Monitoring Tools Working Group

1. Motivation

Monitoring what happens in the network is essential to improve it and to measure the social impact of its solutions.

2. Main Goals

- Block Explorer 2.0
- Data Mining
- Self-Healing Nodes
- Deploy Alethio's monitoring and reporting tools
- Explore Eventeum and its capabilities
- Leveraging existing cloud services for monitoring
- Develop native monitoring tools

3. Participants

- Tech Lead: Sergio Cerón Figueroa
- Coordinator: Antonio Leal
- Supervisor: Marcos Allende

4. Detailed description

4.1 Block Explorer 2.0

Background

A block explorer is basically a search platform that allows users to easily search for blocks, transactions, smart contracts and almost all the data that is contained in a blockchain. An updated block is constantly displayed in the blockchain's explorer using a web browser and shows information on the latest blocks created.

Block explorers allow users to explore, search, visualize, verify, and research information from the blockchain, this is where the term comes from. A block explorer is available in every blockchain network, be it Bitcoin, Ethereum, Dash, Stellar, Ripple, all of them provide this tool. It is virtually impossible to run a blockchain without a block explorer, as no one will be able to visualize and understand what is happening.

Proposal

Improve the current block explorer with additional information regarding smart contracts and more explicit transaction data, as well as data from LACChain's network consensus protocol (IBFT 2). This proposal includes the creation of a new type of observer node that only has access to the blockchain without permission to send transactions and capture enough information to display in the block explorer.

LACChain currently has a light version of the Ethereum block explorer developed by the company aleth.io. However, it lacks multiple information features such as:

1. Broadcasting transactions
2. Decode smart contract data
3. Provide the type of transaction
4. Provide greater traceability of the sender
5. Provide only blocks with transactions
6. Provide the timestamp of the blocks

The block explorer will be a service running within the Observer Node.

Advantages

The advantage of having a block explorer is that they enable some operations such as:

- verifying the content of some smart contracts
- executing some methods from the contract
- facilitating easy tracking of a smart contract
- Tracing who, when, and how that smart contract was operated

Additionally, information in the blockchain is also displayed as charts in dashboards. These dashboards usually try to centralize an abundance of information concerning the respective network, even if not all the data that belongs to that blockchain network. The mentioned charts, regardless of the blockchain network, usually display statistics on the number of transactions performed over a period of time, the total volume of transactions, to provide as much information as possible.

Technical milestones:

- Fork Ethereum Lite Explorer
  - Clone athe.io repository and modify the code with missing features mentioned in the proposal.
  - **Deliverable:** Enhanced Block Explorer.
- Enable extra Plugins
  - Install and configure extra plugins such as: eth-lite core plugin.
  - **Deliverable:** Block Explorer with extra plugins installed and configured.
- Create a docker container with enhanced block explorer
  - Dockerize Block Explorer with all dependencies.
  - **Deliverable:** Docker container with LACChain Block Explorer published in public registry.
- Create a LACChain observer node
  - Create an ansible provisioning script for new node (Observer) similar to a writer node, with permissioning restrictions, that only can observe transactions and not broadcast any transactions.
  - **Deliverable:** Ansible script to provision new LACChain observer node type.
- Deploy Observer LACChain node
  - Deploy the Observer LACChain node and connect to public network and test new block explorer.
  - **Deliverable:** Observer LACChain node.

4.2 Data Mining

Background

Blockchain and artificial intelligence are two of the hottest technology trends of the moment. Despite the disparity in both its applications and the teams working on its development, there is growing interest in possible applications that could stem from their convergence.

Data science is a sub-branch of artificial intelligence that seeks to extract knowledge from structured and unstructured data. This field covers statistics, data analysis, machine learning and other advanced methods used to understand and analyze real processes using data.

The application areas of AI in blockchain technology are many and all important. A relevant area to mention is threat identification and fraud prevention. These issues can be addressed using pattern mining, text mining and outlier detection algorithms. All those technical solutions are already used in finance and banking areas, demonstrating their effectiveness in the financial domain.

