
INFRASTRUCTURAL DEVELOPMENTS OF INDIA- THE KEY FACTOR TO INTEGRATE BLOCKCHAIN IN LAND RECORDING AND LAND REGISTRATION SYSTEMS**Bipasa Sen**Research Scholar Department of Computer Science Engineering, RKDF University
Ranchi, India, bipasa30sep@gmail.com**Dr. Dipti Kumari**Prof. of Department of Computer Science Engineering, Sarala Birla University
Ranchi, India, dipti5679@gmail.com**Abstract:**

Blockchain Technology is beyond finance. After the revolution of Crypto currency like Bitcoin, its underlying Blockchain technology also started adopting in different fields. It started applying for any multi-step verifiable, secure, transparent and non- tampering transaction system. To make a digital friendly country, over the years the government has implemented various schemes. But different bureaucratic loopholes, lack of synchronization between different participating government departments and especially, India has an erratic system to keep land records, which leads to voluminous legal disputes and different fraudulent activities. The judicial department of the Indian Government suffers 66 percent of total civil suits which are associated with either land or property controversy and on an average the pendency of those cases are 20 years. Adopting Blockchain technology could minimize these problems and achieve a trustworthy, secure, economically viable, accountable, interoperable, easily accessible, immutable and real-time land registration and recording system and also immersive experience to the citizens with assured property rights. In this paper we will discuss about the infrastructural development required to integrate Blockchain in the Indian Land Recording and Land Registration Systems.

Keywords: Blockchain Technology, Land Registration, Land Recording, DILRMP, Smart Contracts

I. INTRODUCTION:

In India since the British period, according to the registration act 1908 [1], it considers only plausible property rights. Registration is a record of transactions and acceptable in the court for any kind of litigation. But due to the uncertainty of how many owners a piece of land passed through, tediously accessing all the historical records, it's difficult to identify 'confirmed ownership' [2]. The office of sub-registrar (SRO) is only undertaking deed registration according to the central registration act 1908 and is not liable for validating the ownership of the land[3][4].

The Government of India started digitization of land records to provide modern, transparent and comprehensive e-governance, but because of execution impediment, cyber-attacks and data theft like different flaws regarding personal data people are worried about chances of data loss and data security. So this centralised land record and land registration system which is always prone to

malfunction in every step should be tangled with a secure, synchronised and trustworthy technology to provide a homogeneous Right of Records (RoR) management system. Blockchain technology could be the most promising one in this respect. A pilot project 'Indiachain' organised by the Indian Authority NITI Aayog for exploring the Blockchain era in different sectors like supply chain, identity management, land records management, value chain, foreign exchange, power distribution etc[5] [6]and at the end achieve a sparkling improvement in the agriculture oriented economy of India.

The Immutable and decentralised ledger of Blockchain secure trust providing its users, a fastest and safest way to validate and verify the trivial part of information. Blockchain came-up with a single platform which integrates digitization of maps, spatial as well as textual data, survey/resurvey records, record of mutations and history of all updates of all land transactional settlement records in a reliable, secured, transparent and tamper proof distributed ledger with fasted, automated verification and validation process. Both for any types of land registration and title transfer process, users have to use this single Blockchain platform for their distribution of ownership rights. In this way existing land management systems need to be strengthened while maintaining the comprehensive legal framework that is capable of guaranteeing resource ownership.

The data structure of Blockchain is an append-only continuously growing list of records. Records are not feasible to change data after it has been enlisted to the block considering implementation of consensus mechanism associated with cryptographic hashing technique. Blockchain is an immutable, distributed, unambiguous ledger that stores data reliably according to timestamp, regardless of any central authority. Blockchain technology is therefore congruous for recording, managing, processing transactions, and tracing of immovable assets.

The rest of the paper is arranged as follows. Section II the components of Blockchain technology, section III Blockchain working procedure , section IV explains present land records and land registration system and its pitfalls, section V explains infrastructure required –stepping towards Blockchain, section VI explains pilot projects and proposed architecture, section VII explains consequences of Blockchain technology in land recording and land registration systems and section VIII explains conclusions.

II. COMPONENTS OF BLOCKCHAIN TECHNOLOGY

Following features enhances Blockchain technology [7]:

Node: Nodes establish the infrastructure of a Blockchain which securely stores and shares data. Nodes can be computers, laptops or even bigger servers that are all connected through the network and consistently interchange the latest Blockchain data to keep on updated.

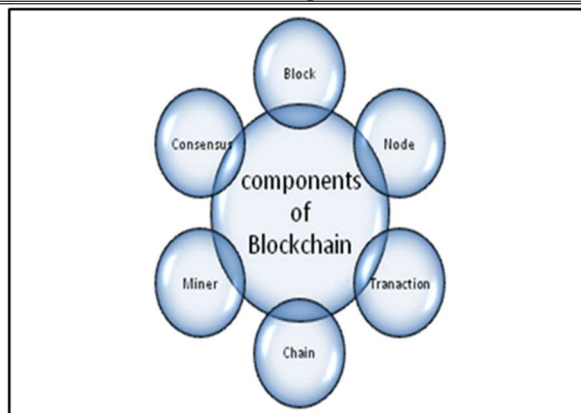


Figure 1: Blockchain components

Transaction: Transactions are individual settlements which assure an atomic event that is allowed by the underlying protocol.

Block: Block refers to a data structure that is used for keeping a set of transactions to be distributed to all nodes in the network. The first block in the chain is called Genesis. Each block in the transaction comprises two fields: the header part (nonce, timestamp, the hash value of the block and a hash value of the previous block) and the data part(record of transactions)[8].

- The data that is stored in each block depends on the type of Blockchain.
- A hash acts as a unique identifier of each block in a Blockchain. It is generated with the help of a cryptographic hash algorithm (following Merkle tree structure). The hash is a fixed length record consisting of some digits and letters.
- A block header also stores the hash value of the previous block and that's how it confirms the security of the Blockchain data structure.
- A nonce is a 4-byte value starting with 0 and whenever the hash calculation is performed, the value of nonce will also increment every time.
- With the help of a timestamp attribute, it's easy to track the creation time or time span of any transaction.

