Securing Land Records through Blockchain

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A blockchain, is a continuously growing list of records, called blocks, which are linked and secured using cryptography. Each block typically contains a cryptographic hash of the previous block, a timestamp and transaction data.

By design, a blockchain is inherently resistant to modification of the data.

A blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without the alteration of all subsequent blocks, which requires collusion of the network majority.
Introduction

“Blockchain creates a shared replicated, permissioned ledger with consensus, provenance, immutability and finality”

REQUIREMENTS FOR BLOCKCHAIN

Shared Ledger – Record all the transactions across the departments transacted between entities (G2C, G2B, G2G). Participants in the network shall have own copy through replication and permissioned so that they can view only appropriate transactions. This defines the shared system of record.

Smart Contract – Business terms embedded in transaction database and executed with transactions which is verifiable, signed and encoded in programming language.

Privacy – Ledger is shared, but citizens visibility is secured by not linking their identity to the transaction. These transactions will be authenticated by a cryptographical hash

Trust – Ledger is a trusted source of information, as relevant authorities endorse transactions and these endorsed transactions are added to the ledger with appropriate confidentiality and possess a verifiable audit trail where transactions cannot be modified, inserted or deleted. This is achieved through consensus, provenance, immutability and finality.
Public Blockchain as the name suggests, anyone/public can participate in Reading, Writing and Auditing the blockchain. These blockchains are open and transparent hence anyone can review anything at a given point of time on a public blockchain.

E.g. Bitcoin, Ethereum, Litecoin

Private Blockchain, unlike public there is an in-charge who read, write and provide access to participants in the network. In-charge provides the secure access to the parties to audit the blockchain.

E.g. Multichain, Hyperledger, Corda

Consortium or Federated Blockchain, unlike public or private, autonomy gets vested with a group of participants.

E.g. R3

Hybrid Blockchain, combination of the private and public blockchain. This system adapts private permission-based system as well as a public permission-less system.

E.g. Dragonchain
BENEFITS OF IMPLEMENTATION

Shared Reference Data provides consolidated, consistent dataset reduces errors
Provides near real-time access to reference data
Supports Code editing and routing code transfers between entities in the network
Increases trust through shared processes and recordkeeping
Improvement in System Utilization
Lower cost of audit and regulatory compliance
Provides access to the auditors and regulators
Change the nature of compliance from passive to active
Increase the speed of execution with reduced cost
Reduces risk – Tampering, fraud and cybercrime
Current Challenges of Land Registry

- Errors in public records affects ownership rights and cause financial strain
- Unknown liens (unpaid debts) by the prior owner creates issues with distressed properties
- Illegal deeds by not documenting prior titles in the chainage may affect the ownership
- Forged or fabricated documents affect the ownership
- Undiscovered encumbrances
- Unknown easements affects right to enjoy the property
- Boundary / Survey Disputes
- Undiscovered will by the deceased owner
- False impersonation of previous owner
Concept of Dematerialization of Deeds

“Dematerialization is the **phased transformation** of paper-deeds with digital deeds ”

- **Objective of Dematerialization of Deeds**
  - to create a golden record, which will provide a reliable record of information about ownership of and interests affecting land and property
  - to provide owners with a land title, guaranteed by the government
  - to provide a title plan that indicates general boundaries

- If the title in the registry is proved to be defective in any way, then the person or persons suffering loss as a result, must be able to claim compensation thru **Title Insurance**
Demat of Deeds – Implementation Steps

Pre-requisites for Demat of Deeds

○ Enactment of AP Property Depositories Act
○ Single agency to manage property records, by establishing AP Property Depositories Agency
○ MIRROR PRINCIPLE – Property records mirror ground reality always i.e. in real-time
○ CURTAIN PRINCIPLE – Probing into past transactions, before a cut-off date
○ Provision of Conveyancing Services through professional lawyers
○ Enhancing existing applications to suit the requirements of Demat
○ Standardization of content of Deeds through Templates
○ Title Guarantee & Insurance provided by the Govt. for indemnifying any loss due to inaccurate land records

Demat Scheme may be implemented optionally for 2 years and mandated later
Towards Dematerialization..