Proposal

Develop a data mining algorithm for LACChain that makes use of the data sent in transactions (normal and smart contracts) based on the unsupervised approach to automate meaningful knowledge discovery within the network. The data must be previously obtained through an indexing system that allows searching information in a practical and efficient way.

Data indexing can be done using open source software like *memento*, a tool developed by aleth.io to scrape and index data from any web3-compatible networks, such as Hyperledger Besu. The main goal of the tool is to scrape raw data from the network, perform the necessary transformations and insert it into an indexed database from which it will be consumed by the IA algorithm.

In parallel, develop a dashboard, to visualize the data obtained by the artificial intelligence algorithm. The information should be grouped into categories, considering the following:

1. Types of executed transactions
2. Types of deployed contracts
3. Behavior in transaction broadcasting by writer nodes
4. Temporary workload of the validator nodes
5. Consumption of time for the execution of contracts
6. Growth of storage space

Advantages

- **Secure trust**: The data recorded in the blockchain is reliable because it has gone through a verification process that guarantees its coherence and consistency. It also provides transparency, as the activities and transactions that take place on the blockchain network can be traced.
- **Prevention of malicious activities**: Because blockchain technology uses a consensus algorithm to verify transactions, it is impossible for a single node to pose a threat to the data network. A node (or unit) that begins to act abnormally can be easily identified and removed from the network.
- **Make predictions (predictive analytics)**: Blockchain data, just like other types of data. can be analyzed to reveal valuable information about behaviors, trends and as such can be

used to predict future results. Additionally, blockchain technology provides structured data collected from individuals or individual devices.

- **Real-time data analysis**: As it has been showcased in financial and payment systems, blockchain can support cross-border transactions in real time. Organizations that require real-time analysis of large-scale data can call on a blockchain-enabled system to achieve this. With blockchain technology, banks and other organizations can observe data state transitions in real time, which makes possible to take informed decisions, whether to block or report a suspicious transaction, and track abnormal activities.
- **Manage data exchange**: In this regard, the data obtained from data studies can be stored in a blockchain network, allowing project teams not to repeat the data analysis already carried out by other teams or erroneously reuse the data that has been used. Additionally, a blockchain technology platform can help data scientists monetize their work, likely by exchanging the analysis results stored on the platform.

Architecture

Figure 1 displays a diagram with the steps of an artificial intelligence process, known as Knowledge Discovery. This process requires prior indexing of the information to perform data mining and culminates with the visualization of data within a dashboard.

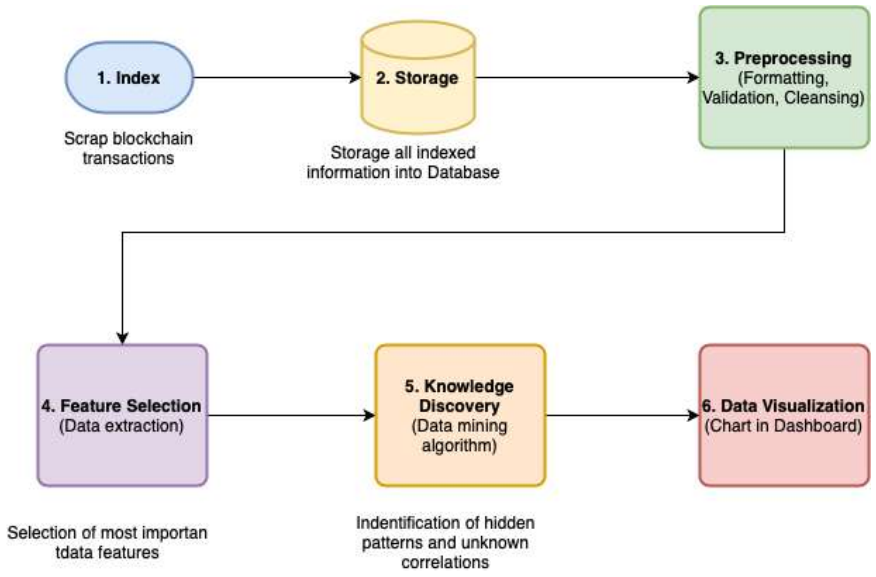

Figure 1. Knowledge Discovery Process.