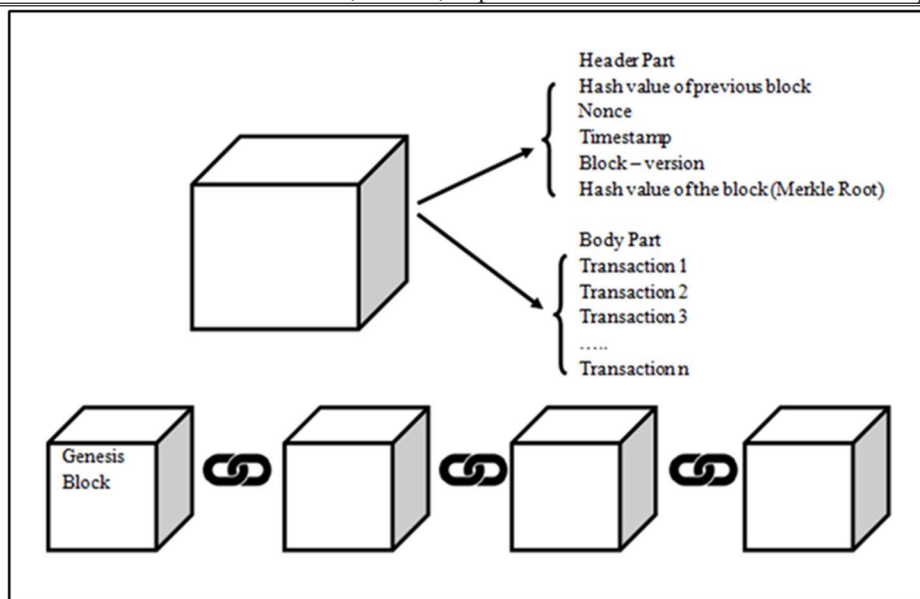


Figure 2: building blocks of Blockchain technology[8]

Chain: Blocks inside a Blockchain network are linked to each other and create an ever growing ordered list called chain.

Miners: Miners perform verification of each transaction and after a successful authentication process add the information of that transaction in the Blockchain structure.

Consensus: Consensus refers to the set of guidelines and algorithms. It governs Blockchain operations. The most popular two consensus algorithms and their respective incentive mechanisms are Proof-of-stake and Proof-of-work.

III. BLOCKCHAIN WORKING PROCEDURE [8] [9] :

Step 1: A transaction is requested

Step 2: The transaction then as a block is relayed to a peer-to-peer network that consists of nodes (computers).

Step 3: Then each node uses predefined algorithms to verify the user's status and validate the transactions. A

verification process of a transaction can involve cryptocurrency, contracts, records or other information.

Step 4: The participating network approved the transaction once verified.

Step 5: The new block is added to the existing Blockchain which is permanent and unalterable.

Step 6: The transaction is now finished.

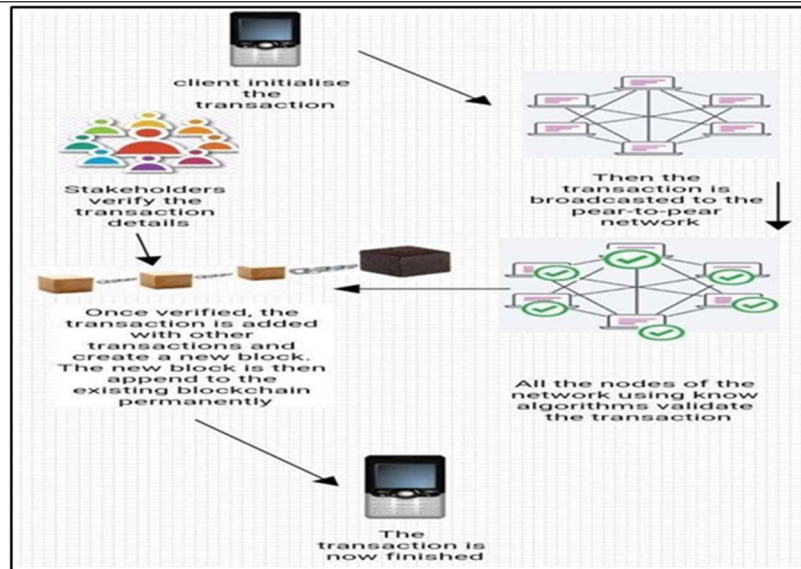


Figure 3: working procedure of Blockchain technology [8]

IV. PRESENT LAND RECORDS AND LAND REGISTRATION SYSTEMS:

For a huge population and growing economy as a fixed capital Indian land is becoming more precious day by day. But our present land registration and recording system is not able to support good governance due to lack of trustworthiness, security, transparency, reliability and very slow data processing. Registration is only recognized as an agreement between two parties for transfer of property. The office of sub-registrar (SRO) is only undertaking deed registration under the central registration act 1908 [10]. In this system SRO does not verify the ownership of the land. So property fraud is uncontrollable in many forms in our country. History shows that by modifying original registered documents, one can sell properties on the basis of modified documents. One can also sell the same property to multiple people by keeping each other under dark.

The BLRO (Block Land Records Office), SLRO (State Land Records Office) and DLRO (District Land Records Office) are the custodian of the land records in our country. They are the authority to maintain the land record details. Land records are under the jurisdiction of state laws [4].

Participants in the land registration process:

- Sellers
- Buyers
- Brokers(optional)
- Legal professionals.
- Sub Registrar
- BLRO (Block Land And Land Reforms Officer)

