

Geodata Enabled Hierarchical Blockchain Architecture for Resolving Boundary Conflicts in Cadastre Surveys and Land Registration

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Information
Technologies Consulting



A Question - A Fact -A Remark

A Question:

Are there other data sources in someone's hands for land consolidation or property valuation?

- Cadastre, Ownership
 - Soil, land use, land cover, forestry, ecology
 - Geology, topography etc.
- Yield
 - Irrigation, spraying, fertilising/chemicals
 - Insurance



A Question - A Fact - A Remark

A Fact:

**There are officially approved, trustable data.
But somewhere...!**

- **Wheat Stock Exchange** ← Yield
- **Grain merchant**
- **State Grain Board**
- **Cooperatives** ← Irrigation, spraying, fertilising/chemicals
- **State Water Works**
- **Insurance Company** ← Insurance
- **Bank**



A Question - A Fact - A Remark

A Remark:

These data can be introduced into the use of people and business...!

- Can these information be introduced in databases for property (cadastre)?
 - Who can introduce?
 - How, is it possible?
- Yield
 - Irrigation, spraying, fertilising/chemicals
 - Insurance



Agenda

- Blockchain Technology
- Introducing the Problem with a Usecase
- Proposed Blockchain Model and Implementation
- Evaluation and Conclusions



Blockchain Technology

- What is Blockchain?
 - facilitates a resilient and highly distributed ledger (registry) for recording transactions (blocks time-stamped in a time sequence)
 - By a network of nodes having equal rights
 - In a secure (encrypted) communication framework.
- Applications:
 - distributed currency, trust and contracts application,
 - distributed data management
 - without central authorities
- Related Work: Cadastre & Land Registry
 - Application: Georgia, Honduras, Ghana
 - Research: Lantmateriet-Sweden, Netherlands



Blockchain Technology

- Why Blockchain is useful for cadastre and land registry works
 - Transactions are created by none/one or many participants
 - The types of transactions are 'create' and 'transfer'.
 - 'Deletion' is generally not applicable
 - The assets are attributed and defined as non-dissolved, non-divisible as well as divisible.
 - Transactions of an asset could be performed by mutual policy defined by the owners.
 - The authorization could consist cryptographically sign due to asset definition.
 - All the information related with an asset in a timeline and time trace are all preserved in the registry.

