**How Blockchain has Advanced the Field of Applied Cryptography,**

**And Why the Public Should Trust it.**

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Abstract:

In this academic narrative, topics will be researched on why the general public does not trust blockchain applications. This will include a brief introduction to blockchain including: the difference between a decentralized system and a distributed ledger, its history through the conception of Bitcoin and thus the birth of Alternate Coins (Altcoins), and the known public distrust from previous thefts such as the infamous Mt.Gox incident and others. Through a technical perspective, an analysis will be performed on why the general public should have more faith in blockchain applications. Popular cryptocurrencies and their respective consensus algorithms will be discussed such as: Bitcoin and its Proof of Work (Pow) , Ethereum and its Proof of Stake (PoS), and Neo with its Delegate Proof of Stake (dPos). These will be expected to answer and show their work on how they solve the Byzantine General Problem (BGP). This will expose their shortcomings while also simultaneously arguing their validity. Following that, some methodologies based off this research will provide examples of how blockchain applications could be used for the general public’s greater good. To protect the validity of this informational, all research was conducted via academic and professional literature. This all was gained from the Institute of Electrical and Electronics Engineers (IEEE) and Association for Computing Machinery (ACM) databases, along with the proprietary documented white papers of the blockchain themselves.

Keywords:

Decentralization , Distributed Ledger, Consensus Algorithm, Proof of Stake, Proof of Work, Byzantine Generals Problem, Unspent Transaction Output, Public Key Infrastructure,

Introduction:

Since the conception of blockchain it has created numerous amounts of topics for discussion. When it comes to understanding what blockchain is, often times we find over simplified answers that abstract away the technical details of the underlying architecture. This maybe be fine when first dipping ones toes into this new technology, but doesn’t really serve as a long term benefit when the worlds needs to be so vested.

Generally speaking, when blockchain first appeared the public wasn’t sure what it was, where it came from, where it was heading, and what it still holds. In this section we will begin to define those answers to those questions. This has been a confusing topic for most because when the general public hears the word blockchain it is often most synonymous with the cryptocurrency Bitcoin and be it true that Bitcoin does use blockchain in its underlying architecture. It is not the only blockchain application.

The truth is that the term blockchain is not a one stop shop term but more of a blanket term that can be interpreted many ways. There are many blockchain applications out there with different underlying architectures built for many different reasons.

Introduction : Distributed Ledger vs Decentralization:

When discussing blockchain architecture, often times you will hear the terms distributed ledger and decentralization thrown around loosely. Although they can have a direct relation to each other, they are not one in the same. In this excerpt of what blockchain is, you can see characteristics at work: “From a data management perspective, a blockchain is a distributed database that logs an evolving list of transaction records by organizing them into a hierarchical chain of blocks. From a security perspective, the block chain is created and maintained using a peer to peer overlay network and secured through intelligent and decentralized utilization of cryptography with crowd computing.”(Viewable on Chain, Security and Privacy on Blockchain). This essentially means that blockchain applications are typically distributed ledgers on a decentralized network. A distributed ledger is essentially a list or a database that is stored in multiple locations or on multiple machines. A decentralized network means that no one single entity or small cliques can take advantage of nodes on the network. So, although an application is a distributed ledger with multiples copies stored in multiple locations, does not mean it is decentralized if all those copies are owned by the same entity! If every entity had a copy and have a fair chance to make changes then it would be decentralized.

These ledgers are typically made of blocks that are chained together creating long chains of stored information. Hence the name “Blockchain”. These databases are stored within the blockchain community and are not centrally located under one entity. Each one of these databases keep a copy of the ledger and agree to make changes to it (Zhang, Xue, & Liu, 2019, Pg. 2). The beauty of this being that if one entity makes a change the others can pinpoint who is trying to make or made the change. This bring the concept of transparency into light. Because transactions are stored transparently on a distributed ledger, they are able to establish trust between multiples parties who once did not trust each other. More formally one could think of blockchains as digital escrow accounts in a loose sense. Except that the escrow account is not managed by a central entity but by a large community of members. If one member were to lie about their copy of the ledger, then the others could cross check their copies and flag the faulty actor as irrelevant and untrustworthy effectively disconnecting them from the network. Sometimes in blockchain technology there will be instances were there can be consequences for acting maliciously as well which can result in a large financial loss.