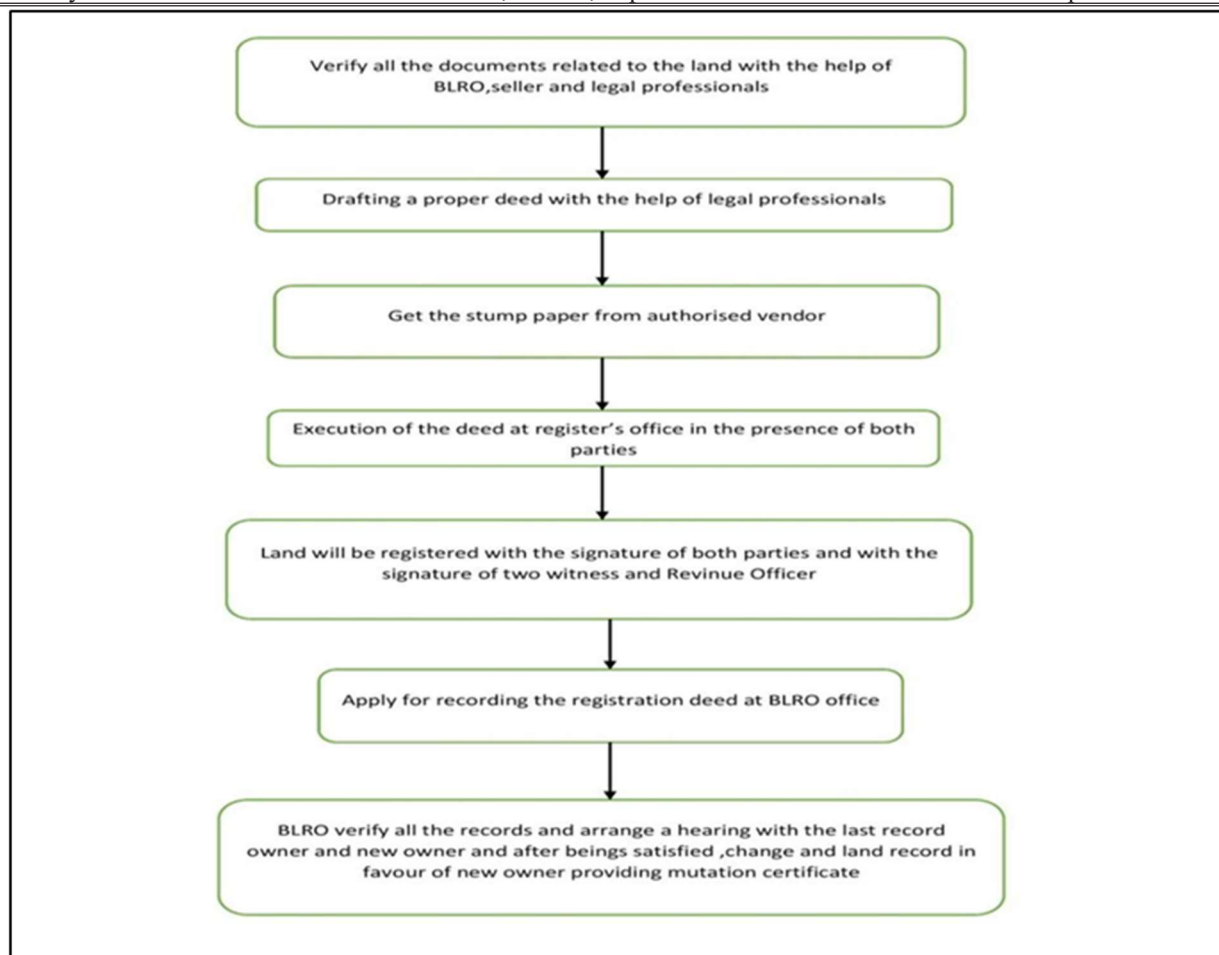


Figure 4: present land registration procedure [11]

This is not a trustworthy process because in every step there is the possibility of manipulations.

A. Major challenges:

Following chances of disputes involved in the present land registration procedure [4]:

1. Land related litigations are increasing due to growing number of fraud cases, corruption in the present system and outdated law
2. Present system has no unique record or golden record system. So anytime there is a possibility of manipulation.
3. Lack of IT infrastructure and cadastral records also not fully digitized. So a less efficient and pricey system to facilitate affairs like survey or resurvey.
4. If someone wants to get loans using land as collateral security, needs lots of paperwork which will create unnecessary delay and that too not foolproof
5. To collect documents like RoR (Record of Rights), mutation extract, crop certificate etc which are necessary for securing loan, subsidy and any other benefit from the Government, farmers have to spend time and money.
6. Additional cost incurred due to involvement of middle man and brokers.

7. Present registration process is time consuming due to lots of paperwork and physical visits.
8. It is difficult to track multiple selling of the same land or landed property.
Hence there is a need for trust to use a common source of data i.e. it has to be the single source of truth to perform approvals for different activities so as to avoid the problem.

V. INFRASTRUCTURE REQUIRED - STEPPING TOWARDS BLOCKCHAIN:

A. Digitization of land record:

Initial infrastructure of Blockchain based land recording and land registration system required the following policy: Digitization of land records, geo-referencing accompanied by map digitization, Aadhaar linked with each and every land or property, neoteric record rooms for data storage etc. Land Reforms (LR) department of Government of India has merged two Centrally Sponsored Schemes viz: Computerisation of Land Records (CLR) started in 1988-89 and Strengthening of Revenue Administration and Updating of Land Records (SRA & ULR) started in 1989-90 and started a new Scheme named National Land Records Modernisation Programme (NLRMP). In 21st August, 2008, the Cabinet redefined this scheme and approved a modernised version of these schemes named Digital India Land Records Modernization Programme (DILRMP) and also developed a hyaline and Integrated Land Information Management System (ILIMS) in the country[12]. Guidelines of DILRMP suggested state governments to fix a feasible cut-off date and thereafter no manual RORs will be entertained, only digitized RORS.

The initiatives of DILRMP has been aimed to digitisation of records as well as map maps and integrate textual and spatial data through Geospatial Information System (GIS) ; survey/resurvey ; automated registration system and automatic mutation, inter-connectivity among department of revenue, department of land land land reform and department of registration; and establish conclusive titling system where the title is guaranteed. But these processes are not uniformly installed in all the states due to various practical obstacles from basic trained manpower to lack of technical infrastructural development, data insufficiency/ mismatch/ errors and lack of initiative of state governments towards public involvement to secure their land records properly. Digitization of land records i.e. The Record of Rights (RoR) under the DILRMP scheme is 94.57% completed in 24 States and Union Territories till April, 2023[13]. The year wise progress report of computerization of land records (CLR) from 2017 to 2022 shown in the Fig.5 and current status of CLR completed (%) shown in the Fig.6.

B. Aadhaar link:

Since Aadhaar number is already compulsory to link with bank accounts of the individuals, it could make other procedures such as property transaction, sale or purchase of property, home loan, agricultural loan etc. easier and on the way of Blockchain technology adoption, it is another important step. The linking of 12-digit unique Aadhaar number will expedite for authorities to identify the owner of the property. For example: Chandigarh has developed an Android base Mobile application for consent based Aadhaar linking with property owners and their property. Fig. 7 shows the total percentage of ROR linkage with Aadhaar in villages 5.81% completed.