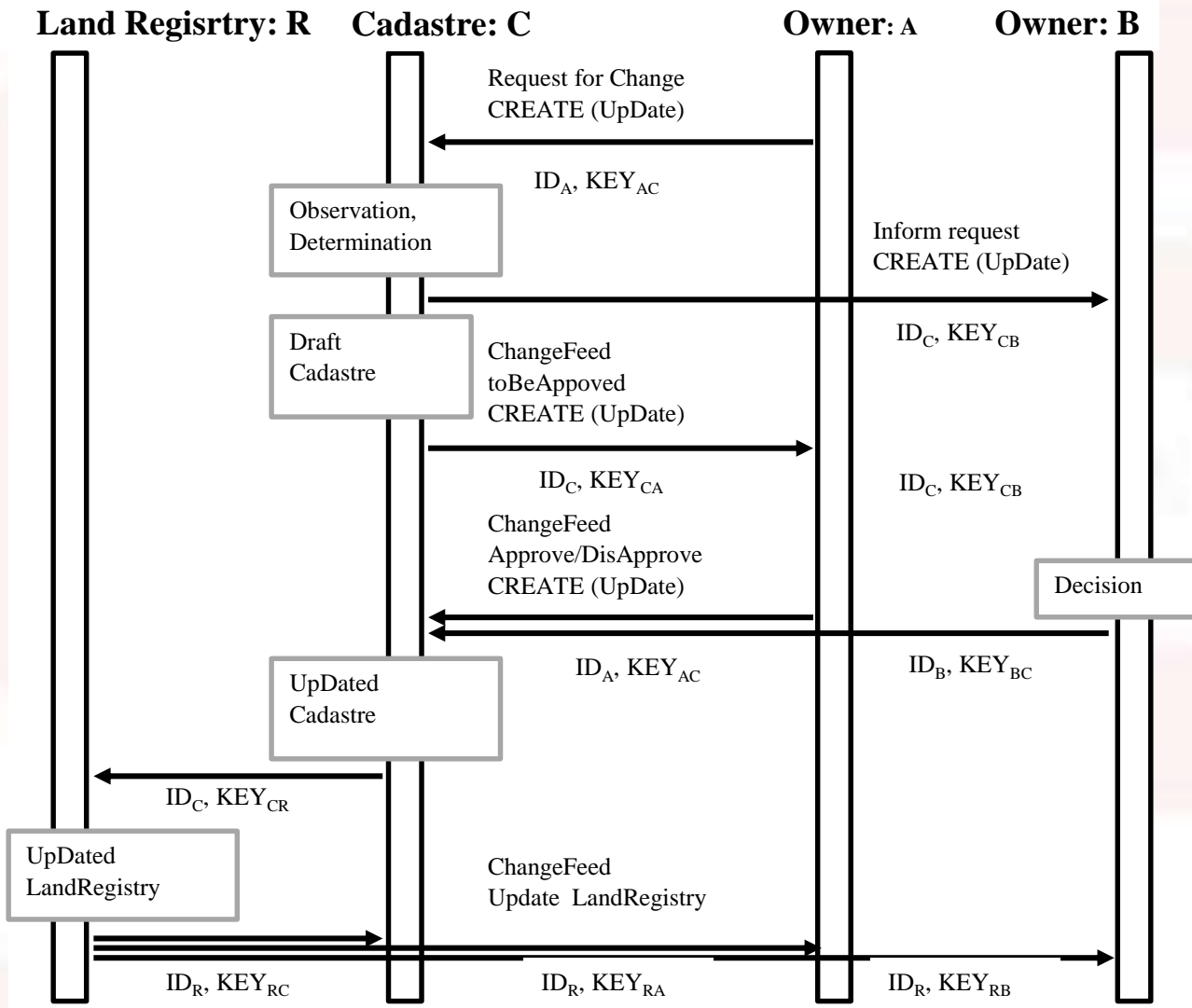


Introducing the Problem

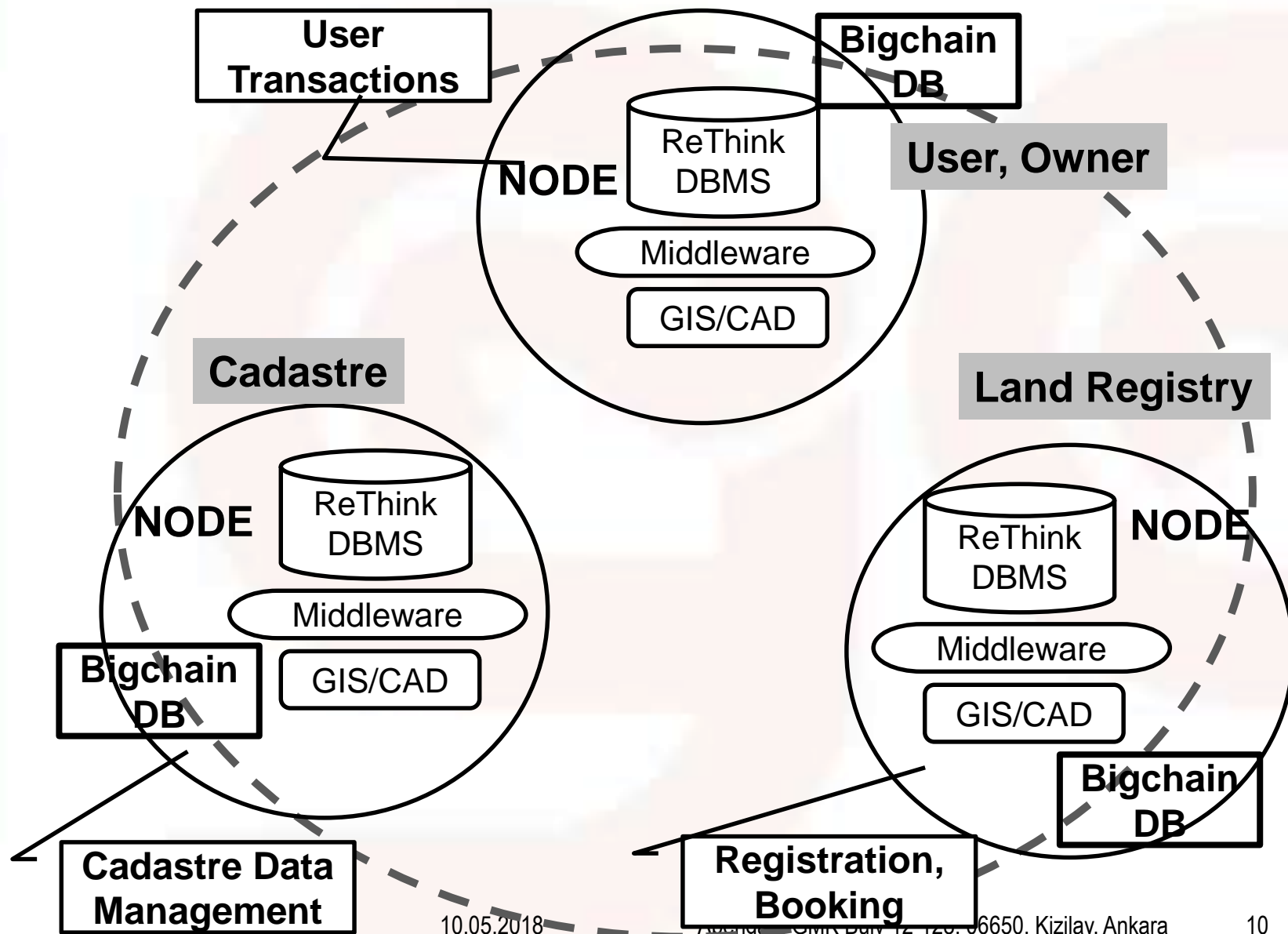
- Parcels in a block
- First cadastral surveys in 1982.
- 'Base Cadastre' due to Law#3402: conducted in 2004
- Updating Cadastre Surveys (22-A): 2016 (planned)
- Area of the parcel 525 m², the gap: 21 m², the tolerance 9.6 m² (= $0.00042 \times \text{scale} \times \text{SQRT}(\text{area})$)



