

# Ether and Applications of Ethereum Blockchains Beyond Cryptocurrencies

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**Abstract--** In today's world everyone has an idea of what cryptocurrency is. There is a misconception that blockchain is also a type of cryptocurrency like bitcoin. In this paper we will be describing what a blockchain is and we will look into Ethereum blockchain and other platforms where Ethereum blockchains is used. We will also explore into the applications of Ethereum blockchains beyond cryptocurrencies. At the end, we will be looking in detail into a case study where Ethereum blockchain was used in construction of a capital city (Amaravathi) in India.

## I. Introduction

A blockchain is a public digital registry that safely records the transactions between two parties in a secure manner. Any exchange performed will be communicated to everyone in the hub on the blockchain. Once a transaction is performed, the record will be stored in a block which is interrelated to the previous blocks. So, in order to change a record in one of the blocks, the recent blocks should also be altered which alerts the whole network and immediate action can be taken. In this way, the whole network will be robust against any alterations. Ethereum is a type of a blockchain. The primary idea of our project is to use an open source software tool (Ethereum) to create our own wallet and generate cryptocurrency, trade them between multiple wallets. This product will help customers to save and trade their cryptocurrencies. The type of the wallet (eg: software, online, mobile etc) to be used will be decided depending on the project details, specifications and assumptions. The primary idea of our project was to build our own blockchain to generate and mine a new cryptocurrency. But as we were researching on the blockchain topic we realized that it was not a feasible idea because of factors like time and computational power restrictions. So we decided to continue our research on exploring uses of blockchains in other industries like healthcare,

banking etc., to show that it can be helpful in many ways other than just in digital currency world.

## II. Ethereum

Ethereum is an Open Source, Public, Blockchain based distributed computing platform and operating system. Its primary functionality is to serve as a ledger that is incorruptible and coupled with an efficient transparency. This very functionality of Ethereum can be used in providing diversified applications in addition to the financial services.

### (a) Ether (Cryptocurrency):

Ether is a cryptocurrency that is used to pay for the computational resources needed to run an application or program. Just like cash, it doesn't require a third party to process or approve a transaction. But instead of operating as a digital currency or payment, Ether seeks to provide "fuel" or "computational power" for the decentralized apps on the network. It is sometimes called "digital oil" because, Ethereum transaction fees are calculated based on how much "gas" the actions requires. Even though Bitcoin has more value in today's market, Ether has its own advantages to become successful. Ethereum has a object-oriented language while Bitcoin is in a stack-based language. The Ethereum transactions are confirmed in seconds while Bitcoin takes minutes. Ethereum uses its own hashing algorithm called 'ethash', while bitcoin uses SHA256 algorithm.



Fig. 1. Ethereum value chart

### (b) Ethereum Wallets:

Ethereum wallets are decentralized applications developed in Ethereum network. All the account transaction histories, public and private keys of accounts are securely stored in the Ethereum blockchain. The Ethereum wallets can be either web browser wallets like MyEtherWallet.com or desktop applications like Ethereum Wallet. These wallets are used to create accounts that can store and trade Ether and other cryptocurrencies from one account to the other. The Ethereum wallets are mostly compatible with other crypto wallets. Each account in the wallets is given an unique account number which is a hash value of the accounts public key. Etherscan is a web browser that shows the an accounts transaction history like a bank statement for a bank account.



Fig. 2. Ethereum wallet account overview

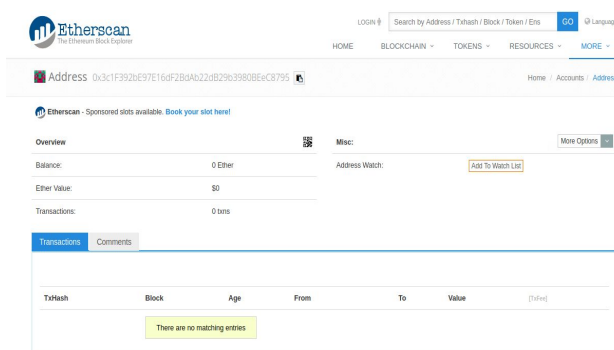


Fig. 3. Etherscan showing account transaction

You can send Ether from one account to another account with just the account ID of the Ethereum account. While transferring funds, it will ask you if

you want to add transaction fee. The speed of the transaction depends on the amount of transaction fee you decide to pay. In a desktop Ethereum wallet, the transaction fee varies from 0 to 0.53 ETH. After the transaction is complete, TX ID will be displayed. This ID will be used to view the transaction details on the blockchain.

