Chapter 5
Block Chain Platforms and Smart Contracts

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5.1 Introduction

The need for modernization has driven rapid development in technologies during the past decade. For example, blockchain has now become an integral part of daily life. Blockchain has received considerable hype, starting with "cryptomania" in the trading markets and then expanding its impact to private and public sectors of society. Blockchain is one of the most exalted technologies with a pervading impact on almost all industries, including banking and financial services, supply chains, agriculture, healthcare, and government.

Blockchain is derived from the principles of cryptography, peer-to-peer networks, and game theory. It evolved as a formal name for tracking the databases underlying cryptocurrency such as Bitcoin, but now it has become a distributed ledger with software algorithms to record all the transactions in form of chain of blocks with trustworthiness and anonymity [1]. Blockchain also uses the concept of smart contracts, in which business rules are implied by agreements that are embedded in the blockchain and executed with transactions.

Blockchain has reevaluated the interoperability of databases. It has pushed reliability, verifications, interaction, and data security to different actors in the arrangement. Despite this, data immutability, digital scarcity deficiency, and the

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solution to duplication of digital data. Blockchain technology is integrated with applications from different domains:

Faster settlements: it provides faster settlements for transactions than in traditional banking, which uses a very slow and time-consuming process.
Security: Cryptography functions and consensus provide secure transactions.
Transparent: Because blockchain is a decentralized platform, third-party inventions are not required at all. All stakeholders of the network can participate in the network, thereby providing transparency [2].
Inexpensive: Blockchain does not require the expensive brick-and-mortar model that facilitates traditional financial transactions, nor is it required to pay large commissions to avail financial services [3].

Blockchain technology provides a better sharing platform, where the suppliers and buyers trade on a trusted network. It does not involve any intermediates or any third parties. Traders can obtain lower prices and earn higher profits. Thus, the technology creates a trusted and transparent marketplace and also a better economy [4].

Today, numerous variations of smart contracts with blockchain innovations have been developed. However, there are differences between an open-system blockchain, such as Bitcoin and Ethereum, and private system types.

5.2 Literature Review

Another paper [5] applied mean peril speculation to methodically research how the risk attitude of purchasers impacts the ideal assessment of the on-demand platform, customer surplus (CS), expected profit (EP) and profit risk (PR) of the platform, and higher help administrators. When the customers were more risk-seeking, then the ideal assist cost with willing drop (increase). When examining the changed risk viewpoints of the customers, it was found that the customers were risk seeking. Ultimately, the customer's risk-seeking can be increased by blockchain advancement.

Another study [6] examined BitFund, which is a worldwide investment platform. Blockchain innovation helped to create a decentralized system where the exchanges are recorded in an open appropriated record, consequently making it transparent and without cost. Thus for the requirement of a good and effective "crowd funding platform" in order to build up a smart country or nation and having the features of blockchain, BitFund was introduced or proposed. Here, speculators can request a particular job along with an offer regarding the time, cost, and required maintenance; the developers can offer proposals with the same parameters to establish a venture proprietorship. A smart contract is created between the speculator and developer to arrive at a solution for the speculator.

The effects of blockchain technology and the Internet of Things (IoT) on the modern healthcare market have been investigated [7]. Medical data needs to be handled in a secure manner. These innovations have improved a number of factors in this regard, including data security, effectiveness, protection, analysis accuracy,

and transparency, among others. By applying blockchain to healthcare services, data security can be improved across the board, ensuring the protection and security of patients' medical information.

Another study [8] reviewed how blockchain technology characterizes the concerns and the functionality identifies the blockchain-based solution for food traceability concerns, includes the advantages and challenges of the blockchain-based traceability systems, helps the researchers and scientists to apply blockchain-based food system by proposing a suitable framework, and analyzing flowchart for the blockchain-based food traceability systems. This paper examines food acceptability and provides critical information to researchers and professionals on the most ideal approach to use blockchain-based food structures.

Researchers [9] also investigated the mechanisms used in blockchain technology and analyzed the security protection and lack of transparency in digi-cash. Blockchain has become a hot issue in the market due to its qualities of decentralization, verification ability, and protection against alterations. Blockchain is a key strategy that can maintain Bitcoin and achieve data encryption while remaining anonymous and secure.

