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

Constantinos Papantoniou[a]*, Brian Hilton, Ph.D.[a]

[a] Center for Information Systems and Technology, Claremont Graduate University, Claremont, USA
* constantinos.papantoniou@cgu.edu, cpapantoniou@esri.com

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Introduction

Blockchain is a cutting-edge and emerging technology today. However, there are mixed views and attitudes from users due to the complexity of the technology, its maturity level, and unconventional usage that do not highlight the real value of blockchain. The first implementations of blockchain were cryptocurrencies artifacts such as Ethereum and Bitcoin (Yuan and Wang, 2016). While unusual, these use cases proved that blockchain technology could orchestrate valid transactions across a distributed network and store those transactions in unalterable ledgers across multiple nodes (Sharma et al., 2019). Each transaction becomes a new block; blocks are organized chronologically to form a blockchain. The main advantages of blockchain are the speed of transactions, data accessibility, and data accuracy (Yuan and Wang, 2016). The value of its use is the increase in transparency and visibility among partners while reducing the risk of corrupted information flow and the overall cost of moving items within the system chain and organization network (Croxson et al., 2019).

Geographic Information System (GIS) technology, an inherently location-based technology, can help answer the question of where a blockchain transaction has occurred (Wingreen et al., 2019). The combination of blockchain with GIS underlie the concept of GeoBlockchain. This new tool can be used to support the analysis of spatial-temporal trends of blockchain transactions via a geospatially-enabled blockchain. The result of this research was the design, development, and implementation of a prototype land ownership GeoBlockchain solution.

Method

As mentioned, 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 (Figure 1).