Figure 2 describes how the Knowledge Discovery process can be applied to the LACChain network using indexing tool *memento* from aleth.io.

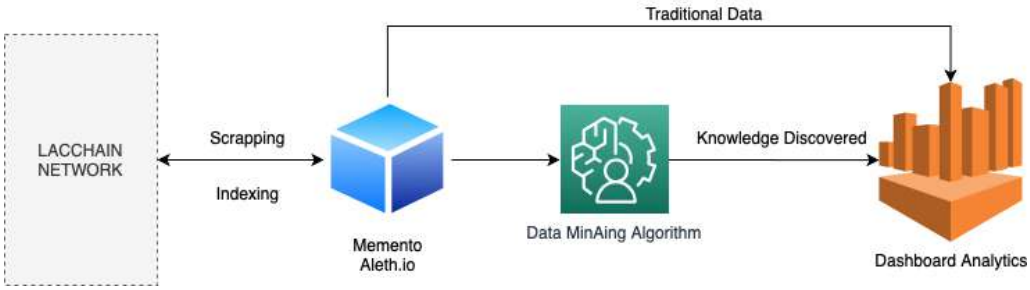

*Figure 2. Knowledge Discovery using **memento** tool in the LACChain network.*

Technical milestones:

- Index transactions
  - Install memento from aleth.io to scrap and index historical transactions from the LACChain network, and store in a document database.
  - **Deliverable**: Indexed transactions stored in MongoDB.
- Data Mining
  - Implement an artificial intelligence algorithm based on unsupervised approach to search unknown patterns inside indexed information stored in the database.
  - **Deliverable**: Clustered categorization of transactions data, unknown patterns.
- Dashboard
  - Design and deploy a dashboard to show all the information obtained from the Data Mining algorithm.
  - **Deliverable**: Dashboard and charts.

4.3 Self-Healing Nodes

Background

All distributed computing systems, whether implemented in virtual cloud computers or hardware networks, will occasionally fail, even in decentralized architectures. To protect against failures, systems must be able to detect such failures and provide enough information for mitigation and if possible, to recover automatically.

One of the most important features of decentralized systems such as blockchain networks is its ability to be fault tolerant, given its redundancy these networks are practically immune to certain types of attacks and failures common in centralized systems. However, the malfunction of certain critical nodes of this type of network can lead to a performance degradation of the entire network.

To help overcome these challenges, blockchain keyless signature infrastructure technology provides a unique value proposition with its potential to help optimize and secure these critical data sets from emerging cyber threats. Combining AI and blockchain capabilities could also provide a real-time security response to unauthorized attempts to modify critical data, configurations, applications, network appliances and sensor infrastructure. Autonomous detection of data anomalies reduces the burden with normalized evidence across a unified timeline for incident analysis. As an example, blockchain technology may be used as a data

exchange platform using smart contracts for the automated trading and settlement of contracts in the electricity production value chain.

A self-healing system is defined as a system with the ability to detect that it is not operating properly and automatically make the required adjustments to restore itself to a normal operation. What this means is that a self-healing system can monitor and identify a potential variance from its standard parameters, compare it with a degree of confidence and resume normal operations without external intervention.

Proposal

Develop a collection of monitoring tools that analyzes the performance of the LACChain network in real time, allowing the resources of each node to be automatically scaled, as well as detecting and correcting certain types of common connection errors.

Implement pre-built tools to monitor the execution of smart contracts and map network infrastructure to detect performance issues and run automated optimization tasks.

Design artificial intelligence algorithms for behavior detection when executing smart contracts and broadcasting transactions.

Program tools based on Artificial Intelligence algorithms for self-correction of errors and adjustment of parameters in runtime (Memory and CPU), using statistical and behavioral data obtained by monitoring tools.

Advantages

IA Algorithms can be used to achieve a variety of blockchain analytics functionalities, suitable for many use cases. These use cases can be classified into three categories along a timeline:

- **Forensics Analyzing:** past occurrences and transaction history.
- **Real-Time Monitoring:** Analyze the current state by generating alerts on specific occurrences.
- **Forecasting:** Predicting future occurrences.