A review [10] of blockchai focused on the existing public key infrastructure (PKI) innovations and the key administration of a blockchain wallet. The PKI is used in blockchain technology to guarantee the verification of the entities and the integrity of the blockchain. To maintain privacy of the records in the blockchain, a group key management scheme for batch correspondence was proposed.

The potential of blockchain technology in the energy sector has also been discussed [11]. The energy sector has expanded the use of renewable energy sources beyond decentralization in the market. Blockchain technology plays a key role in this ongoing change by offering decentralized interfaces and frameworks as a possible way to deal with the current associations in the energy market. Blockchain incorporates all socio-specialized and authoritative setups in the energy sector, dependent on the usage of the blockchain technology for energy exchange, data stockpiling, or expanded direct energy services.

Another paper [12] examined the connection between blockchain innovations and social networking sites. In recent years, the decentralization of social networking administration has been viewed as a major opportunity to tackle numerous issues on online informal communities. Blockchain is a decentralized strategy that has been considered to establish a new age of social networking platforms. This paper examined the platforms in detail by describing the administrations they offer, their primary advantages, and their disadvantages.

Another paper [13] described how blockchain can be used to support economically important systems. The execution of blockchain is isolated form the external world and hence requires the blockchain operators or agents to get the data from the outside world. Despite the fact that blockchain is considered to be very dependable, agents and operators are off-chain segments that could be a point of failure in the whole blockchain-based network. Accordingly, the paper examined the dependability of the instruments, as well as upgrades for the weak connections in a blockchain-based framework.

The incorporation of blockchain with 5G systems has also been explored [14]. 5G wireless systems still face some security challenges, including decentralization, transparency, information interoperability, and system security. Here, blockchain becomes an integral factor because it is very important for 5G to have decentralized and secure provisions. Blockchain may engage significant 5G administrations, including execution, information sharing, and virtualization.

The possibility of overcoming the disadvantages of distributed cloud storage by blockchain technology have been discussed [15]. The expanding number of cloud storage customer leads to issues with the integrity of the cloud. The traditional examining scheme excluding the third-party auditor or evaluator which is not always available in the outside world and also tends to increase the price of the service. Consequently, a blockchain-based smart contract may increase capacity.

An information-sharing model based on a transformative game hypothesis using blockchain with smart contracts has been proposed [16]. Information-sharing methods have been considered to fundamentally reduce recurring work. However, there are difficulties with respect to the arrangement of common trusted connections and the expanding degree of client support. Blockchain 2.0 with smart agreements has the option to automate trusted transaction between users.

Smart contracts have been examined in another paper [17]. They could allow engineers and developers to send decentralized and secure blockchain applications for IoT. To allow smart contracts to obtain off-chain information, the paper proposed an information exchange that is savvy and flexible for a blockchain-empowered IoT environment.

Elsewhere, researchers [18] proposed a convention for contract marking that is dependent on blockchain innovation. Electronically signed agreements are fundamental for web-based business exchanges, so contract signing conventions should facilitate trade. The method proposed in this paper does not need third-party verification. The proposed convention fulfills the essential security requirements.

An overview [19] of the various uses of blockchain technology in financial transactions is provided elsewhere. Blockchain offers unprecedented opportunities for innovation in financial transactions in banking, money transfer, insurance, and lending. This paper examined the risks, security requirements, and challenges of such innovations.

5.3 Survey of Existing Blockchain Platforms

This section discusses the various blockchain-based platforms that have emerged in recent years.

5.3.1 Waltonchain

One of the platforms for the IoT sector is Waltonchain. Waltonchain can integrate the transparency, responsibility, and provenance properties of blockchain technology with radiofrequency identification (RFID), which is used to capture and read information that is stored on a tag attached to an object equipped with IoT hardware.

The Waltonchain open blockchain platform and the software stage or platform that uses or interferes the hardware with the blockchain. The general aim of Waltonchain is to assist with Value IoT (VIoT), which is appropriate for a broad range of IoT applications, such as supply chain racking, authentication, and identification and so on.