- **Economic Value** – Better access to formal credit, higher land values, higher investment in land, and higher output/income
- **Business Value** – Ease of Doing Business
- **Risk Value** – Title Insurance as a system of Title Assurance
Blockchain for Demat Land Registry

Blockchain is a distributed, shared, encrypted database that serves as an irreversible public repository of information

- Benefits of Blockchain Technology underneath the Land Registry
  - Absolute record of title where the value will be exchanged over a network
  - May revolutionize contract law and processing capabilities without human intervention
  - Blockchain records are visible to all, even as viewing function hence shared or distributed ledger
  - After verification happens, approved on distributed ledger, will be reflected in real-time
  - Blockchain records are always tamper-resistance, immutable and auditable
Concept of Trading of Deeds

“Trading of Deeds refers to **online purchase and selling of digital deeds** ”

Objective of Online Trading of Deeds

- to create a platform for online purchase and selling of urban and rural land parcels
- Security and transparency in land transactions
- to increase the velocity of land transactions

Pre-requisites for Trading of Deeds Online

- Dematerialized land parcels
- Registration Department to manage online and offline land transactions
- Provision to Registration Dept. for dynamic fixation of prices
- Enhancing existing applications to suit the requirements of Trading
Business Orchestration for Online Trading of Deeds

- Online Trading of Deeds
  - Buying
  - Selling
- Blockchain DB
- Dematerialization of Deeds (Single Source of Truth)
- Document Management System

Departments involved:
- Panchayat
- MAUD
- Revenue
- SSLR
- All Departments
Benefits of Dematerialization and Online Trading

Dimensional Analysis

- Economic Value
- Business Value
- Risk Value

Outcomes / Benefits

1. Immediate Transfer of Titles
2. Establish Proof of Ownership
3. Cost Effective Transactions
4. Secured Record of Titles
5. Direct Beneficiary Transfer
6. Boost State Economic Growth
7. Minimization of Frauds

Recommendations

- Blockchain Tech for Land Records
- Auto Mutation
- Interoperability
- Title Insurance
- Building Trust
- Other Recommendations
Changes Recommended

1. Fundamental Changes
   Requiring new enactments / major amendments to law

2. Procedural Changes
   To improve efficiency, convenience & transparency

3. Institutional Changes
   For Scalability and Sustainability
Fundamental Changes - Recommendations requiring new enactments / major amendments to law

1. **Building Trust:** To ensure that Land Registry creates single source of truth for both citizens and government

2. **e-Stamping:** To enhance Citizen experience by enabling them with an online channel and channel through authorized banks for paying stamp duty and registration fees and to prevent fraudulent transactions by tracking / accounting of stamps

3. **Interoperability Policy:** To maximize the opportunities for cooperation amongst people, processes and applications to deliver seamless and customer-centric Land related services, and to promote system integration and reuse
Procedural Changes - Recommendations to improve efficiency, convenience and transparency

1. Auto-mutation and Online Mutation (e-Mutation) and Real-time Dashboard: To provide Real-time dashboard to get the details of mutation, online application for mutation, Suo-moto mutation after completion of registration

2. Fraud Prevention Mechanism: To create trust amongst property holders

3. Block Chain for Property Registry: To maintain the trail of the transactions in land records.

4. UIDAI, Aadhaar Registered Devices: To make the land transaction secure through the devices with end-to-end traceability

5. Financial Recommendations: To make the proposed value-added services operationalize in a self-sustaining manner
Institutional Changes - Recommendations for scalability and sustainability

1. **Land Management Authority**: To institutionalize an apex authority for undertaking strategic and tactical decisions regarding all aspects of the Land Management

2. **Customer Relationship Management**: To provide a Single point of contact for the stakeholders and to enable effective issue resolution by government officials in lesser time.

3. **Conveyancing**: To validate the history of transactions and ownership prior to the registration of a property deed
Securing Land Records through Blockchain

Amaravati - Capital City
Maps – Capital Region

AP CAPITAL REGION DEVELOPMENT AUTHORITY

2/3/2020 APCRDA 19
9 thematic cities

- Stadiums, academies and swimming pools
- Cultural places of interest, museum, convention center
- Secretariat, Legislative assembly and all government buildings
- High courts, legal firms, arbitration centers
- R&D centers, IT centers, incubation centers
- Finance institutions, banks, insurance companies
- Cultural City
- Knowledge City
- Health City
- Sports City
- Government City

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
<th>Employment</th>
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<tbody>
<tr>
<td>Tourism</td>
<td>2,62,793</td>
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<td><strong>36,00,000</strong></td>
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Mar 2018  APCRDA  21
The land pooling mechanism is mainly adopted for development of the Capital City area.