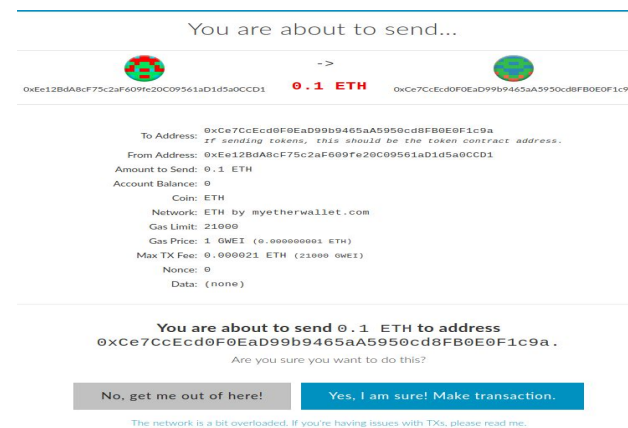


Fig. 4. Ether transaction between accounts

### (c) Ethereum Smart Contracts:

Smart contracts are used to exchange money, property, shares or anything of value in transparent, conflict-free way. They define rules and penalties around an agreement like any other traditional contract. Unlike the traditional contracts the rules of smart contracts are enforced as soon as the contract is compiled. Ethereum smart contracts are written in a programming language called Solidity (similar to Java) in Ethereum wallets and then they are deployed to the Ethereum Virtual Machine (EVM). The contracts are stored in Ethereum blockchain securely and compiles the code that performs the changes required.

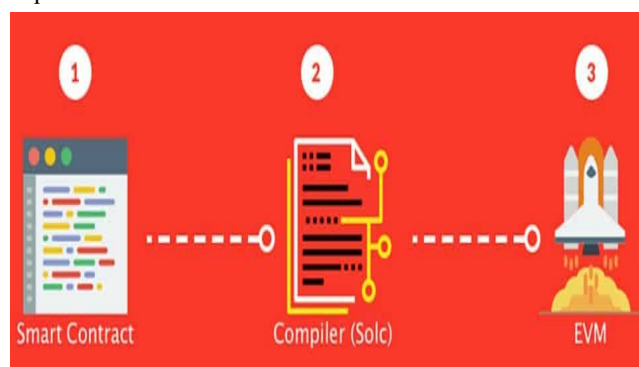


Fig. 5. Smart contract flowchart

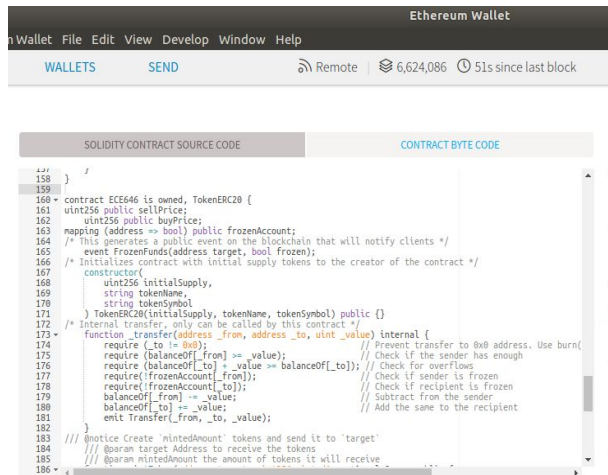


Fig. 6. Smart contract in ethereum wallet

### III. Applications of Ethereum Blockchains Beyond Cryptocurrencies

#### (a) Blockchain Technology:

In a peer-to-peer network of computers, validating data is important to make sure nothing is altered or tampered with during transactions. Blockchain helped the digital currency world validate and also ensure false data was not sent. All the cryptocurrencies are generated and mined through their own private blockchain (database). In the beginning our idea was to build our own private blockchain and mine our own cryptocurrency from it. But, along the processes we realized that it is not feasible to build a new blockchain from scratch and mine our own cryptocurrency since it takes years and well experienced developers to accomplish it. So we decided to take a case study on applications of blockchain beyond cryptocurrencies and analyze it.

