AutoCarto 2020
WhereNext

Workflows and Spatial Analysis in the Age of GeoBlockchain: A Land Ownership Example

Constantinos Papantoniou & Brian Hilton, Ph.D.

CENTER FOR **INFORMATION SYSTEMS & TECHNOLOGY**
Claremont Graduate University

Agenda

- Introduction
- Background and Phenomenon
- Research Objectives
- Research Methodology
- Results
- Limitations and Future Work
- Acknowledgements
- Questions and Answers

Introduction

- Land ownership use cases are an enormous business challenge for both the public and private sectors

- Every organization has different needs and wants

- They are researching and exploring ways to add value and impact their ownership tracing processes
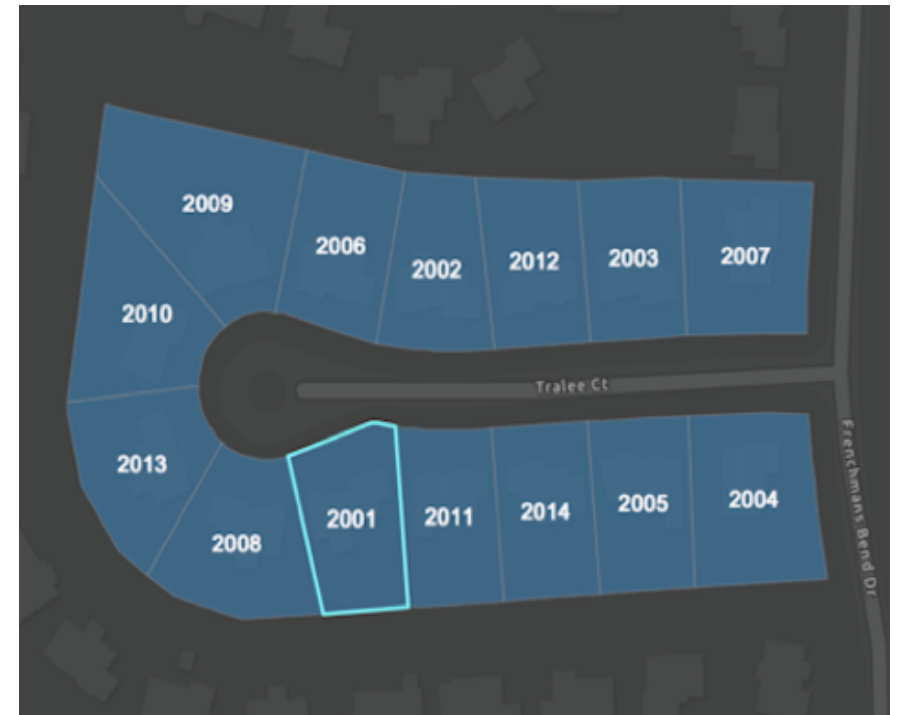
Background and Phenomenon

- **Background:**
  - Mixed views and attitudes
  - Complexity of blockchain technology
  - Real value of blockchain?
    - Maturity level
    - Unconventional usage
  - First implementations
    - Cryptocurrencies: Ethereum, Bitcoin
    - Proved that blockchain technology could orchestrate valid transactions across a distributed network
    - Store those transactions in unalterable ledgers across multiple nodes

- **Phenomenon:**
  - Organizations might use a distributed ledger for a land ownership use case
    - Record and track the geolocation of properties
    - Answer questions such as why, where, and how
    - For example, did a property owner A transfer the land ownership to property owner B with legal parcel data?
    - How is that different from a typical system?
    - How Blockchain and Geospatial technologies work together to answer the where and why?
    - By incorporating rules and roles into the blockchain, you can give a trust context based on location to tabular transactions to answer and explore the "trust" of a transaction