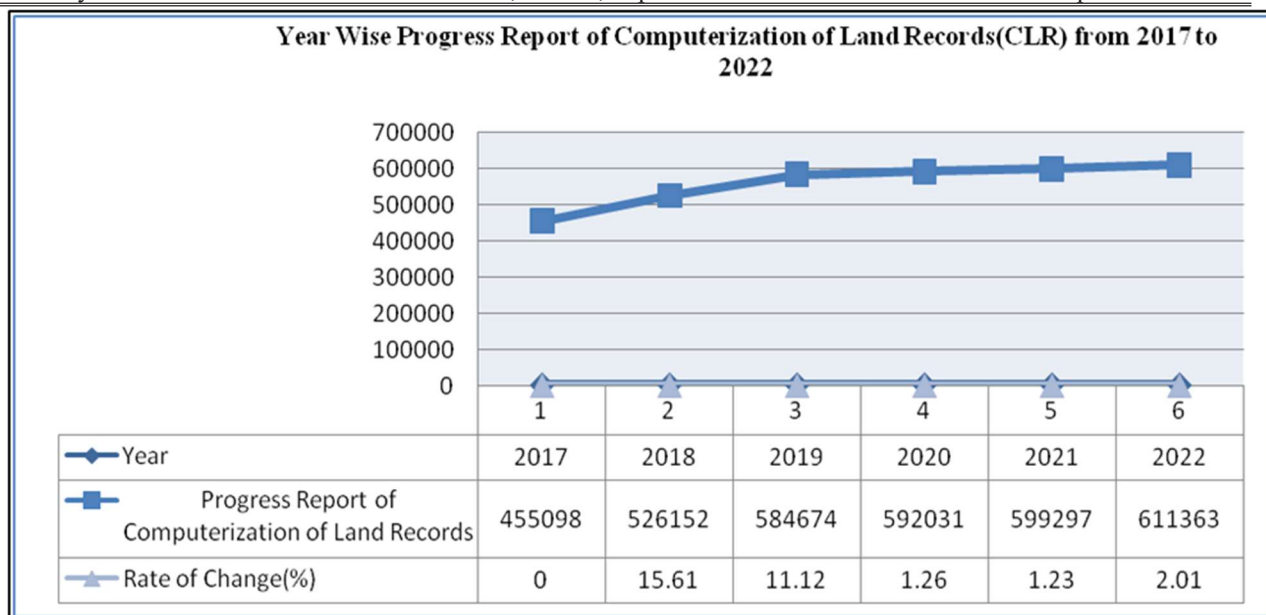


Figure 5: year wise progress report of CLR from 2017 to 2022

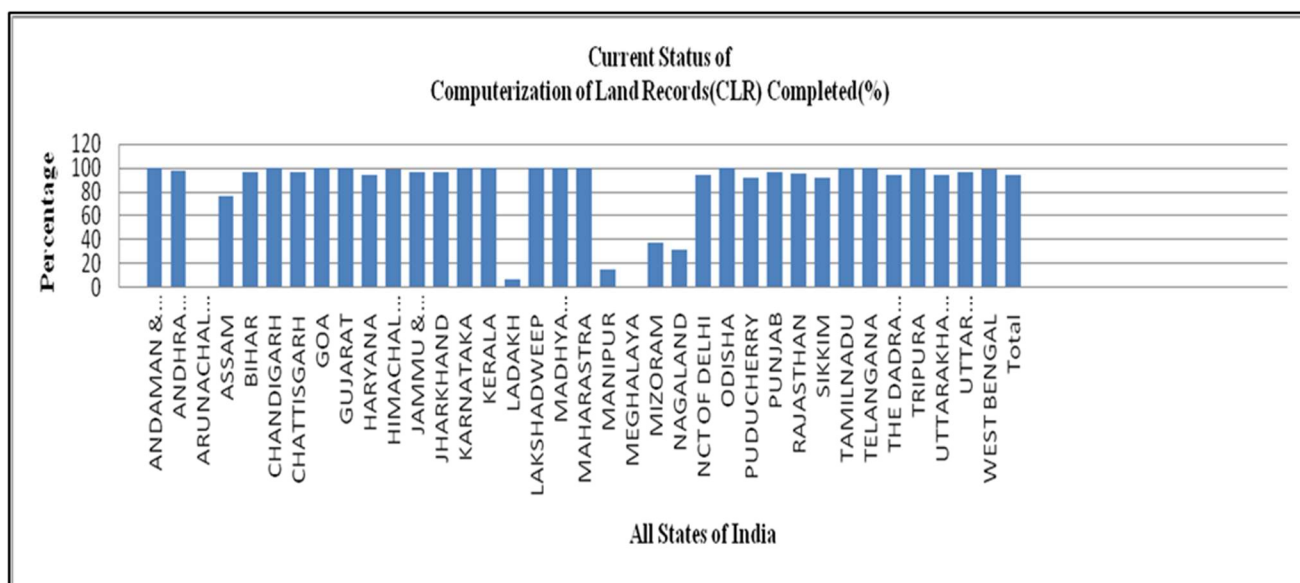


Figure 6: current status of CLR (completed %)

C.Modern Record Rooms:

It envisages modern record rooms with higher storage areas and modern high speed computers/ server computers. Because of unstructured data, storage capacity of those computers are also huge. All other related accessories like scanner, printer, network devices etc are also available. Fig. 8, shows the total percentage of the number of modern record rooms completed 85.75% and current status of all states and Union Territories(UTs) till April, 2023 [13][14].