Use Case for Land Registry and Cadastre Process



Blockchain Node, Cluster and Concoortium



Proposed Architecture for Blockchain NODE Model

LAND REGISTRY & CADASTRE (LR&C) BLOCKCHAIN (BC) NODE

LR&C BC Database

LR&C BC APPLICATION (Python)

LEVEL 1 : Institutional (Region/Block)

LEVEL 2: Landowner (s) (Object/Parcel/)

LEVEL 3: Geometry (Part/Edge/Node)

LR&C BC TRANSACTION ENGINE MODEL (Python)

LR&C BC Engine

LR&C Data Model

Community Consensus

BC INFRASTRUCTURE

LAYERS

BigChain DB

ReThink DBMS

Ubuntu (+ Relevant Drivers)

Loosly Coupled LR&C BC and GIS/CAD Middleware

LR&C Transactions Middleware (Python)

Synchronizes the 'LR&C BC DB' and 'Temporal GIS/CAD Engine for LR&C Transactions'

and

Maintains Common Registry (Ledger) (Specific to the 'Node LR and C')

Spatio-temporal GIS/CAD Engine for LR&C BC Transactions

GIS ENGINE FOR CADASTRE DATA MANAGEMENT (ArcGIS)

GIS Data Management, Analysis and Monitoring

GIS/CAD Simultaneous Trans. Module

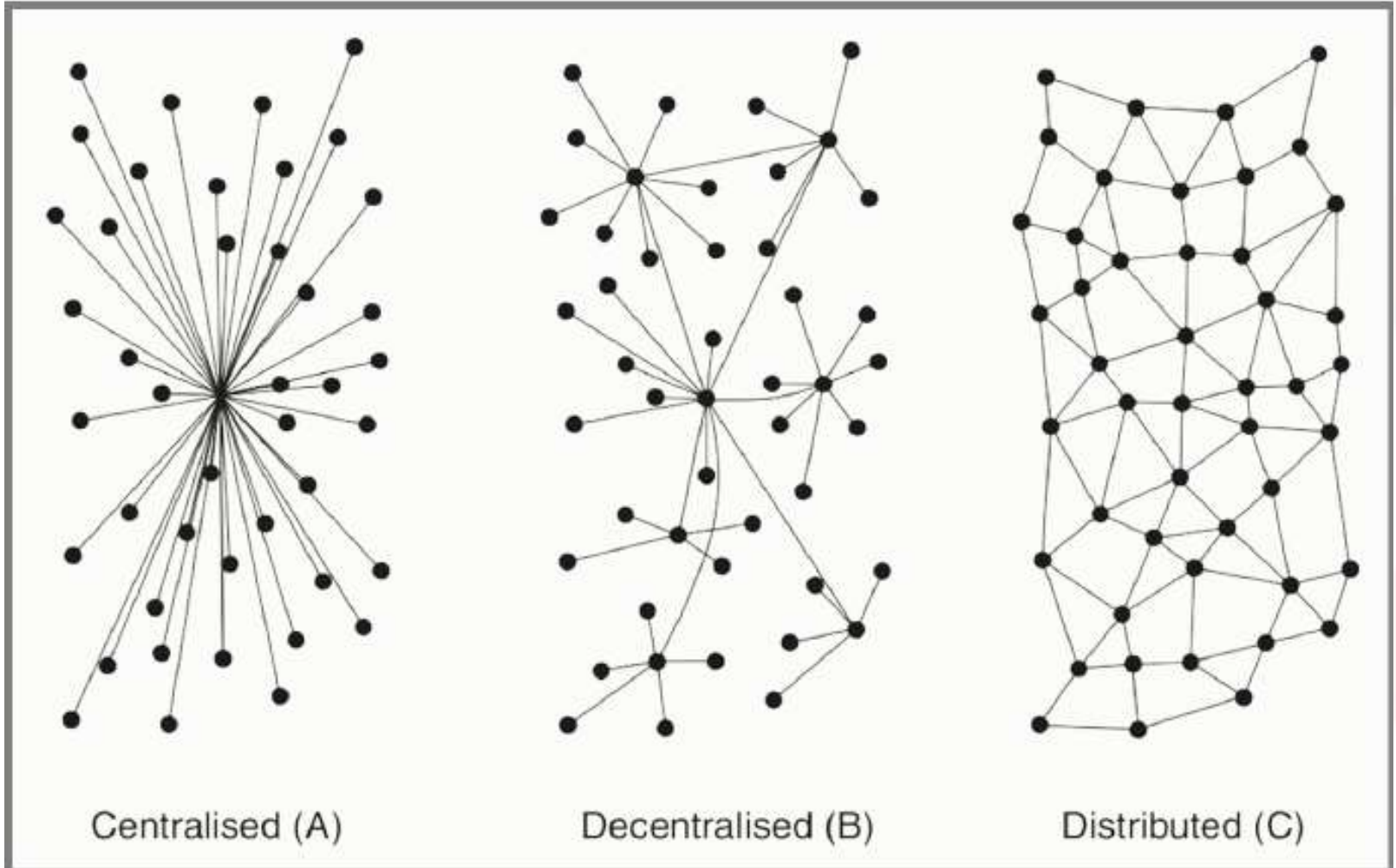
Temporal GIS/CAD Integration Module (Simplification&Generalization)

CAD ENGINE FOR CADASTRE DATA MANAGEMENT AND TRANSACTION (ArcGIS)