Introduction : The CIA triad:

Since everyone has access to the main copy of the database and can cross reference with each other, blockchain covers the concept of Availability in the Confidentiality , Integrity, and Availability (CIA) triad. To cover Integrity, most blockchains implement a consensus algorithm. This is a voting algorithm on who gets to decide what is added to master chain. This is similar to how in an Agile software engineering environment when a team lead and other reviewers will be the deciders of what gets added to the master branch. This time instead of one or a few deciders from entity, it is a multitude of entities agreeing on a change. This bring integrity because no single entity can manipulate the network and you can be insured that your information is true by checking the latest data, pin pointing where the changed occurred, who changed it, and then discussing and comparing with other nodes. Since Blockchain applications are high in the Availability and Integrity factors of the CIA triad, they sometimes struggle to overcome the Confidential aspect. Again, your accounts and transactions are typically displayed for all the world to see. So how does one over come the burden of remaining confidential? Many blockchains will overcome this by establishing a Public Key Infrastructure (PKI) of public and private keys. The Public key is your Pseudonym or alias for all your transactions. If no one knows who that public key belongs to then your assets are still confidential. Keeping in mind that the CIA triad of each blockchain application will vary for each’s specific purpose. How each applications purpose fills out the CIA triad should directly influence the general public trust about that blockchain application.

Introduction: The Byzantine Generals Problem:

After an application is developed it will be analyzed using the CIA triad to give its characteristics. This is more of a score card although should always be kept in mind when developing projects. The true problem that blockchain aims to solve is the Byzantine Generals Problem (BGP). Although this problem is referenced though the lens of a medieval general, it shows, and questions the trust between different parties still today. The BGP is a huge topic of discussion and many narratives have been written on how to solve it.

In essence the problem goes as so, In the days of the Byzantine Empire. Many general are camped outside an enemy city that needs to be besieged. The generals all need to make a decision on a plan, and verify it is executed at the correct time, without falling prey to malicious actors. In the case of the Byzantine General, bad actors would be traitors or impersonators to their cause. Communications between generals are only by message so trust has to be established so that the message is authenticated and shows integrity. In those days a seal or stamp would be a sign of authenticity and integrity but in a digital word this is now resolved through digital certificates and digital signatures.

Another concept of establishing trust is by staking, If a general wanted to vote on plan of action to take the city they could put up something as collateral. If armies did not win the battle the general would lose their collateral. This gives them incentive not act maliciously. This hold especially true when in the middle ages your collateral could be your loves ones.

Publics Negative Trust:

When it comes to conversations about blockchain, it is all to common to hear the general publics negative review. More often or not associated with words like scam or pyramid scheme with out knowing what the underlying functionality of it is.In this sections we will discuss and analyze a few notorious facts and incidents that would bestow the public’s trust.

Publics Negative Trust: Blockchains Informal Conception.

Since its conception, blockchain has showed properties that would make even the most bullish or novice investors weary. We do not really even know where this technology came from! It is no secret that the concept of blockchain technology was first general introduced through the publication of the Bitcoin white paper. What makes the story that more intriguing is that the write of this white paper went under a pseudonym pen name Satoshi Nakomoto. These has been much speculation as to who Satoshi is and whether they are a singular person or multiple entities. None the less not knowing who the creator of this technology is sure to have misguided the public’s trust.

Publics Negative Trust: Silk road.

One of the most infamous reasons my bitcoin came to light was its was for a short time perfect for black market trading. One of the most notorious was the Silk Road where users could purchase all kinds of devious products and services using Bitcoin. That eventually got shut down and even raided by the FBI. The inherently confiscated a lot of server that held cryptocurrency wallets ultimately making uncle Sam one of the largest holders of Bitcoin. Since cryptocurrency’s are synonymous with black markets the inherently have lost the public’s trust.

Publics Negative Trust: Mt.Gox.

One of the largest online thefts in history happened on the Mt.Gox cryptocurrency exchange. Interestingly enough. Mt.Gox stands for Magic the Gathering Online Exchange and was originally used to trade Magic the Gathering Cards until it transferred its business into a crypto currency exchange. In short, the exchange got hacked and over a million Bitcoin were stolen, This was due the agile software development process of Mt.Gox or rather lack there of and also how digital wallets were designed. Essential anyone with access to the private wallets could see the wallets private keys in clear text to be used nefariously later at another point. This large of a cryptocurrency heist was a huge set back for bridging trust between blockchain and the general public. Although most would argue this heist from a faulty agile pipeline rather than an architectural flaw. The flaw of storing private keys in plaintext within wallets has now been secured further by encrypting them.

Why the Public Should Adopt More Blockchain Applications:

Now that we have discussed reasons on why the general public has developed a negative view towards blockchain, we will now begin to discuss why they should change there point of views to further adopt and trust blockchain applications. These will be more technical in nature and argue why blockchain is safe but how you deploy it can lead to vulnerabilities. Similarly, to how you cant hack a dollar bill but you can leave your wallet open to be stolen.

Bitcoin and Proof of Work:

UTXO:

Ethereum and Proof of Stake:

Neo and Delegate Proof of Stake:

Quantum Proof Blockchain:

Introduction



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