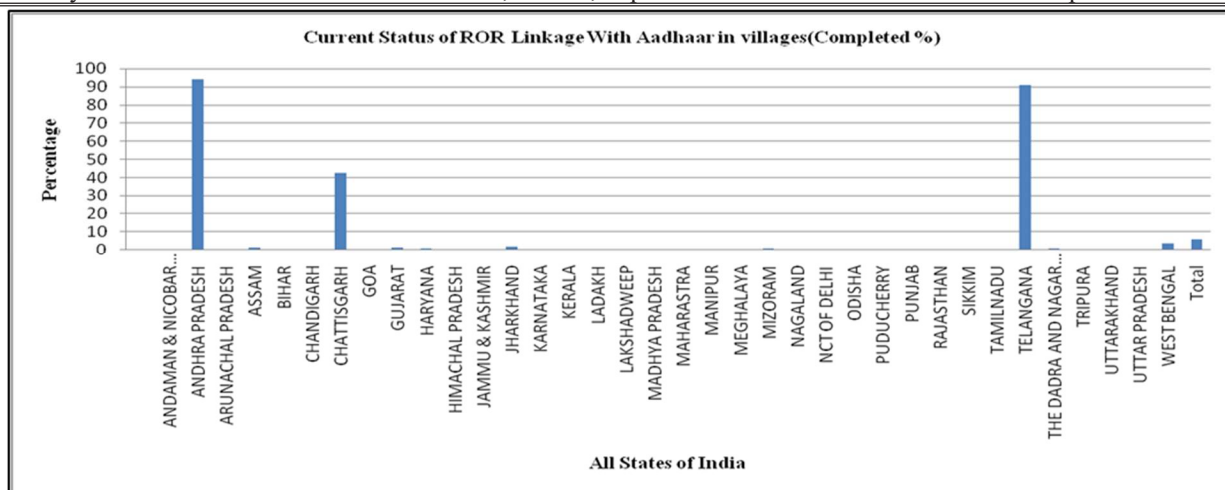


Figure 7: current status of ROR linkage with aadhaar in villages(Completed %)

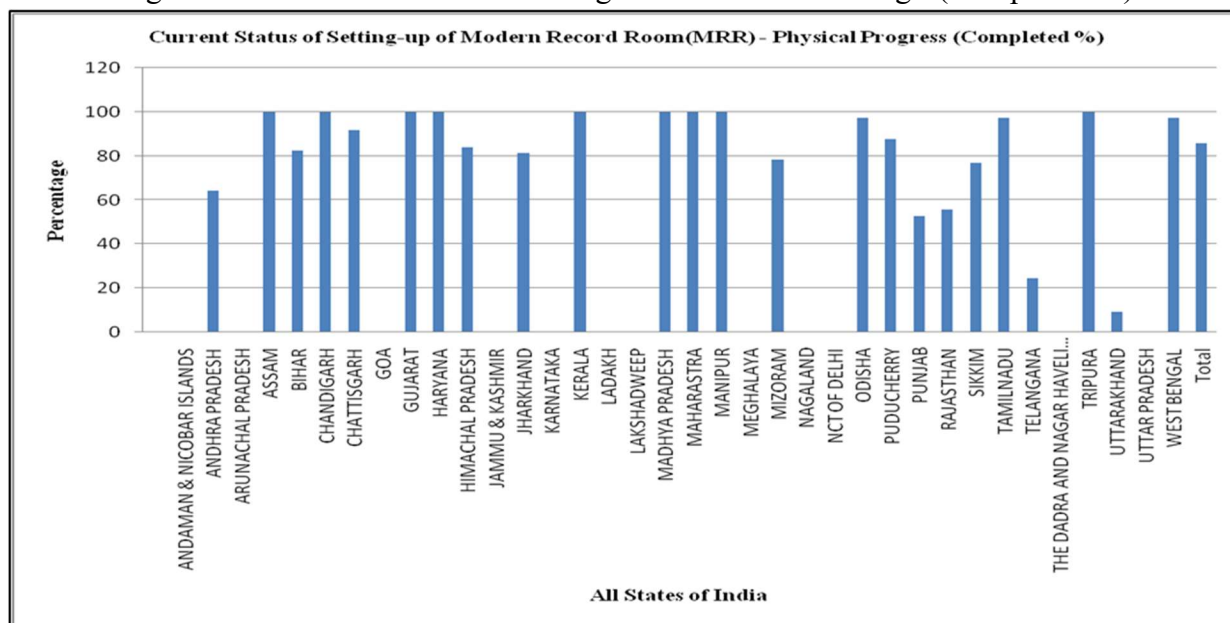


Figure 8: current status of setting-up of Modern Record Room (MRR) - Physical Progress (Completed %)

D. District/ Sub-Division/ Tehsil Computer Data Centers:

Another important aspect is Computer Data Centers. Computer Data Centers at the Tehsil level maintained property records village-wise. Whereas District Computer Data Centers will accumulate all the sub-divisional land records and Tehsils wise land records of the respective district. These District level records contribute state level data verification, analysis, planning etc. The total number of Tehsil Computer Center Completed in percentage till April, 2023, in all states and Union Territories (UTs) shown in Fig. 9 [13][14].

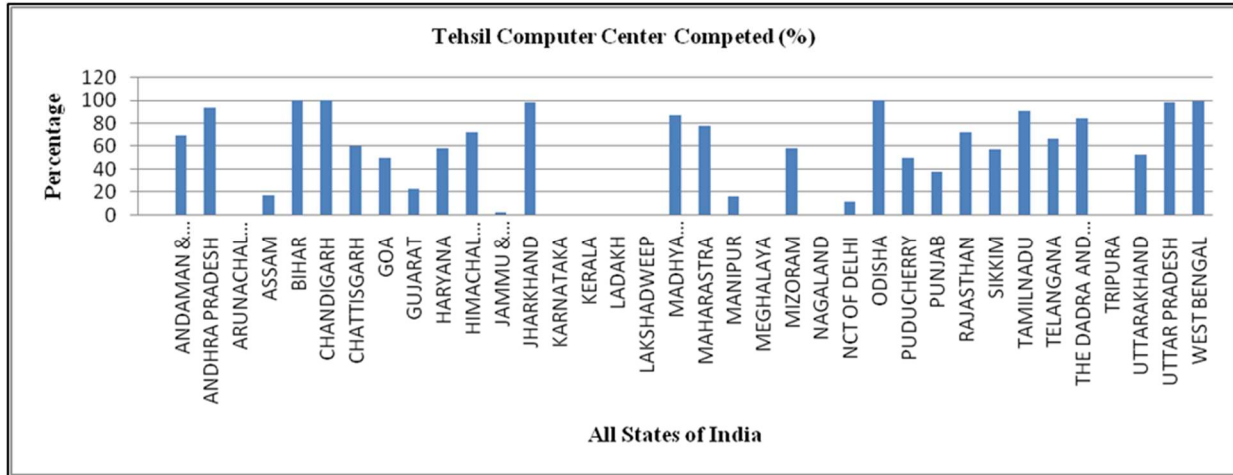


Figure 9: tehsil computer center competed (%)

E. Map Digitization:

Conversion of paper maps to GIS enable digitised cadastral form is also very urgent which integrate high resolution of satellite image (spatial data) and textual land records. So whatever updates happen in RORs it will always synchronize with cadastral maps. The total percentage of the map digitization completed 75.62% till April, 2023 in all states and Union Territories(UTs) of India with their current status[13][14].