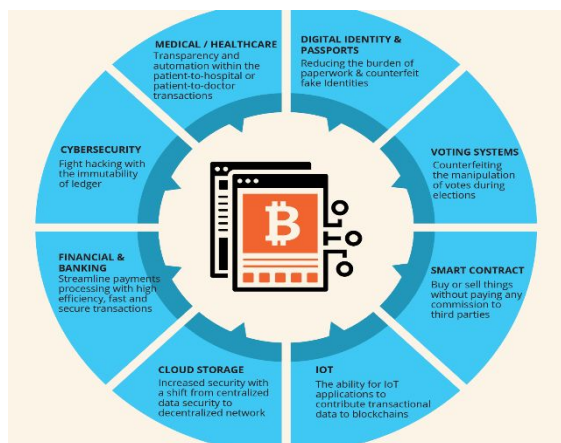


Fig. 7. Applications of blockchain beyond cryptocurrency

As blockchain is a digital, distributed and decentralized ledger it was primarily aimed at logging all transactions without the need of a financial intermediary such as bank. Due to its highly secured and encrypted nature it has been used as the foundation for world’s most famous cryptocurrency: the bitcoin. But the applications of blockchain are limitless and aren’t just confined to the financial services. The basic nature of Blockchain which allows tamper-proof maintenance of data allows it to expand its domain beyond cryptocurrencies. Some of its other applications are:

- Data Sharing
- Digital Voting
- Land Registry
- Food Safety
- Medical Record Keeping
- Managing IoT Networks

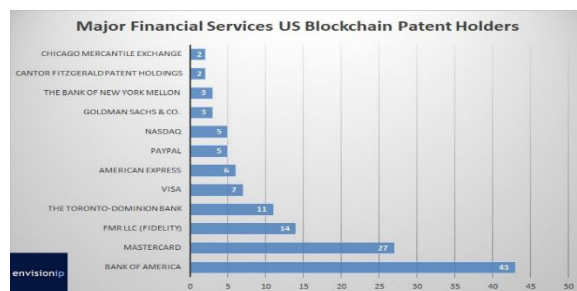


Fig. 8. Blockchain patent holders in USA

Major firms utilizing blockchain on a large scale are:

- Walmart: Helps the customer streamlining the restocking process
- World Bank: Pilot projects to improve governance, social outcomes like voting and land registries.
- United Nations: Provided Cryptocurrency based vouchers to redeem in markets for 10000 syrian refugees.
- FedEx: Launched a pilot program to help solve customer disputes.
- Cisco: To support tracking and monitoring of IoT devices.

#### (b) Blockchains in Land Registry:

##### (I) Working

Blockchain in the field of land registry enables ‘Instant Transfer’ of the property securely. Smart contracts of blockchain will speed up the process of automatically updating the ledger instead of owners transferring the ownership through an application

form. It also enhances the trust between the parties in transactions as the smart contracts gets executed automatically and also ensures that the outcomes obtained are validated by everyone in the network. Blockchain in land registry relies on the basic principle of Proof Of Existence (POE):

- Proves that a certain document or file is created on particular date and time.
- It works independent of location and doesn't require prior technical knowledge.

(II) Hashing the documents

In land registry, hash numbers of citizens land documents are saved in blockchain protecting from data leak, data manipulation and even removal of it. Hash number of document saved on the blockchain will prove that they are legit and valid. It will be verified as when the document provided should produce the same hash value as the one stored in blockchain. A minor change in the document will result in different hash number thus indicating the tamper of data. Even in scenario such as destruction of the servers will not prevent from the users reclaiming the data with the help of hash number.

A buyer and seller will proceed to the land registry office with their sales deed. The govt. Official would enter the data into the blockchain in their presence. It will process the signatures of both the parties and push the transaction to the approval stage where the transfer of ownership is completed. Both the parties will be able to view and monitor the state of property and sale deed in the real time. The best part of the system is that neither of the parties will require any blockchain accounts or wallets nor will they see any change in the interaction with the land registry.

(III) Appearance on the blockchain



Fig. 9. First blockchain document in land registry

This is how the document appears after placing in the blockchain just like an old Govt. document with a long string of letters and numbers followed by a QR code used for finding out the property deed location on the Ethereum blockchain.

(IV) Advantages of Blockchain in Land Registry

- Improves the resistance to the failures as the vulnerable point to failure is distributed among the nodes.
- Increase in trust as the data is not controlled by one governing body capable of manipulating it.
- In case of a large peer to peer network, it is impossible to disconnect any prospect application request especially if the nodes are separated by large geographical boundaries.

