottery systems on the blockchain and leveraging them for bolstering the education system by, for example, improving community cohesion is an interesting way to take something slightly negative for society and twist it for good. Also, since certificate authorities are so involved with the validation of transactions in the blockchain, they will likely be very important for security auditors to investigate and ensure transactions are being approved accordingly. The notary nodes will likely be the points through which most data will flow into the blockchain, so ensuring these nodes are well designed are a must for green-lit infrastructure and data audits. The blockchain will create a new set of reports for the world to work with and also help potentially improve the private sectors cooperative efficacy through the sheer number of novel measures that can be implemented to monitor transaction activity on the blockchain.

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