Waltonchain consists of two types of blockchain: the parent blockchain and the child blockchain. Waltonchain is a public blockchain platform, which allows anyone to participate. A child blockchain can be either public or private, depending on the use case. Child blockchains may be designed according to the prerequisites, such as for implementing trade fundamentals for a particular industry or use case. The newly created child blockchain uses a unique exchange that is documented in the parent blockchain. Waltonchain uses a half-and-half agreement calculation known as Waltonchain Proof of Contribution (WPoC). WPoC is a mixture of three distinct agreement calculations: Proof of Work (PoW), which is used in Bitcoin; Proof of Stake (PoS), a stake-based agreement calculation; and Proof of Labor (PoL), a formula for cross-chain information transmission.

5.3.2 Origin Trail

Origin Trail is a decentralized, open blockchain information sharing platform for multiorganizational conditions. The platform integrates the blockchain technology with supply chains to allow or permit supply chain immutability and integrity. The aim is to provide a typical blockchain-based arrangement with a boosted convention to guarantee item norms and the security of clients or purchasers.

Origin Trail uses an Electronic Product Code Information Service (EPCIS) system to encourage a layered, extensible, and measured plan over the whole structure. The Origin Trail environment can be viewed as a four-layered system: At the top of the blockchain layer, there are two system layers—the system and information layers, which actualize an off-chain decentralized shared system known as the Origin Trail Decentralized Network (ODN). On the head of the system layer, there is a decentralized application layer, which interfaces between the clients and the structure to provide information input. The current version of Origin Trail executes a PoW that runs on the head of the Ethereum blockchain. Future versions are anticipated to include distinctive blockchains with various agreement calculations.

5.3.3 IBM Watson

IBM Watson is a coordinated innovation consolidating Watson IoT stage and blockchain. Watson use a Hyperledger Fabric system to provide blockchain administrations. It can capture information continuously by IoT gadgets and provides data analyses to the client.

The Hyperledger venture is a two-way application between IBM and Linux Foundation to create a venture-grade, open-source disseminated record system and code base. The aim of this undertaking is to provide an open-standard blockchain platform with the goal that any venture can assemble its own solution. There are a few dynamic ongoing tasks in the Hyperledger venture, such as Burrow, Fabric, Sawtooth, Iroha, and Indy. Texture is the most pertinent stage in this group; it is a permissioned blockchain framework with measured design that arranges various kinds of algorithms. It also assists with the execution of smart contracts (called "chain codes" in Fabric) and enrollment administrations given by a Certificate Authority, overseeing X.509 endorsements that are used to validate roles and jobs.

There are three types of hubs in the Hyperledger Fabric:

1. **Orderer node:** This node provides a correspondence channel to customers and peers, over which messages can be communicated. Being a permissioned blockchain, it can uphold an impressive number of transactions. However, the number is dependent on the utilization case and how they are sent.
2. **Peer node:** This node maintains the records and obtains requested updates for submitting new exchanges to the record. "Endorsers" support an exchange by confirming whether it satisfies requirements.
3. **Client node**: Customer hubs follow up in the interest of end-clients and facilitate exchanges.

5.3.4 Slock.it

Slock.it is an IoT platform on the head of the Ethereum blockchain. Its objective is to build up a genuinely decentralized sharing economy that will empower immediate communication between a maker or proprietor and a customer of IoT objects. A sharing economy allows individuals to share their unused physical or virtual assets, such as housing, vehicles, power, or even time, for financially motivated reasons. The customary methodology requires a great deal of human mediation, with major issues regarding trust and transparency. In the current utilizations of a sharing economy, for example, Uber and Airbnb are not decentralized; rather, they depend on their monopolistic incorporated suppliers, which charge a significant expense. Security, trust, and transparency issues are predominant in such applications.

Slock.it intends to address these issues by providing a platform composed of IoT objects. The Slock programming platform and smart contracts based on the Ethereum blockchain have introduced completely computerized machine-to-

machine, machine-to-human, and human-to-human connections. The IoT items interact with each other through a smart contract or agreements conveyed in the Ethereum blockchain. An individual can communicate with each IoT object using a preferred gadget, such as their cell phone. Of note, Slock.it does not have its own blockchain. Rather, it uses Ethereum as its underlying blockchain stage. Subsequently, it depends on Ethereum's current consensus mechanism, compensating measures, and different properties.