In this process, the land parcels owned by individuals or group of owners are legally consolidated by transfer of ownership rights to the authority.

It later transfers the ownership of a part of land back to the land owners for under taking of development of such areas.

In Land Acquisition process, there will not be any link between the land owner and the Government after payment of land compensation and taking over the possession of land. Whereas, in LPS the land owner will be getting Returnable Plots for the land he has given consent.

In the LPS, he is the partner and the bond between land owner and the Government will be continue further in developmental activities.

All the major decisions regarding implementation of LPS in Capital City i.e. package for Returnable Plots, Execution of Development Agreements, finalization of Master Plan, Allotment of Returnable Plots, development of Infrastructure etc. will be taken in consultation with the land owners.
Options to select returnable plot sizes among 498 Residential & 497 Commercial Categories has been provided

Allotment is completed in 22 Revenue villages out of 24

60533 plots allotted to 24767 land owners

- **Residential**: 35737
  - Dry: 25649
  - Jareebu: 10088

- **Commercial**: 24796
  - Dry: 19723
  - Jareebu: 5073

Total plots allotted: 60533

- 1573 Villa plots allotted.

- Lottery done for the Extent Ac. 30707.91
# Allotment of Returnable Plots – Unit Wise

## Details of Returnable Plots Allotted Village wise – 03.04.2018

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<th>Unit No</th>
<th>Name of the Village</th>
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<td><strong>35737</strong></td>
<td><strong>24796</strong></td>
<td><strong>60533</strong></td>
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</table>
## LPS Process – Total Land Details

**TOTAL GEOGRAPHICAL EXTENT**: 53748.00

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<th>Govt. Land Total: 14888.25</th>
<th>Private Land Total: 38859.75</th>
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<tr>
<td>Tanks / River / Water Bodies</td>
<td>Patta Lands 34072.16</td>
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<tr>
<td>Lanka Government</td>
<td>Endowment Lands 1017.037</td>
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<td>Path / Road / Donka</td>
<td>Wakf Lands 27.27</td>
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<td>Village Site (RSR)</td>
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<td>Burial Grounds</td>
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<td>Private Land Total 38859.75</td>
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<td>Assigned (RF)</td>
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<td>Lanka - Assigned</td>
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<td>Eroded</td>
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<tr>
<td>Extended Habitation</td>
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<td>Grazing Ground</td>
<td>31.62</td>
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<tr>
<td>AW / UAW</td>
<td>38.07</td>
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</table>

Govt. Land Total **14888.25**

Private Land Total **38859.75**
Solution Architecture

APCRDA
Land Records System
(GIS Server)

Query APIs exposed to public

User

Query APIs optionally exposed to public

PRIVATE BLOCKCHAIN
Problems with current state of land records

- No **Golden Records** of Ownership for Registrars to verify validity of documents or transaction itself
- No Mechanism in place to check Duplicate or **Fake document** based registrations
- No **Unique ID** for properties Land, House or Apartment unit

“70% of the 3 Cr+ pending cases with Indian courts pertain to disputes of land or property”

Current system plagued with challenges such as Incomplete Records, Forgery, Fake Documents etc.

Blockchain offers a compelling solution to the problem of combining accessibility with privacy and security. Ensuring 100% **Tamperproof** and **Hackerproof**
Implementation Process

• Blockchain solution integrates with existing department systems thru API calls & co-exists non intrusively.
• Uses http API calls – can integrate with systems/GIS Systems on different technical platforms.
• APCRDA GIS System data (Land Information) has been stored in Blockchain thru Geo-json format.
• Modifications/Alterations of land records to be followed the process and option is given for Authenticated Users only.
• Upon User request, GIS System(ArcGIS Server) generates Parcel images (Parcel,Block & Colony level location maps) along with Coordinates and Centroid of Parcel for Registration.
• Request API at Block chain server generates Block Chain Certificate embedded with QRCode (Information of Property).
• Flexible & option based:
  • Existing systems include all transaction validation business logic & call APIs of Blockchain for respective data.
Attributes of a Property