GeoBlockchain Foundation

- **Blockchain**
  - Trust; Immutability; Transparency
  - Public: Cryptocurrency
  - Private: Enterprise World
- **Geographic Information Systems**
  - Location-based technology
  - Spatial Analysis
  - Answers the question of where
- **GeoBlockchain Concept**
  - Combination of Blockchain with GIS
  - Geospatially-enabled Blockchain
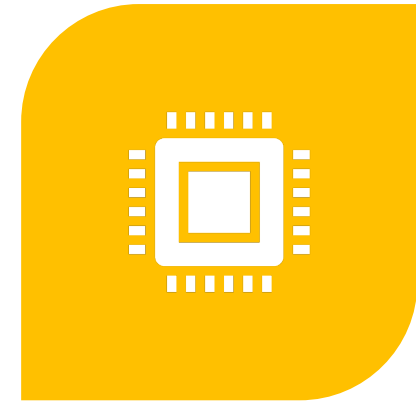 - Analysis of spatial-temporal trends

BLOCK CHAIN

Research Objectives

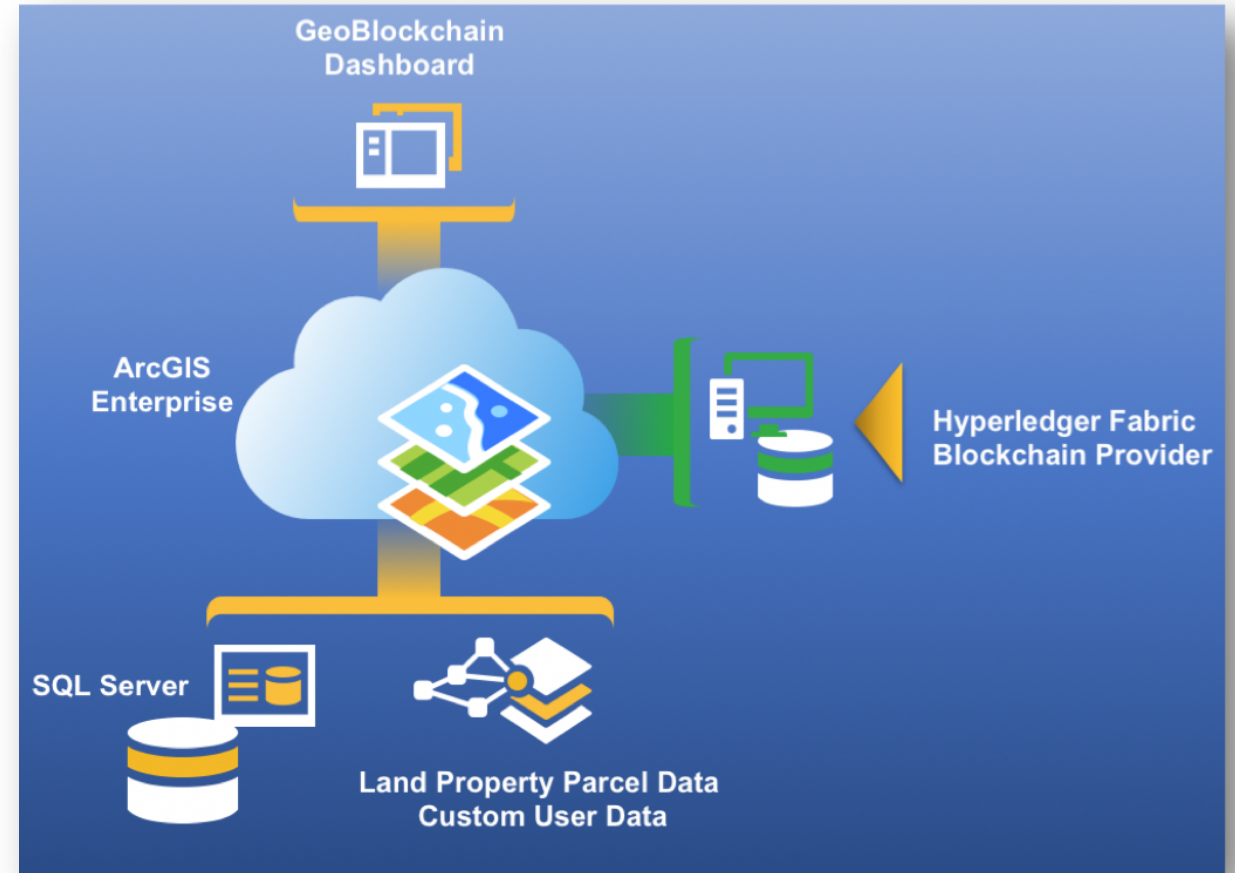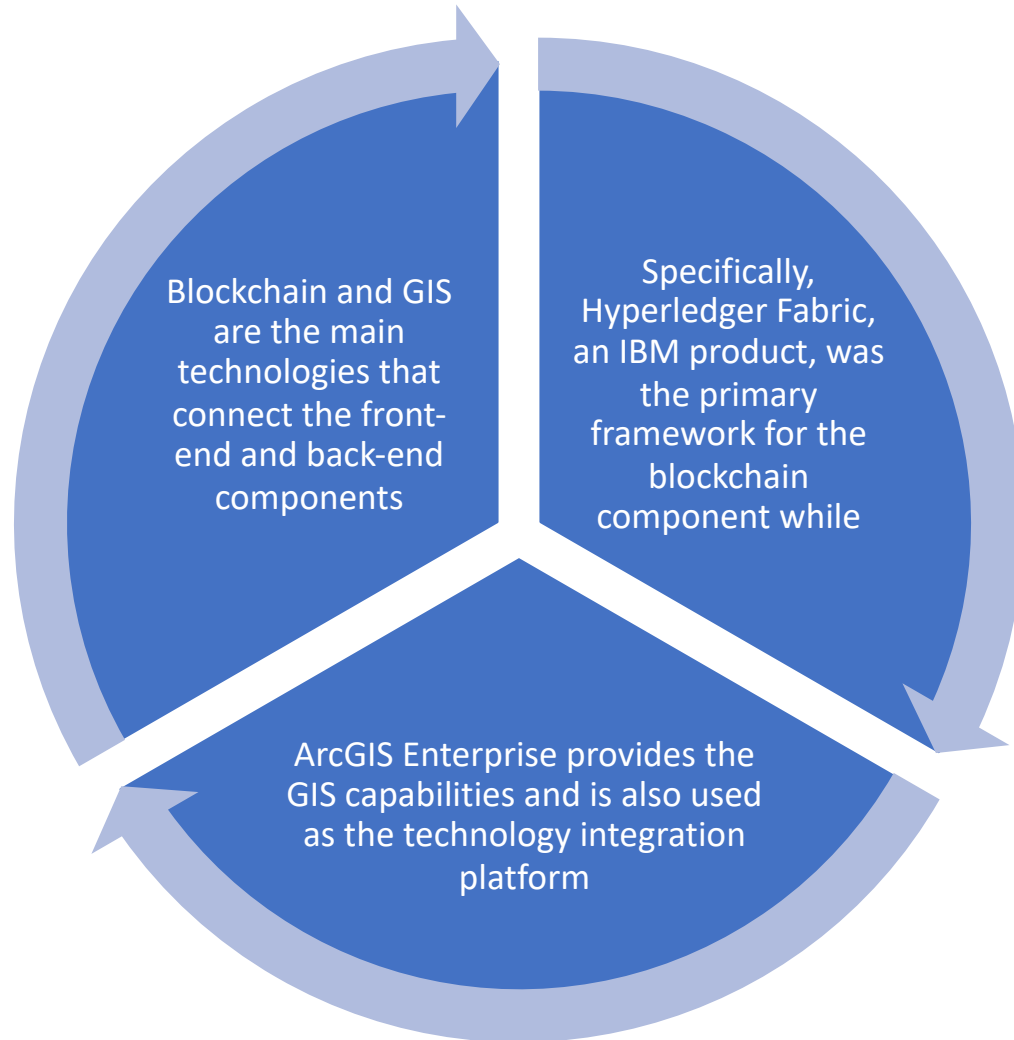BUILD AND EVALUATE AN ICT-ARTIFACT THAT COULD BE USED TO
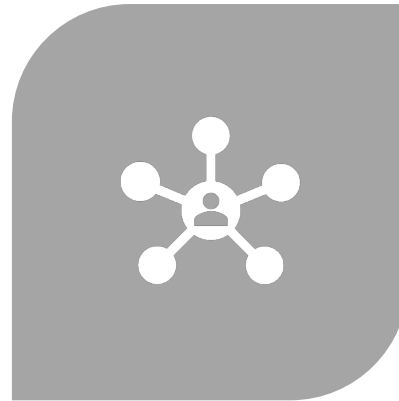
STUDY THE TRENDS AND BEHAVIOURS OF PARTICIPANTS (USERS) GEOGRAPHICALLY AND SPATIALLY