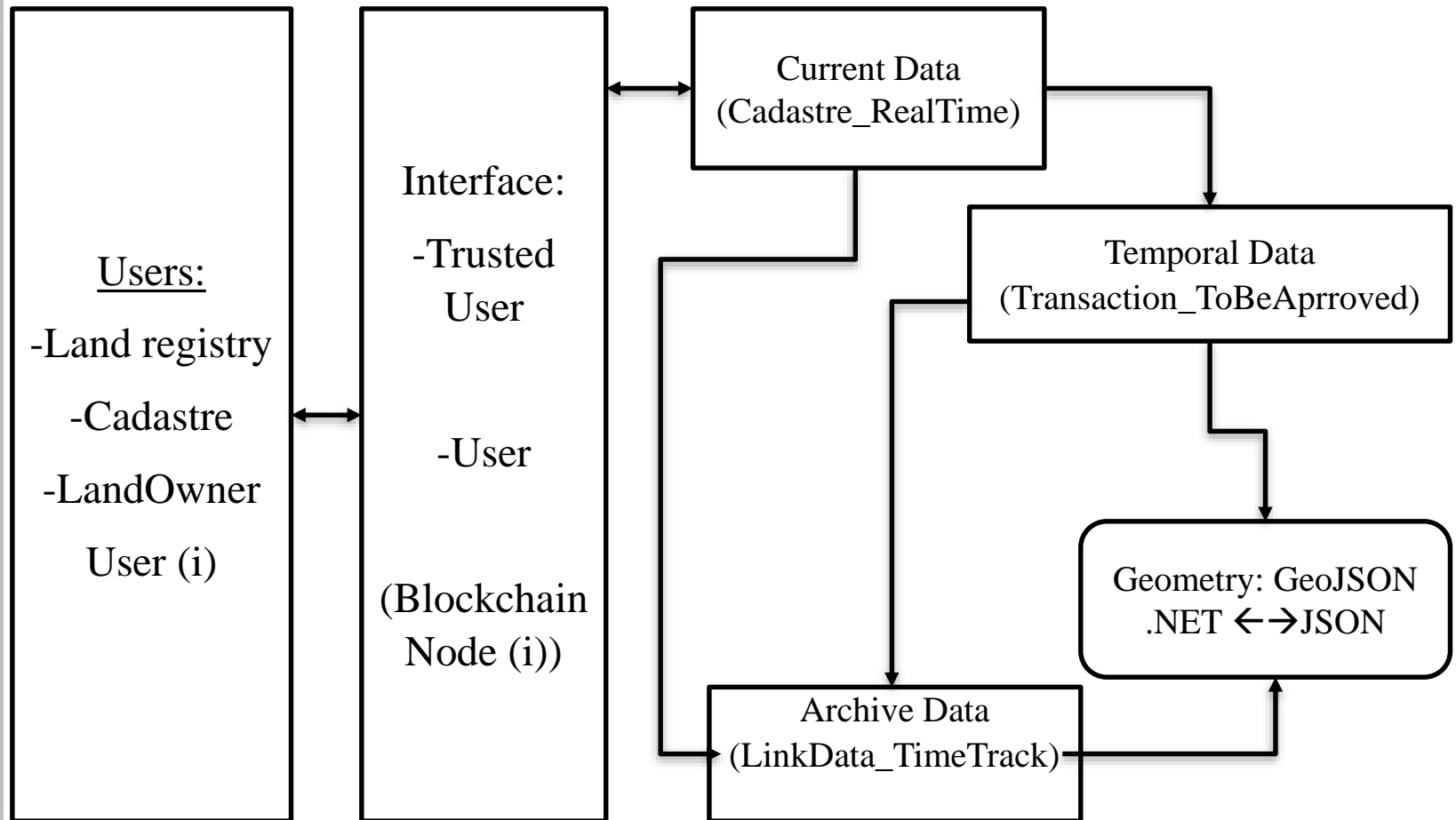
Temporal GIS/GIS Common Data Trans. Module



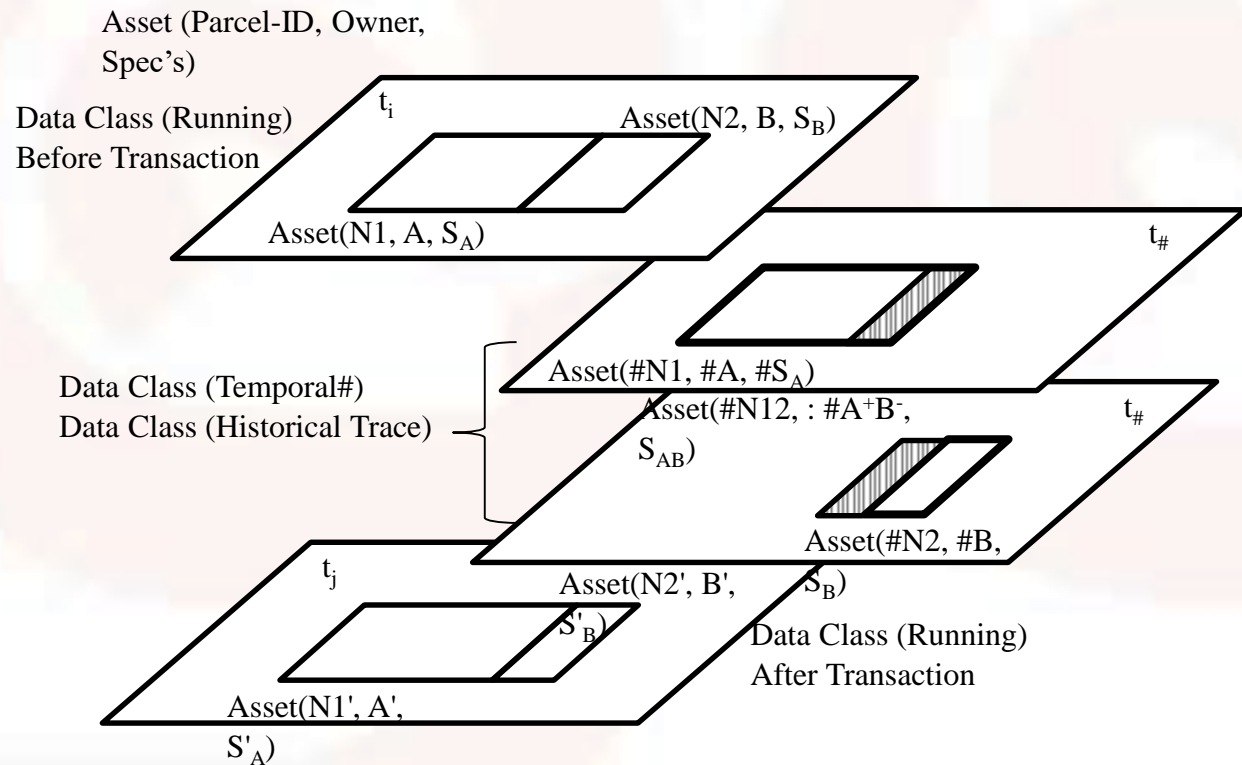
Network Architecture for Blockchain Clusters and Concoortiums