**Static attributes:**
- PropertyId (System generated OR APCRDA system id)
- Geo-Co-ordinates (latitude/longitude)
- Plot No.
- Dimensions
- Alloted Area
- LandUse
- Boundary Information
- Category- (forestland, government land, barren land....) ...etc

**Dynamic attributes:**
- Farmer Name (Person ID)
- Mortgage Information
- Litigation status
- Related court case numbers
- Building Approval
- Sub-divided Property IDs
- Parent Property ID
- Staleness Flag

*All Attributes are Queryable*
Transactions/Events Recorded on Blockchain

Each of following events is chronicled:

- Mutation
- Filing of a court case on a property
- Stay by court
- Sale
- Building Construction approvals
- Land conversion
- Mortgage
- Loan
- Death of owner
- Transfer duty paid on a property
- GPA

All Above Information is Queryable
Comprehensive solution

Blockchain for APCRDA

Property details
- Owner Name: SARADA NAGA JYOTHI GUNDAVARAPU, GUNDAYARAPU SRI NIVAS
- Aadhaar no: xxxxxxxxxxxx80, xxxxxxxxxxxx708
- Plotcode: 25-779-4675-1-K6
- Block: 4675
- Colony: 779
- Zone: 0
- Township: 25
- Sector: 182
- Extq sqyds: 599,9983
- District: Guntur
- Mandal: Manchalagiri
- Village: Nowlur

![Property Details Map](image)

View APCRDA system map

Application Link
### Attributes stored on Blockchain

**Static Attributes:**
- Unique Property ID
- Plot code
- Geo-Co-ordinates (latitude/longitude)
- Survey Number
- Area
- Boundary Information
- Category- (forestland, government land, barren land....)
- Flexibility to add new attributes as and when needed

**Dynamic Attributes:**
- Owner (Person ID)
- Mortgage Information
- RoFR
- Litigation status
- Related court case numbers
- Building Approval
- Sub-divided Property IDs
- Parent Property ID
- Staleness Flag

**Events**
- Mutation
- Filing of a court case on a property
- Stay issued by court
- Sale
- Building approvals
- Land conversion
- Mortgage
- Loan
- Death of owner
- Transfer duty payment on a property
- GPA
To enable illiterate and non-computer savvy citizens easily query current details of a property from blockchain, QR code is printed on their allocation certificates. Just scanning the QR code with
Innovative features of the project

- **Much higher TPS** (transactions per second)
- **Strong indexing capability** due to which query are super quick even with huge data volumes
- **Blockchain components** integrates with http APIs which means different systems of APCRDA which are built on different technology platforms can interact with it
- **Flexible** to accommodate changing requirements of departments and to leverage public and private blockchain utilization
Cumulative Hashing for Ultimate Tamperproof

Due to Cumulative hashing even a superuser can’t tamper data as the hashes go out of sync
Benefits of the Project

- Geo-fencing capability to identify overlaps across plots.
- All property record creation and changes are entered into the immutable ledger along with digital signatures of the authorized officers.
- QR code-based property ownership Blockchain Certificates to citizens.
- Capability to integrate with property tax system to enable simple, efficient and transparent record of ownership and tax transactions on a given property.
- Capability for instant data exchange through Smart Contract powered Data-as-a-Service (Daas) API calls with banks and financial institutions for quick and secure execution of loans and sale transactions.
This API is called when a new property is issued. Internally the API adds a party, property and maps the property to its owner.

**Input fields:**

- **Person details:**
  - Aadhaar_No(string)
  - Person_Name(String)

- **Property Details:**
  - OBJECTID(integer)
  - Plot_Code(string)
  - Lottery(String)
  - Plot_Categ(String)
  - Cat_Desc(String)
  - LU_Code(String)
  - LU_Desc(String)
  - Nat_Site(String)
  - Zone(integer)
  - Township(integer)
  - Sector(integer)
  - Colony(integer)
  - Block(integer)
  - PlotNo(integer)
  - Extn_SqYrd(double)
  - Area_Sqm(double)
  - District(String)
  - Mandal(String)
  - GP(String)
  - Village(String)
  - LPSVillage(String)
  - RS_No(String)