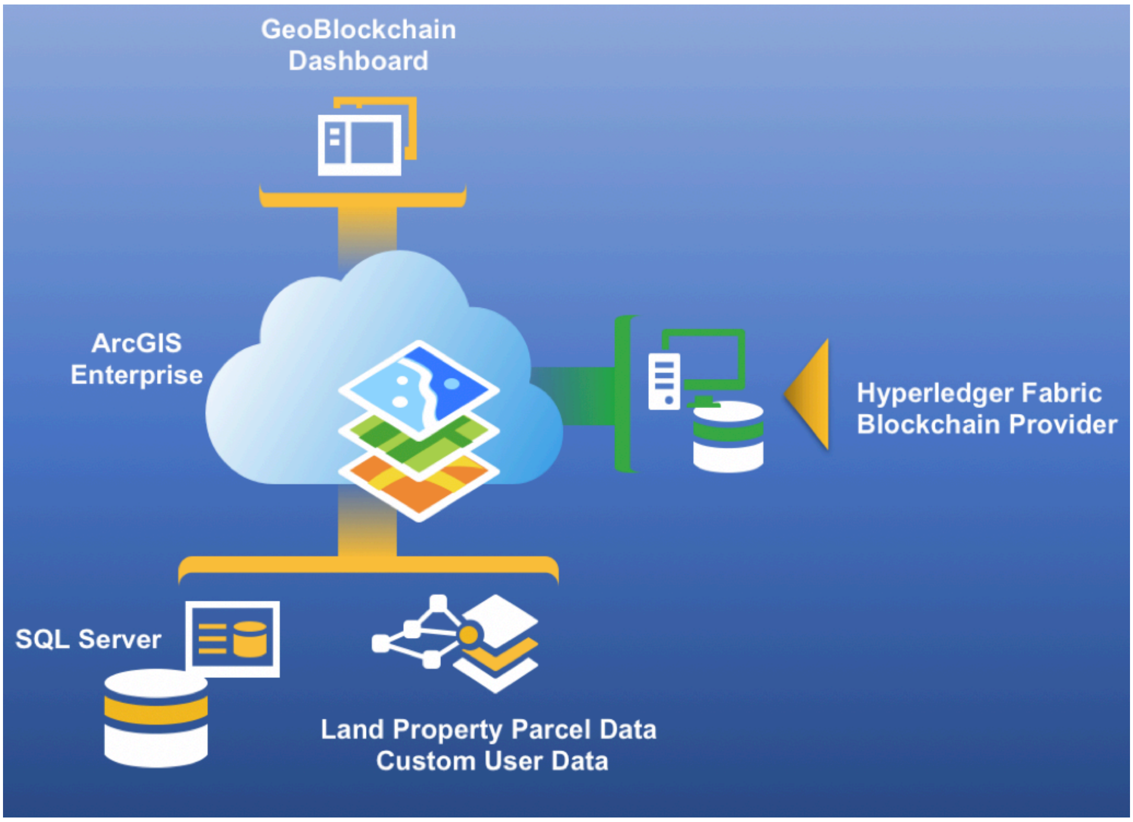

Figure 1: GeoBlockchain Architectural Design

There were three main phases for the creation of this prototype. Phase-1 was the 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 was the creation of various coding artifacts that connect the blockchain API services and GIS API services resulting in the creation of the GeoBlockchain. Finally, Phase-3 involved the 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 (Figure 2). This tool also allows the user to add and edit land ownership transactions.

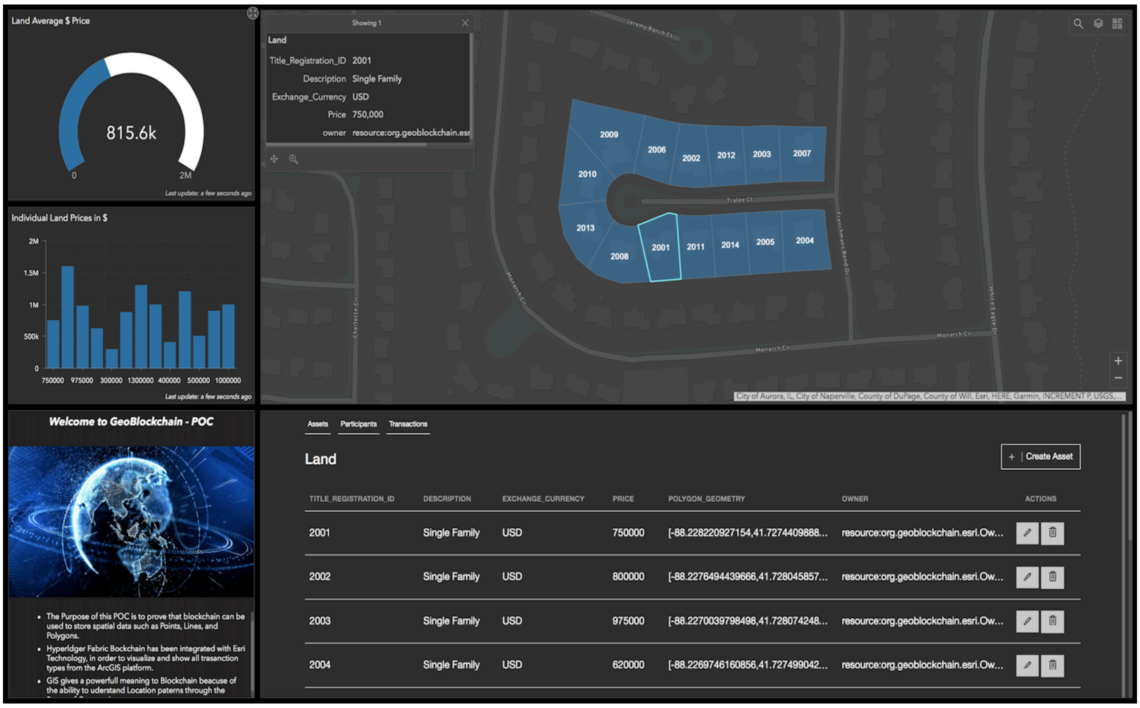

Figure 2: GeoBlockchain Dashboard

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. As displayed in Figure 2, 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.

Discussion and Conclusion

<u>Discussion:</u>

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; and (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. On the other hand, 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.

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