Architecture

The diagram in figure 3 displays the general self-healing process of any system:

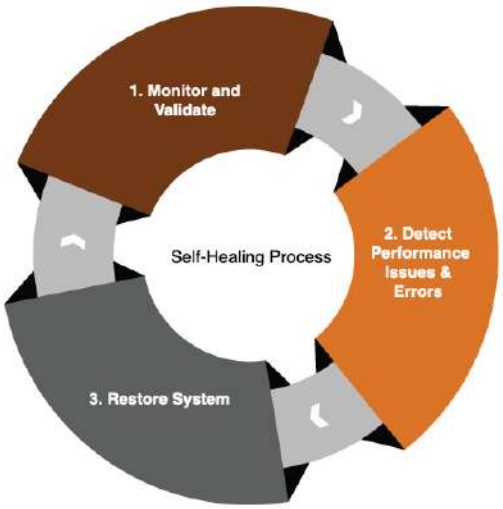

Figure 3. Self-Healing Process

Which consists of three phases:

1. Monitor and validate the general state of the system.
2. Detect performance issues, errors, or security problems.
3. Correct and restore the system for optimal operation.

Figure 4 displays the general diagram of the implementation of a self-healing system in the LACChain nodes using artificial intelligence algorithms and the Eventeum tool to control resources and connections automatically and in real time.

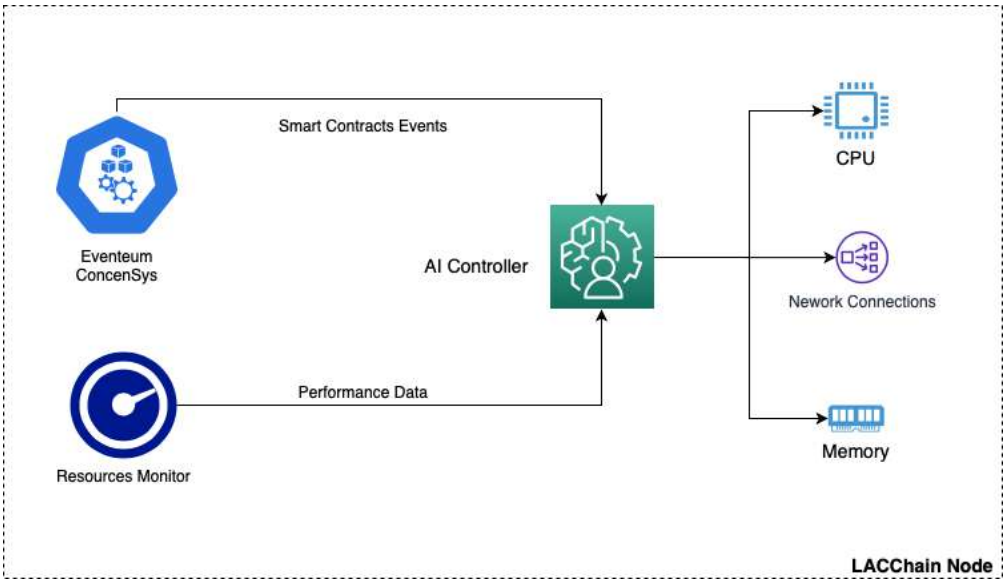

Figure 4. Self-Healing LACChain Node Architecture.

Technical milestones:

- Deploy Eventeum
  - Install, configure, and integrate Eventeum from Consensys within a LACChain node.
  - **Deliverable**: Eventeum deployed and running.
- Resource Monitor
  - Code a process to monitor (CPU, memory, network connections) and send information in real time to a self-Healing controller.
  - **Deliverable**: Resource monitor daemon.
- Self-Healing Controller
  - Develop a program that acts as Self-Healing Controller, using artificial intelligence algorithms to combine smart contracts events from Eventeum and Resource Monitor data and take dynamic actions depending on lack of resources or security breach.
  - **Deliverable**: Artificial Intelligence algorithm as decision support system.