- **Geometry:**
  - type(String)
  - coordinates(array of vertices)

**Output:**

Boolean
API: getPropertyDetails

**Input:**
Plot_Code(string)

**Output fields:**

**Personal details:**
- Aadhaar_No(string)
- Person_Name(String)

**Property Details:**
- OBJECTID(integer)
- Plot_Code(string)
- Lottery(String)
- Plot_Categ(String)
- Cat_Desc(String)

- LU_Code(String)
- LU_Desc(String)
- Nat_Site(String)
- Zone(integer)
- Township(integer)
- Sector(integer)
- Colony(integer)
- Block(integer)
- PlotNo(integer)
- Extn_SqYrd(double)

- Village(String)
- LPSVillage(String)
- RS_No(String)
- Area_Sqm(double)
- District(String)
- Mandal(String)
- GP(String)

**Geometry:**
- type(String)
- coordinates(array of vertices)
<table>
<thead>
<tr>
<th>APIs</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>addParty</td>
<td>Person, group or organization</td>
</tr>
<tr>
<td>addProperty</td>
<td>Unique Property id is an input parameter</td>
</tr>
<tr>
<td>mergeProperty</td>
<td>For merging adjacent properties</td>
</tr>
<tr>
<td>updateProperty</td>
<td>Change of static attributes</td>
</tr>
<tr>
<td>splitProperty</td>
<td>In the event of subdivision</td>
</tr>
<tr>
<td>getPropertyDetails</td>
<td>Gives all static details of the property</td>
</tr>
<tr>
<td>getCurrentOwner</td>
<td>Returns owner per transaction trial/mutations</td>
</tr>
<tr>
<td>getStakeholdersOfProperty</td>
<td>Returns all stake holders including past owner RoFR holder etc</td>
</tr>
<tr>
<td>getPropertiesOfParty</td>
<td>Returns all the properties owned by a party. Input can be a person id</td>
</tr>
<tr>
<td></td>
<td>like Aadhar.</td>
</tr>
<tr>
<td>generatePropertyId</td>
<td>Generates a unique ID for a property based on geofencing</td>
</tr>
</tbody>
</table>
## Implemented APIs

<table>
<thead>
<tr>
<th>APIs</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>recordRofr</td>
<td>Right of first refusal</td>
</tr>
<tr>
<td>recordMutation</td>
<td>All mutations</td>
</tr>
<tr>
<td>recordDeathOfOwner</td>
<td>Death of owner or joint owner</td>
</tr>
<tr>
<td>recordCourtFiling</td>
<td>Filing of a court case on a property</td>
</tr>
<tr>
<td>recordCourtStay</td>
<td>Stay ordered by court on transactions</td>
</tr>
<tr>
<td>recordBuildingApprovals</td>
<td>Building construction approvals by MAUD</td>
</tr>
<tr>
<td>recordLandConversion</td>
<td>Conversion from rural to urban, agricultural to commercial .......</td>
</tr>
<tr>
<td>recordMortgage</td>
<td>Mortgage events on the property</td>
</tr>
<tr>
<td>getPropertyHistory</td>
<td>Shows all events related to that property</td>
</tr>
<tr>
<td>getProvisionalCertificate</td>
<td></td>
</tr>
</tbody>
</table>
# Block Chain Certificate

<table>
<thead>
<tr>
<th>Certificate Number</th>
<th>Date</th>
<th>Issued To</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-525-3404-43-C5</td>
<td>10-01-2017</td>
<td>MADALA MADHUVI</td>
<td>Valid</td>
<td></td>
</tr>
</tbody>
</table>

**Table:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-01-2017</td>
<td>Valid</td>
<td></td>
</tr>
</tbody>
</table>
Name: MADALA MADHAVI
Plot Code: 13-525-3404-43-C5
Aadhar: 309908240359
Colony

Name: MADALA MADHAVI
Plot Code: 13-525-3404-43-C5
Block: 3404, and Colony: 525
URL’s Accessing the GIS Apps

WebGIS – Amaravati LPS Layout Info :

Registration pdf’s integrated with Blockchain

BlockChain Certificate View for Public :

BlockChain details View for Officials :
Thank You