BASED ON DISTRIBUTED NODES, TRANSACTIONS, AND GEO-LOCATIONS THROUGH THE BLOCKCHAIN TECHNOLOGY

Research Methodology

Blockchain and GIS are the main technologies that connect the front-end and back-end components

Specifically, Hyperledger Fabric, an IBM product, was the primary framework for the blockchain component while

ArcGIS Enterprise provides the GIS capabilities and is also used as the technology integration platform

GeoBlockchain Dashboard

ArcGIS Enterprise

Hyperledger Fabric Blockchain Provider

SQL Server

Land Property Parcel Data
Custom User Data

Research Methodology - Phases

Phase-1
- Design and development of the back-end components where the IBM Hyperledger Fabric blockchain API service was utilized along with the ArcGIS Enterprise GIS API rest service

Phase-2
- Creation of various coding artifacts that connect the blockchain API services and GIS API services resulting in the creation of the GeoBlockchain

Phase-3
- Creation of the front-end; an interactive dashboard that visualizes the GeoBlockchain results in a web-based application that include various widgets and map-based output. This tool also allows the user to add and edit land ownership transactions

Results

- The outcome of this research was the instantiation of a GeoBlockchain for land ownership transactions and a related dashboard

- Through this prototype, participants (land owners, customers, and other stakeholders) can exchange (buy or sell) land through the blockchain component, and instantly view the results through the GIS component