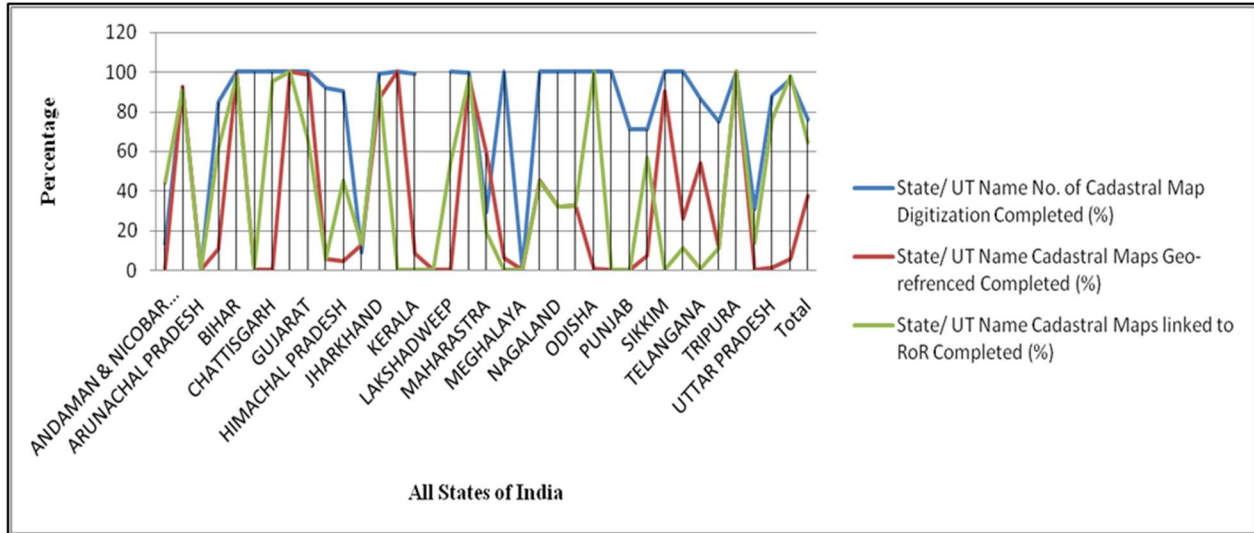


Figure 10: map digitization completed (%)

F. Unique Land Parcel Identification Number (ULPIN):

Besides Aadhaar linkage, another most important step has taken by National Informatics Centre (NIC) of Government of India under DILRMP scheme is Unique Land Parcel Identification Number (ULPIN). ULPIN, called 'Bhu Aadhaar' is a 14-digit Alpha-Numeric Unique ID or Conclusive titling for each land parcel. The identification will be based on the parcel vertices

specified in longitude and latitude coordinates (PNIL) of the land parcel and dependent on detailed surveys and geo-referenced cadastral maps. ULPIN helps to identify disputed lands and prevent transfer through registration systems. It will provide compatibility so that all states can adopt it easily and help to develop land banks based on each land parcel's geographic coordinates, ownership, and purpose of usage. Since it's a unique ID like Aadhaar, it also avail certificate-less e-governance. Pilot testing has been successfully carried out in 6 States and 13 states/Union Territories (UTs) started implementing ULPIN. They are Jharkhand, Goa, Bihar, Odisha, Sikkim, Tripura, Gujarat, Rajasthan, Maharashtra, Andhra Pradesh, Haryana, Chhattisgarh and Jammu & Kashmir [15][16][17][18].

G. Steady network services and trained community:

Before adopting a Blockchain based land recording and land registration system, we need a proper network infrastructure to support. Like presently used Infrastructure as a services (IaaS) and Software as a Service (IaaS & SaaS), for land recording and land registration systems also initially we can have Blockchain as a Service (BaaS) type of model from multinational companies [19]. So it will be more cost effective and beneficial to get uninterrupted network services.

Network services are not the only limitations, the community that will implement this system will have to adapt to this new arrangements. Starting from all land related offices personnel to all land owners, financial institutions and also judiciary departments will get used to this new Blockchain oriented system.

At the State level all land related government departments (District/ Sub-Division/ Tehsil) personnel from officers to ground - level workers required regular basis thorough training through different workshops, awareness/appraisal training short as well long term, hands- on training so that they should be familiar and operate this modern technology based system.

VI. PILOT PROJECTS AND PROPOSED ARCHITECTURE:

The Government of India has adopted Blockchain technology all over the country through pilot projects and has already been implemented in a few states [5][20][21]. Among several Indian states, the first flagship opportunity grasped by the government of Andhra Pradesh in 2017. The Andhra Pradesh government started a pilot project working with Swedish startup company ChromaWay as part of the Fintech Valley Vizag on Blockchain-powered land registry system [22][23].

Department of Land Registration of Gwalior, Madhya Pradesh has taken initiative to take up Blockchain -based land management systems. In this adventure the government has associated with PricewaterhouseCoopers (PwC) India along with Madhya Pradesh Agency For Promotion of Information Technology (MAPIT) [22].

IIIT – Hyderabad, National Informatics Centre (NIC), Government of Telangana, Tech Mahindra and Centre for Development of Advanced Computing (CDAC) have developed a Blockchain integrated prototype for property registration management system (PRMS) as pilot solution for Telangana and this project was so successful that under Digital India Category at the 66th SKOCH

summit, the Telangana government secured national level 'Gold Skoch' award in 2020[24][25][26].