5.3.5 NetObjex Platform

NetObjex is a decentralized advanced resource platform that utilizes IoT and blockchain to offer assistance to four significant market segments: supply chain and coordination, manufacturing, smart cities, and the automotive industry. The platform uses IoT for information exchange and supports a wide range of correspondence conventions, such as cellular, mid-run conventions (LoRA, Sigfox, NB-IOT), wi-fi, Ethernet, BLE (Bluetooth Low Energy), and other specific conventions (DSRC). Moreover, it empowers ventures to share data safely through blockchain and to authorize business rules through smart agreements. To guarantee authenticated access to delicate data, NetObjex stores them in cryptographically secure records using blockchain technology. The NetObjex platform provides an adaptable framework for clients to create and convey their own smart items. It coordinates various enormous databases, appropriates record advancements, and manages devices with its center blockchain middleware component to encourage interoperability and cross-correspondences among various segments. The NetObjex stage executes a normalized instrument for smart gadgets to communicate internationally with one another. To interface between the advanced resources used by various associations within a solitary environment, the platform uses an innovation layer through its IoToken system. It additionally supports IoToken local cryptographic money for interdevice exchanges.

5.4 Smart Contracts

Smart contracts are reshaping traditional industry and business practices. When integrated with blockchain, smart contracts allow the authoritative terms of an agreement to be upheld without the intervention of a third party. Ethereum is an extensively used platform for the execution of smart contracts. Thus, these smart agreements or contracts can reduce administration time and cost, improve productivity, and decrease risk. Smart contracts can be stored and managed in the appropriate blockchains in a peer-to-peer marketplace.

5.5 Tourism Industry

Digital innovation has caused rapid development in the travel industry. The capabilities of blockchain can reduce costs and increase the efficiency of processes, while also alleviating the risk of information double-dealing and increasing the degree of trust among the colleagues. In this manner, it is imperative to concentrate on all parts of blockchain innovation and its associations within and among businesses in order to foresee future changes in the travel industry [26, 27]. This innovation could affect several areas of the transportation business, including action plans, money transfer frameworks, security, execution, and trust [20].

Travellers need to display proof of identity in various stages during their trip, from booking through boarding and lodging registration. With the assistance of blockchain, this strategy can be disentangled so that tourists only need to show identification one time [21, 25]. SITA is a technology undertaking that gives IT backing and broadcast communications to the airline business. This organization has proposed a strategy that can simplify the traveler's journey and streamline their identifications. It utilizes blockchain technology to actualize a solitary and secure biometric personality framework that permits travelers to demonstrate their identity using a wearable or portable device during their trip. Therefore, identification cards, travel papers, and driver's licenses would not be required. For example, a customer may have a token that contains their own biometrics and various confirmations or verifications attached to it. Hypothetically, the traveler could then be identified using a biometric check combined with a token verification. None of the traveler's data would be shared or visible to organizations, as the entirety of the checks would happen in the organization's machinery. Blockchain innovation could be especially helpful in monitoring baggage, particularly during international travel when a customer's baggage may change hands more than once during their visit. The utilization of a decentralized database would make it easy to share records among organizations [23, 24].

5.6 Future Works

Military Use

Digital technologies have changed modern warfare. Nowadays, soldiers use connected devices for air strikes, and drones on the battlefield are controlled from remote locations. In the past, hackers could take control of the operator's terminal and could see, in real time, whatever the operators saw on their screens. Hackers could then compromise the system and send a pop-up alert on the user's screen. A London-based non-governmental organization warned in a January 2018 report that nuclear weapons systems are becoming increasingly vulnerable to cyberattacks. The Nuclear Threat Initiative, a US non-profit organization, published a report on cyberthreat to nuclear weapons. They concluded that there is a high Block Chain

Platforms and Smart Contracts possibility that US nuclear weapons systems could be compromised [13]. Considering these cyberattacks, a new paradigm is needed to address the vulnerabilities of defence systems. Blockchain can be a key player in rectifying these weaknesses. The potential benefits of blockchain to protect defence systems against cyberattacks can be presented as distinct use cases:

- Defending basic weapons frameworks
- Managing robotized, swarm frameworks
- Defending critical weapons systems

The system operator receives data from many sensors. These data notify command authorities about an incoming threat. Command authorities then direct the weapon to respond to threats. In a centralized system, there is one point of vulnerability that can be breached by external bad actors. Therefore, command authorities of the weapon system may receive deceptive information, which could lead to either illegal use of weapons or even failure to respond to a legitimate threat. Alternatively, when using blockchains, data transmissions from sensors to the operator are validated using a consensus system. Because a transaction is approved by most of the nodes within the blockchain network, any hacker would have to hack all nodes in the chain simultaneously. The computing power needed to hack such a system is magnificent [5].