Blockchain Cadastre Transaction System : The Process Workflow



Geodata Transaction at Data Set (Database) Level in Blockchain



Implementation

Realization of Physical Model of GIS/CAD Component of the Blockchain

- ESRI ArcObjects SDK for .NET, C#
- Multivalued item instances: serializing JSON, GeoJSON

The screenshot displays the ArcMap interface for a project named 'cadastre_BC.mxd'. The main map area shows a parcel with a red boundary and a yellow hatched interior. A tooltip for 'Kadastro otorite takip ekranı' is positioned over the map. The Table of Contents on the left shows layers for 'olay' (with sub-layers for 'Durum', 'Onay Bekliyor', 'Onaylandı', and 'Reddedildi') and 'kadastro'. The data table at the bottom lists parcel details:

OBJEC	SHAPE *	ParseID	Tarih	Kullanici	Onay	OnayTarihi	Değişen
5	Polygon	12	10/5/2017 6:49:39 PM	user-1	<Null>	<Null>	["Tipi":"1","Sahibi":"","EklemeTarihi":"","DegismeTarihi":"",""]
6	Polygon	10	10/7/2017 12:39:00 PM	user-1	<Null>	<Null>	["Tipi":"1","Sahibi":"","EklemeTarihi":"","DegismeTarihi":"",""]
7	Polygon	6	10/22/2017 12:10:40 PM	user-1	<Null>	<Null>	["Tipi":"1","Sahibi":"tuğut","EklemeTarihi":"","DegismeTarihi":"",""]
8	Polygon	13	10/22/2017 12:10:40 PM	user-1	<Null>	<Null>	["Tipi":"1","Sahibi":"","EklemeTarihi":"","DegismeTarihi":"",""]
9	Polygon	12	10/22/2017 12:31:43 PM	user-1	<Null>	<Null>	["Tipi":"1","Sahibi":"","EklemeTarihi":"","DegismeTarihi":"",""]

The 'Onay Bekleyen İşlemler' dialog box shows the following fields:

- ID: 6
- Kadastro ID: 10
- Tarih: 10/7/2017 12:38:59 PM

The dialog also displays a table with columns 'Alan' and 'Değer':

Alan	Değer
Tipi	1
Sahibi	
EklemeTarihi	
DegismeTarihi	

Buttons at the bottom of the dialog include 'Reddet', 'Onayla', and 'Geni Dön'.

Evaluation

- Sustainable Cadastre
 - Need for new quality surveys
 - Data compilation by multiple institutions
 - Linking ANY related data with cadastre DB
- New User Requirements
 - Multiple versions (updates) already used in design, project and decision making
 - Smart cities and DIGITALIZED World
 - Decentralized and democratized data access and compilation
- The new generation do everything on the NET [They are not LAND-OWNERS yet!!]

Conclusions

- Proposed a Model of Blockchain Cadastre Database
 - Model of Land Registry & Cadastre (LR&C) Blockchain (BC) Node with three components
 - A Prototype of 'GIS Engine for Cadastre Data Management' part of the 'Spatio-temporal GIS/CAD Engine' component



Conclusions

- New and Innovative
 - Use of Blockchain in Cadastre
 - Easing Errors and minimize dispute cases
 - Decentralizing and democratization of cadastre data
 - Decreasing hegemony of government on cadastre data
 - Introducing, data in hands of Land Owners into use
- More Research is Needed
 - Aperigae continues research and implementation



Who wants to be rich?
The sooner...

There are slim 'BIT-PARCELS' with no owner.

Needs BIT-PARCEL mining effort...

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