A. Proposed architecture:

In this test platform squared land records need to be precisely saved in the land bank. First, the present history of transactions on a piece of land needs to be added into the private Blockchain after getting consent by Revenue functionaries of the State. Then using smart contracts, authenticated data will be digitally signed and saved. This will be a starting point for any mutation. Private Blockchain will then save the certificates issued by the Revenue Department and can be used by other agencies like the bank or finance institutions for any query of the verification processes during a transaction on the land parcel or owner. Any further change related to the transaction, the smart contract-based verification process should be done using blocked data and after modification, modified data of transactions should be saved in the Blockchain[4].

The registration department will fetch details using ULPIN from the Blockchain and ensure that the ownership of the land before initiating a sale. After obtaining the signature of the purchaser and seller in the sale deed, the scanned document should be moved into the Blockchain Network to create a new block. Once the block is created it cannot be tampered. Similarly, every time the property title is changed from one person to another a new transaction is added into the existing block or a new block and makes the Blockchain an ever growing list.

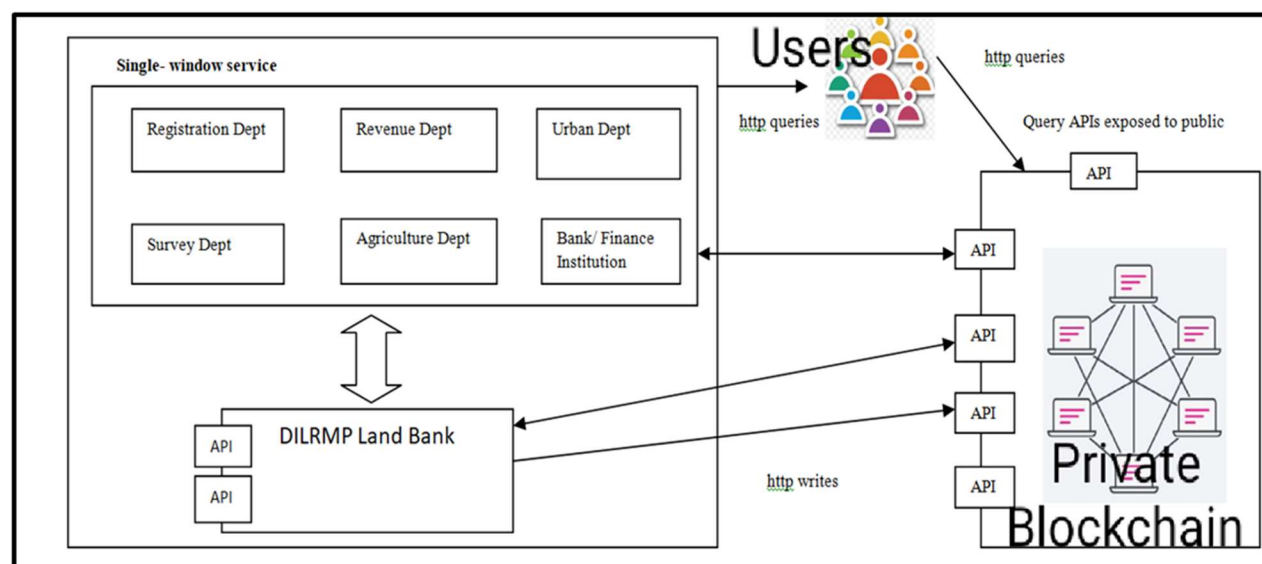


Figure 11: proposed architecture for land record and land registration System using private Blockchain technology with smart contract [4][27][28]

Smart contracts are similar to ordering contact but applicable through self-executed lines of codes which are stored on a Blockchain. Smart contracts have been executed when a predetermined set of constraints are met and verified to make an auditable, confidential, secure, speedy and cost effective electronic transaction among anonymous parties without the involvement of any third

party or central authority and legal system[29]. Data structure of smart contracts for land recording and land registration system where it contains following two types of attributes:

- Static attributes:ULPIN, Geo-Coordinates(latitude and longitude)Plot no, Allotted area, Land use, Boundary Information, Category- (forest land, government land, barren land....) etc and
- Dynamic attributes: Owner Name, Aadhaar number, Mortgage Information, Litigation status, Related court case numbers, Building Approval (In case of Residential), Sub- divided Property IDs, Parent Property ID, Category- (Residential land, water body, government land, barren land....) etc[30][31].

So, we can query the smart contract to find a certain piece of land and see all related details. Also, implementing smart contracts, certain events such as registration of the land,approval of loan by the bank, crop details updating can easily be facilitated by Blockchain [6].

VII. CONSEQUENCES OF BLOCKCHAIN TECHNOLOGY IN LAND RECORDING AND LAND REGISTRATION SYSTEMS:

Blockchain enabled land recording and registration systems become a blessing over the error-prone contemporary land record systems. Cost transparency among all stakeholders makes the country more progressive. Also all landowners can lead to stress-free ownership rights and plentiful benefits in the land management system as a consequence of Blockchain alliance [32]. Fig.13 shows consequences of Blockchain technology in land recording and land registration systems.