IV. Case Study: Blockchain in Construction of a new city

(a) Brief History about Amaravati:



Fig. 10. Map of India of state bifurcation

Unlike the western countries where the capital cities of a state aren't expected to be the flag-bearers of the economy and infrastructure, in India the Capital cities are expected to drive the economy of the states. Considering the states of Virginia and New York, we get to know that the capitals are confined to the administrative activities mostly and the economy of the state will be run by other metro corridors like D.C and NYC. In India, the capitals are expected to carry the legacy of the state, economy and infrastructure along with the administration. In 2014, in the South-eastern India the erstwhile state of Andhra Pradesh with a capital Hyderabad (One of the metro's in India) has been bifurcated into two states of Telangana and Andhra Pradesh(new). As per the law, Hyderabad remained as permanent capital for the

state of Telangana and temporary capital of the residual Andhra Pradesh for a period of 10 years. So unfortunately the residual state has to either build a new capital city or to convert existing towns into large metro's. The govt. Has decided to go with the former option with an eye on the future. So, after an extensive research the govt. Of Andhra Pradesh have decided to develop a new city by the name "Amaravati" which was once the name of capital to an ancient dynasty ruled in the same place around 2,200 years ago.



Fig. 11. Present Amaravati



Fig. 12. City to be developed

(b) Land Acquisition for the City:

Building a city from scratch to a world class metro is not an easy task and has very complexities in execution. After considering various metro's across the world like Singapore, Amsterdam, NYC the govt has estimated the land required would be 53,621.9 acres. The govt has chosen a Land Pooling scheme as a way to acquire 33,000 acres of land belonging to farming community as the rest of the land has fortunately been under the control of govt from a long time. As ownerships are transferred through land pooling cases, landowners gets the plot along with an annual compensation for 5 years.

Policy designed by the govt: An acre of land given to the govt will fetch the donor 1300 sq. Yards (approx quarter of an acre) of the developed land in the new city which with a division of 1000 sq.yards for residential purpose and 300 sq. Yards for commercial purposes.

(c) Reasons for choosing Blockchain:

- There is a high probability of fraudulent transactions happening (if done on paper), which can lead to disproportionate compensation to the land donors.
- Digital land records are also facing manipulations leading to 1.3% loss of nation's GDP.
- Moreover, the wrath of WannaCry Ransomware has alerted the Govt to find alternative options for secure and transparent storage which led to the option of Blockchain.

(d) Agenda:

Blockchains have automated the entire process of allocating the plots, registration and storage of the data. More technically around 58 attributes or details are given as input to the hashing algorithm on an Ethereum blockchain and are linked to each property database such as Names, Aadhar card number (similar to SSN in USA), mobile numbers, boundaries of lands with latitude and longitude coordinates, neighboring plots etc. The govt of Andhra Pradesh has collaborated with Zebi, a blockchain based company comprising of graduates from MIT, Oxford, Stanford and IIT. It has taken up the responsibility of entering the data into the Ethereum Blockchain. As of June 2018, around 83000 records have been moved into the blockchain costing around \$0.071 per record. Around 40000 of these plots have been allocated to over 24000 farmers and the rest to the Govt and research institutions. Once the data has been recorded, it cannot be altered retroactively.

(e) MANA AMARAVATI app:

An app by the name "MANA AMARAVATI" has been developed which allows the owners of the allotted plots to reach out to the investors across the globes to get a better deal of sale or lease. A primary feature in this app is "Know your plot code" where an user can log in with his Aadhar number and view the details of allocated plots. Any complaints from the users side can also be lodged which will be addressed by the concerned authorities in a stipulated time frame.



Fig. 13. Mana Amaravathi app



Fig. 14. Map of land pooling in mana amaravathi app

(f) Possible Pitfalls:

Irrespective of the advancements, this particular technology will not be able to completely eradicate all the flaws as it is still vulnerable to Hacker attacks and Data manipulation. The biggest concern with the project is that Blockchain official who is entrusted with the responsibility of entering the land details into the blockchain might be compromised to perform malfunctions in such a way that the farmers might lose out the appropriate compensation. Because of this mistrust, some of the minor segments of the farming community not to completely believe in the proposed project. We can try to defend these kind of “**Man in the Middle**” attacks by ensuring a system of multiple approvals and verifications by the second parties. Even the blockchain must be in synchronization with ever updating location relevant data laws.

## V. Conclusion

In the paper we have given a brief knowledge of Ether and Ethereum. We showed how to create Ethereum wallets and how the transaction (of ether) can be done between the wallets. We also explored some other uses of Ethereum Blockchain. We had a brief comparison between ether and bitcoin on the bases of feasibility in mining. We also discussed the in depth use of blockchains in land registry and presented in-depth knowledge of a use case (building a capital city Amaravathi using ethereum blockchains). Even --- Amaravathi will be the first state in history which was built using blockchain technology.

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