MULTILAYERED INTEGRATED DECISION-MAKING PLATFORM ARCHITECTURE

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Although human evolution was primarily driven and inspired by observing nature and natural phenomena, little to no effort was allocated to finding ways in which we can integrate the solutions nature has to offer in the way we organize ourselves as a society and the way we make decisions as individuals or groups. Decision-making, as a concrete manifestation of our will, is the fundamental process that allows for meaningful change to happen. Optimizing the way we make decisions and creating correlations between the decisions we make, the actions implied by those decisions and the effects the actions bring on the governed body (individual or group) will allow us to improve both the way we make decisions and the outcome of our decisions, while at the same time help us to identify the primary directives that need to be considered as fundamental parameters when making decisions that affect organic life, with the intention of reaching a consensus, in the form of a universal wise normative that will be unanimously accepted by all humans regardless of gender, nationality, religion etc. For such a consensus to be found we need to identify the natural distinctions that give life its diversity but at the same time acknowledge and understand the existence of the point where everything converges to form a unified and heterogenetic organism. For this scope we will present the solutions nature offers that can be integrated into an actual platform that will fundamentally change the way we govern ourselves as a society and as individuals

Keywords: Organic Integrated Decision-making Platform, Swarm Decision-making Platform, Peer Validated Voting, Collaborative Decision-making, Participative Organic Governance, Anatomically Correct Decision-making Platform, Online Organic Self Governance

1. Introduction

As the complexity behind the social structures humans increases, the mechanisms that allow us to coordinate with each other must evolve, in order to cover our needs in each context where governance and decision-making are required. Because the framework created by modern technology encourages human connectivity to become a basic need and requirement we can soon replace most of the archaic and outdated governance systems with global online platforms

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and protocols that are better suited to manage and optimize the way we act and evolve as a society and at the same time provide a transparent resource management system which will allow for a total eradication of corruption.

This article is one in a series of articles that come as a proposal for such a platform and protocols. The ideas behind an integrated decision-making platform that can act as a global governance hub to replace all existing governance systems can only come from nature itself. In that regard we started by researching about the ways the human body governs itself and how insect swarms coordinate with each other using well established protocols that incorporate hierarchies, signals and roles.

2. Decision Blockchain

Blockchain technology was first used in cryptocurrency systems to keep a ledger for transaction. Each transaction was saved in a list and when the list arrived at a certain size a new list was created and the old list would been hashed, and the hash code to the old list would become the starting value of the new list so each block(list) would be chained and validate each other.

This way if a change would have been done to an older list, let's say something would add a fake transaction so it would seem their account has more resources than it actually has, the hash of the resulting list would be different than the next list after it. So if you would actually want to add a transaction you would have to go through all old lists that were already processed and calculate a new hash for each of them. And that would be from a processing point of view almost impossible because the blockchain is distributed and the one doing the change would need more processing power than all the other nodes that keep a copy of the list put together.

A system of this sort should be used in the way we keep track of each decision we do as individuals and as a society. This way we will keep a track record of all decisions made that would be impossible to counterfeit from which we could extract and learn using Artificial Intelligence software the best course of action for each issue in such a way that new decisions would have the support of the best suggestions extracted from past data. This can be applied to each individual but also to the governance structures we use in society in any form of organization, like education, transport, health, environment, economy, etc.

The blockchain (Fig. 1) is a way of storing data that creates a distributed and decentralized database which ensures data consistency through cryptography. Blockchain technology became popular because of the Bitcoin crypto currency. Crypto currency is a form of digital currency that uses the blockchain as a ledger for financial transactions, which also provides transparency because of its

distributed and decentralized nature, and cryptography as a means of protection against double spending.

Fig 1. