



ROBUST SECURITY FEATURES EXPECTED FOR GENUINE E-TICKETING USING BLOCKCHAIN: A COMPARATIVE STUDY

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Abstract : Blockchain technology has recently gained much attention because of its decentralized nature and distributed public ledger and peer-peer network. Because of its smart contract and consensus mechanism it is possible to develop tamper proof digital platforms for data storage, sharing documents and payment. Blockchain can be used in various areas like Internet of Things, supply Chain management, Voting system, Finances and many more.

The scope of this paper is to make comparative study on privacy and transparency issues in buying the ticketing for events, sports or music concerts and how Blockchain technology made it possible to develop the secured models for ticketing. This paper also reviewed present ticketing systems which have successfully adopted Blockchain technology and delivered tickets successfully and find gaps in the existing system.

IndexTerms: Blockchain Technology, e-Ticketing.

I. INTRODUCTION

If the event is very popular then buying tickets to popular events like musical events, concerts, sports matches becomes a tedious task. Sometimes tickets sold out in just a few minutes for such popular events (Clark, 2018). In that case event attendees purchase tickets through middlemen, who may sell tickets with more than the actual ticket price. Other possible ways may be duplication of tickets, intentionally buying many tickets at a time etc. Scalpers buy tickets very fast, these scalpers use some software called bots which purchases the tickets faster than humans (Krueger, April 2008). This leads to fraud, unauthorized entries and loss of revenues to event hosts. The combination of high demand and low supply leads to injustice, loss and frustration to the event fans. This issue can be solved using Blockchain technology.

Blockchain is a technology which uses cryptographic validation structure among transactions and it can be employed for authenticating and authoring produced data. (Nakamoto, 2008)

A Blockchain offers the same record-keeping functionality without any interference of centralized databases (Nakamoto, 2008). To be certain that the transactions are legitimate without a validating central authority, Blockchain uses a decentralized ledger. Every node holds a copy of the ledger, and anyone can request a transaction to be added to it. To accept a request for an added transaction to the Blockchain, all the other users must agree that the transaction is legitimate. This is achieved automatically using different methods of consensus. Blockchain eliminates the need for the third party trust and has no single point of failure. Blockchain is immutable; any new block to the ledger must reference the previous version of the ledger which will lead to the creation of an immutable chain. Therefore a safe and robust ticketing system can be developed using Blockchain technology.

II. BENEFITS OF BLOCKCHAIN TECHNOLOGY IN TICKETING

Blockchain enables trust among the participants. It uses decentralized structure and it creates an unalterable record of transactions using end-to-end encryption. Blockchain is immutable which ensures transactions cannot be changed or deleted. As all nodes in the network share a copy of the ledger, the data on the Blockchain ledger is easily accessible for everyone to view and hence transparency is maintained.

As transactions are in encrypted form, no one can alter a record once it is written. So Blockchain is secured.

Blockchain applications are developed for money transfer, financial exchanges and lending loans. Money transactions take less time and transfers in the secured mode. Applications for insurance, real estate, store personal documents and information in the secured manner are also developed.

Voting applications and government related applications for cost benefit operations and to reduce fraud are developed. Using Non Fungible Tokens (NFT) digital assets, artist royalties, documents storage, medical records etc are maintained using Blockchain technologies.

Blockchain technology allows more secure and trustworthy transactions in the domain of finance and banking, Finance, Internet of Things (IoT), health care, ticketing and many more. Many organizations and companies have already started adopting Blockchain technology and succeeded.

III. PROBLEMS ASSOCIATED WITH TICKETING

Over the past few years many articles and papers have been published to discuss the problems associated with ticketing and security of ticketing systems. Below are some of the studies based on the reference available for ticketing.

A study was conducted by Alan Krueger (Krueger, April 2008). He analyzed data from a set of surveys that were conducted at 30 scientifically selected concerts in the U.S. from August to October 2006. Over 3,000 fans were asked how they obtained their tickets, how much they paid for their tickets, why they turned to the secondary market, and other questions. They also presented evidence from surveys of 1,700 fans at a Bruce Springsteen concert in 2002 and a U2 concert in 2005 to provide additional information on sold out superstar events. They found that the secondary market accounts for about 10% of all concert tickets purchased, and that the markup for resold tickets is 45% to 60%, on average. They estimated the total size of the U.S. secondary concert ticket market in 2006 to be around \$600 million.

In the Year 2016 Prof. Michael Waterson (Professor Michael Waterson's, 2016) carried out ticket study for music and events tickets and reviewed the problems existing in the market for tickers especially fraud, pricing and ticket availability and in particular to music and sport events and he has recommended laws for the government.

In the Year 2017 Kilimanjaro live chief Executive Stuart Galbraith carried out a study about ticket abuse and found that 450 of their customers who purchased tickets were found having invalid tickets (Galbraith, 2017).

Again in 2017 because of infrastructure and evolution of mobile ticket sales, big growth opportunities in the global secondary ticket market were seen and found that secondary ticket market or reseller tickets were dominated in the sporting events segment which increased both concerts and theater income with a market share of 54.73% (technavioBlog, 2017).

New York State Attorney General Eric T. Schneiderman studied secondary market ticketing and found one bots operator alone scooped up 1012 tickets to a concert in 1 Minute. Stakeholders from politicians to musicians to fan alliances are clamoring for fairness in online ticketing. Some performers have gone to extreme lengths to remove bad bots from sales, including taking ticketing totally offline (Schneiderman).

In 2019 Study was conducted on bad bots ticket purchasing activities and found that nearly 1 in 4 web requests was made by a bad bot, and bad bots are especially prevalent in ticketing, making up 40% of all ticketing website traffic in 2019 (How Bots Affect Ticketing, 2019).

Study of literature of above papers shows that there exists a secondary market in ticketing. Most of the tickets purchased are for higher prices as compared to original prices of the tickets. Existing secondary market for tickets create fraud, unauthorized entries loss of revenues, ticket unavailability and many such problems and sometimes genuine fans for the event may not get the tickets. This study approach will present a survey of the state of art paper in which Blockchain is used for ticketing in various domains with some level of convenience, authenticity, privacy protection, transparency, traceability and scalping prevention.

IV. TICKETING SYSTEM BASED ON BLOCKCHAIN

Many companies and organizations are trying to adopt Blockchain technology to solve security and privacy problems associated in the ticketing domain. Some of them are well established but most of them were created in the past four to five years, and their common desire is to bring convenience, authenticity, privacy protection, ticket traceability, prevention of scalping in ticketing. Some of the ticketing systems are discussed below.

GUT ticketing

Guts company was founded in 2017 (Mire, 2019) the founder used Blockchain to cut down the number of intermediaries for soccer matches, concerts, festivals, or other live events. A GUT created a Protocol for ticketing, and has its own GET token. It was used for popular local star Guus Meeuwis's June 2020 event. Here they tried to reduce scalping and fraud. Every ticket is linked with the user's phone, and a barcode was made available just few minutes before the event. A Gut uses the Public Blockchain of Ethereum to store and process ticketing data and transactions to ensure the transparency of the ticketing system. For privacy protection Guts used a method of asymmetric encryption to generate a key pair and then encrypt the private information with the public key to protect the privacy of data stored in the public Blockchain. For scalping prevention Guts used the consumer's phone number or social media account as proof of identity.

Aventus ticketing

This company was founded in 2016 (Mire, 2019), it uses Blockchain technology in ticketing to reduce touting and fraud. Aventus brought permission and interoperability of public Blockchain with security. The Aventus Network applications uses Blockchain technology, cross-chain, and plugged into the Polkadot ecosystem. The Aventus Network can scale to 2,000 transactions per second (Aventus Whitepaper 2021). They claim that the average transaction cost on this system decreases over time. The Aventus Network will process a token transfer within 0.13 seconds which is faster than Ethereum Blockchain.

Aventus Protocol foundation also used the public Blockchain of Ethereum to store and process ticketing data and transactions to ensure the transparency of the ticketing system. For the problem of fake tickets, digital signing technology is used by Aventus. Aventus gives a solution for scalping prevention by using the face id, credit card and ID card number as the identity proof of ticket purchaser. Later Aventus used QR code method of scalping prevention.

Upgraded ticketing(Ticketmaster)

Upgraded affiliated with Ticketmaster in Oct 2018 which uses cryptographic algorithms to issue smarter and more secure tickets. It was founded in 2016 (Ticketmaster, 2018) it uses Ethereum Blockchain to convert paper or e-tickets into secured digital assets protected by public or private keys. Only the owner of the ticket can access it and reduce theft and fraud. Smart contracts are implemented so that tickets will not be released to the buyers until payment is fulfilled. UPGRADED tickets are easily accessed via the mobile app or can be embedded into partner sites.

Sponsors can sponsor the ticket that can be linked to content and E-commerce. Event Owners can provide integrated opportunities for fans to purchase merchandise, parking or other items directly from tickets. When the ticket holder is near the Venue the Bar codes are generated. Tickets can be transferred to friends or relatives and can be immediately accessible on their smart phones.

Blockparty ticketing

Blockparty company founded in the year 2017 (Blockparty, 2019), It tried to solve the ticketing problems like bots, illegal scalpers, astronomical, unfair prices, and fraud . It was done through the Blockparty protocol which assigns transferable digital identities to each ticket and link it to owners. It uses facial recognition or fingerprint scanning technology to reduce fraud.

Blockparty is built on Ethereum Blockchain, it deploys Ethereum smart contracts for the system model. For ticket issuance, where each ticket is coded in an Ethereum smart contract and purchasing tickets using fiat currency. To protect from scammers, fraud, identify theft a Phone based ticket storage and scanning for gate entry and phone based fingerprint or facial recognition for identification is used. The encryption technique is used to prevent anyone from being able to identify or recreate a digital fingerprint. Because of the uniqueness and one way encryption technique ticket cannot be copied with photocopier or any other copying mechanism

True Tickets

This company was founded in 2017 (True Tickets) and it has two different ways to interact with the customers. The software supports the Tessitura Network which has integrated many of the independently owned and operated venues, and provides a conventional way of selling a ticket. In the second way they built ticketing using Hyperledger Fabric running on the IBM Blockchain and uploading the subsequent data to the Google cloud, The Blockchain solution maintains a perfect record of each time the ticket is transferred to user, permitting the venue to see who exactly is in possession of the ticket ,it maintains a perfect and permanent record of each, and every transaction, in this case the purchase, transfer or redemption for entry of a ticket.

4.6 Blocktix ticketing

It was founded in 2017 (Mire, 2019) this enables a platform seeking to replace the fragmented event ticketing market with a single, secure solution for ticketing. It tries to reduce fraud and allows peer to peer ticket exchanges (Florian Mathieu), it helps reduce distribution, transfer and promotional costs for event organizers.

All tickets in the network are linked together through Network and they are all uniquely attributed in such a way they prevent fraud .It uses facial recognition for ID verification so that it ensures ticket holders are identified and associated with their tickets only. There is a chain of contracts when creating a new event in the system. This ensures the sanity of the contracts being loaded and thus essentially disallowing attackers from launching their own malicious contracts and inserting them into the Blocktix system for security purposes. Event creators call the Blocktix contracts which in turn create the BlocktixEvent contract, thereby removing the possibility of tampering.

Based Global ticketing

It was founded in 2006 (Based Global) . It tried to develop a highly scalable Blockchain powered ticketing platform. Immutable Smart tickets lock is provided, tickets can be sold only if owner is permitted. With smart ticketing artists and promoters get a view into attendees and their demographics information also.

EventChain ticketing

It was Created by father/son duo Jay and Ashton Addison in the year (EventChain Whitepaper, 2017). It eliminates many problems associated with ticketing and gives a better ticketing system for event organizers, producers and artists.

EventX ticketing

Founded in the year 2017 (Mire, 2019) by Dutch startup EventX to bring Blockchain-enabled payment to the live event scene. Event X ticketing app allows users to purchase and store tickets also to arrange and reserve parking, purchase locker storage , order food and drinks and locate restrooms, reserve merchandise and many more.

Evedo ticketing

Evedo has B2B Platform to create an environment for all businesses involved in ticketing such as event organized, owners, sponsors, (evedo) etc., Using Blockchain technology connected to event organizer and attendees and transparency is provided. The purchase of tickets through the B2C platform will be done using BTC, ETH or Fiat currencies into EVED and are stored in user's cryptographic wallets. Cancellation of a ticket will trigger the smart contract functionality that returns the EVED tokens to their owners. Bots and resellers are taken care of, by providing clear rules for the smart contracts.

Table 1. A comparison of the platform used, security protection and scalping prevention techniques for ticketing systems based Blockchain

Ticketing	Platforms used	Privacy protection techniques	Scalping prevention techniques
GUT ticketing	Ethereum	asymmetric encryption	consumer's phone number or social media account as identity proof
Aventus ticketing	Ethereum	digital signing technology	face id, credit card and ID card number

UPGRADED ticketing (previously known as ticketmaster)	Ethereum	Smart tickets lock	Bar code
Blockparty	Ethereum	peer to peer ticket exchanges	used facial recognition or fingerprint scanning technology to identify ticket holders
True Tickets	Hyperledger Fabric	Maintains ledger records	Ticketing platform serves as an immutable ledger, allowing artists, venues, promoters and fans to track a ticket through each stage of its lifecycle.
Blocktix	Ethereum	Blocktix contracts	Blocktix contracts
Based Global	Ethereum	Smart tickets lock	Smart tickets lock in ownership data that is immutable, unless the owner is permitted to re-sell
EventChain	Ethereum	Smart Contracts	Smart Contracts
EventX	--	--	mobile app to provided to purchase and store tickets, to reserve parking, purchase locker storage, order food and drinks, locate restrooms, reserve merchandise, and many more
Evedo ticketing	Ethereum	Smart Contracts	Smart Contracts

A successful ticketing system requires many key features. Security and privacy issues are one of the most important features. Using Blockchain technology security has increased in ticketing and prevented scalping. Other features need to be included in ticketing systems based on Blockchain like convenience, authenticity, privacy protection, system transparency and ticket traceability. Some of these major features in ticketing using Blockchain technology are compared.

Table 2. A comparison of various features adopted by different ticketing systems based on Blockchain

Ticket	convenience	authenticity	privacy protection	system transparency	ticket traceability	scalping prevention
GUTS	Yes	No	No	Yes	No	Yes
Blockparty	No	No	No	Yes	Yes	Yes
Blocktix	No	Yes	Yes	Yes	No	No
Eventchain	Yes	Yes	No	Yes	No	No
EventX	Yes	No	Yes	Yes	Yes	No
True Tickets	No	Yes	No	Yes	Yes	Yes
Upgraded	Yes	Yes	No	Yes	Yes	Yes
EventDO	Yes	Yes	No	Yes	No	No

V. Conclusion

Blockchain has recently drawn remarkable attention in decentralized application systems. It provides entirely different ways to store, distribute, update and verify data and will play a vital role in the future ticketing system.

Authors reviewed the issues associated with ticketing for the favorite shows or events and found there exists a secondary market, bots, scalping of tickets etc. They also reviewed the existing e-ticketing system which implemented ticketing using Block chain Technology. Various features adopted by different ticketing using Blockchain technology. In this paper authors have compared existing e-ticketing using Blockchain based security techniques and features. After this comparative study they got to know that no single ticketing system fulfills compared security features. However many security factors underlying cryptography and its ecosystem need to be considered, these will be discussed in future research activities.

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