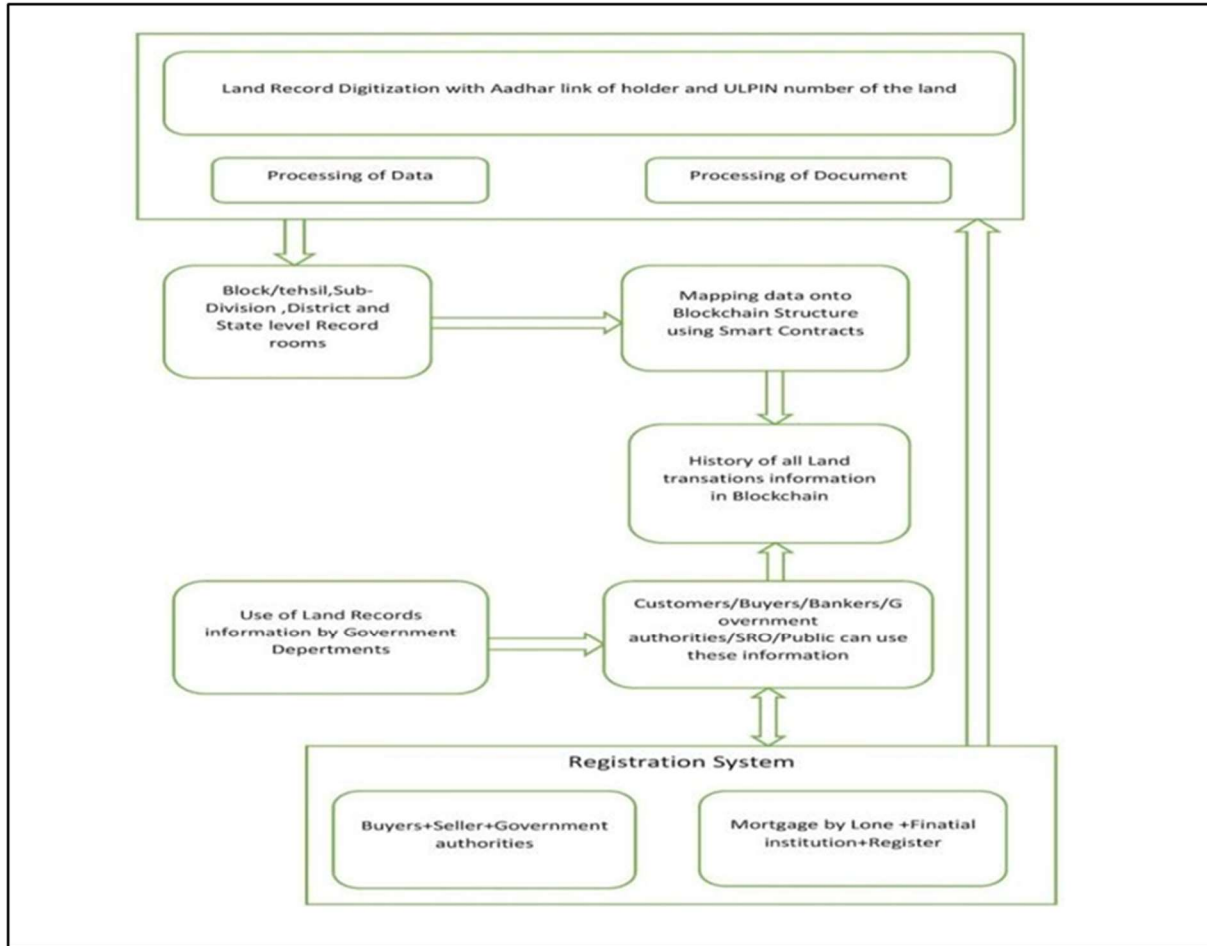


Figure 12: physical layout of dataflow through Blockchain-based land and registration systems.

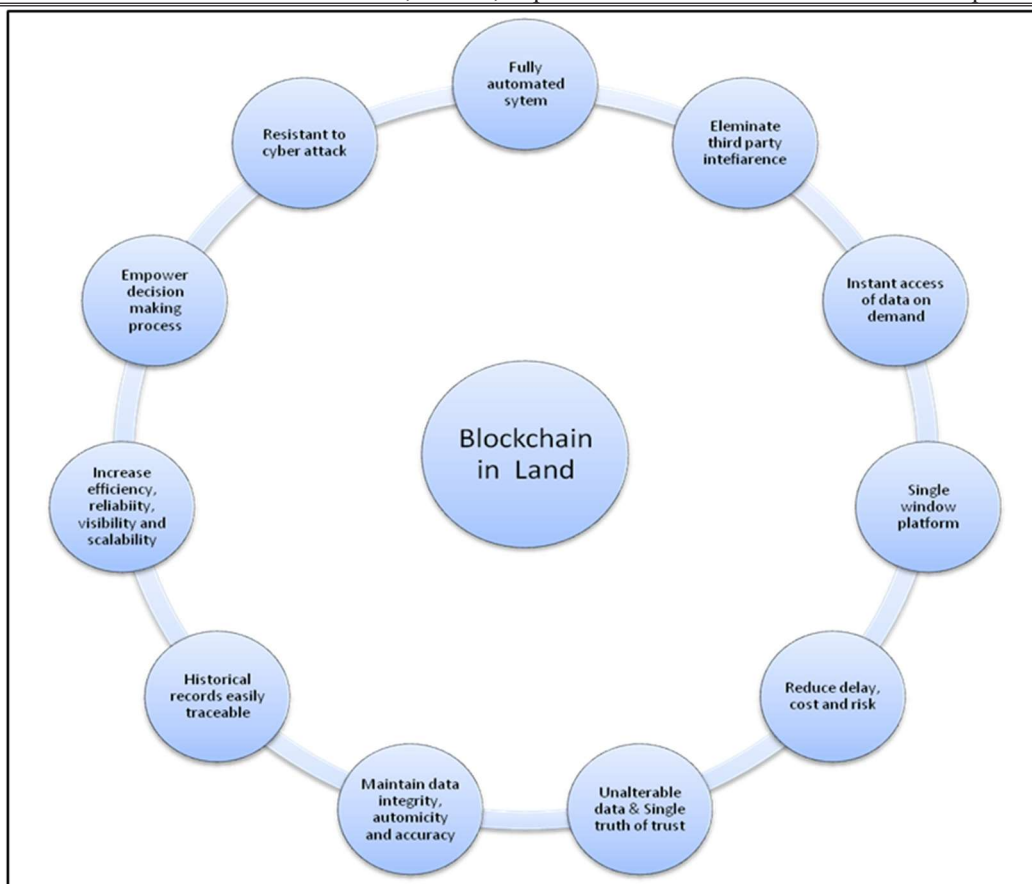


Figure 13: consequence of Blockchain alliance

VIII. CONCLUSIONS:

In this paper, we have discussed various components of Blockchain technology, its working principle and have exchanged views on the present Indian land registration and land recording system and its several barriers. Also, we have considered the necessary infrastructural development required to integrate new Blockchain technology with existing systems facilitating an improved, scalable, transparent, efficient, robust and sustainable system over traditional one. Few Indian states has already been launched Blockchain based land management system as a pilot project , but to reach all over the country, firstly, the government needs to emphasize completion of the Aadhaar link of land and Unique Land Parcel Identification Number (ULPIN) for each land parcel and secondly, infrastructural changes and getting awareness of this technology among common people.

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