Results - Continue
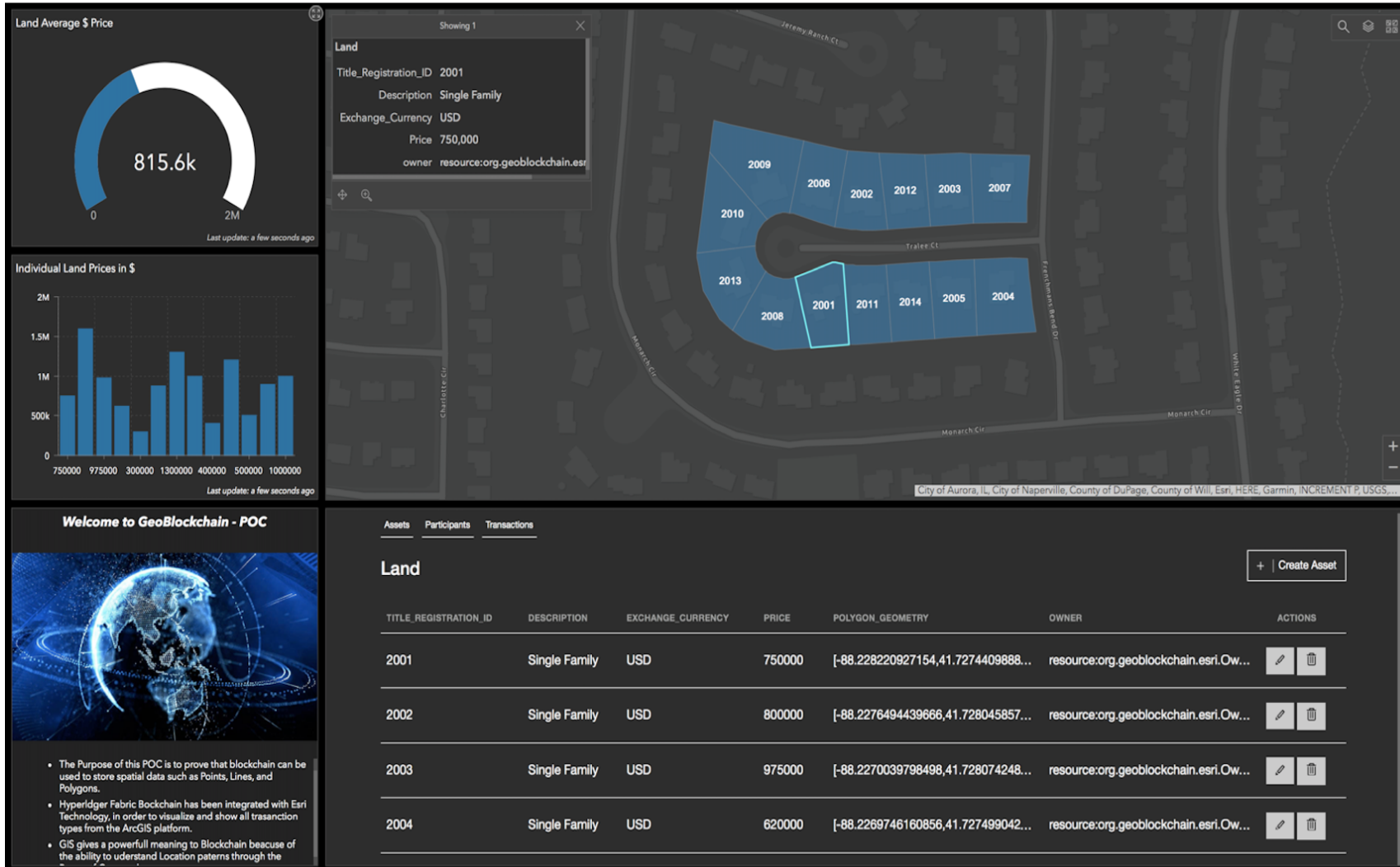
- A single-family property with ID 2001, and USD price of $750,000, was transferred from Owner A to Owner B

- The Geoblockchain dashboard allows participants and stakeholders to track overall land ownership and various statistics

- Such as average price at the selected geographic location and/or examine the individual land price using the GIS-based statistical tools

Limitations and Future Work

The main limitations of the current research include:

    (1) further iterations are required to improve this prototype
(2) a production enterprise environment is required for real- world testing, and related to this
(3) the prototype needs to be tested with a larger data set, and finally
(4) a formal end-user assessment needs to be conducted

Future plans include:

    (1) completing the next generation of solution prototype artifact
(2) multiple iterations to improve artifact blockchain design
(3) improving the suitability evaluation analysis
(4) research other types of blockchains such as hybrid blockchains for suitability and relevance
(5) completing the pre-test and post-test evaluation in order to add assess the GeoBlockchain framework

Conclusion

The outcome of this research, a working prototype, demonstrates that blockchain technology can be integrated with geospatial technology resulting in a GeoBlockchain

The value that blockchain gives to geospatial technology is security, immutability, and trusted data information

Geospatial technology provides the power of location to the blockchain

The result is a concept that should impact society by simplifying the land ownership transaction experience for organizations, citizens, and government

12

Acknowledgements

- Advanced GIS Lab at Claremont Graduate University

- Environmental Systems Research Institute, Inc

- Several Blockchain consortiums

- Various stakeholders that collaborated with this study

Questions and Answers

Thank you !!

"Please feel free to email me for any questions"

constantinos.papantoniou@cgu.edu,
cpapantoniou@esri.com