Managing Automated Swarm Systems
Swarm robotics is a way to coordinate many robots as a system. It can implement a desired combined behavior from the connection between many robots, as well as the interaction of robots with their surroundings. The dependence of robots on communication and interaction opens a loophole for hackers. Blockchain proposes a mechanism to protect intraswarm coordination. In this system, each robot of the swarm acts as a node in their blockchain. In such an implementation, the swarm can exchange information and protect itself from cyberattacks [6].

Intelligent Transportation Systems
The intelligent transportation system (ITS) has potential in various fields, such as communication frameworks for vehicles and decentralized transportation frameworks. It is fundamental for modern smart vehicles to have continuous Internet access, allowing them to speak with one another with respect to their environmental factors, along with other transportation design improvements. In present-day ITS, smart vehicles are ready to speak with one another through different system interfaces, such as Bluetooth, wi-fi, and so on. Therefore, the decentralized and circulated nature of blockchain can make this framework more proficient. Moreover, the coordination of blockchain with ITS also highlights their security risks due to its start-to-finish encryption. The combination also improves security and trust, as well as protection against hazards in the transportation arrangements. For example, the vehicles can be associated with each another in a vehicular system of ITS; each vehicle will trade distinctive sensor data with one another. This correspondence can be made safer by utilizing the key encryption innovation of blockchain, so that no one from outside the system can view the transmission message. Moreover, clients

inside an open blockchain can obtain data with respect to different clients. In this way, the reconciliation of a safeguarding technique on the head of blockchain-based ITS design is required, and differential security can be the most appropriate decision for it due to its ever-changing nature.

Real Estate

Real state transactions should be straightforward and transparent. However, agents are commonly used to facilitate these arrangements. The transaction may include many intermediaries, such as specialists, assessors, and legal officials, which can be difficult and costly. To improve these circumstances, a blockchain-based land arrangement may be used to eliminate the need for brokers. A decentralized open blockchain would allow vendors to promote their properties using the broadcast facility in the system; in addition, purchasers can select their ideal properties, make exchanges, contact dealers, register properties with their names, and broadcast the offer to the system using a blockchain-based site. Along these lines, blockchain would eliminate the utilization of mediators, thus reducing the overall cost.

This framework would work like Bitcoin, which has been effectively operating for a decade. So far, a few projects integrating blockchain for real estate have been done by analysts, such as MultiChain and South African Blockchain models. These blockchain-based land frameworks are quite secure and productive. For example, after the successful acquisition of any property or while promoting a particular property, the identity of the purchaser and vendor would not be exposed [22].

Blockchain technology enables a trade or exchange between the purchaser and vendor, without the involvement of any third party. Making false name (pseudonym)-based identities will provide a sense of insecurity for the people who are often trading and earning good returns. This being the case, then the protection using open key cryptography is not sufficient as there are experiments which show that the identity can be tracked using hash and public keys. To ensure this cycle, and so as to make it safer and private differential security based blockchain land framework will be a feasible arrangement.

Health Care Systems

Because of population growth, conventional healthcare frameworks are incorporating more mechanically advanced approaches, with numerous health-related gadgets for well-being support and continuous vital sign monitoring. These smart healthcare services can contain patient data that can help specialists and caregivers to monitor and investigate a particular ailment, even from remote locations. Because medical records are private and critical, where a minor change in any attribute may constitute a high health risk to a patient, it is important to protect these systems. Therefore, to improve security and trust, blockchain-based smart healthcare frameworks are expanding quickly. The secure nature of blockchain can support patients and emergency clinics in controlling the use and sharing of their information just to certain specialists. A few approaches coordinating blockchain-based security approaches have been proposed in the literature.

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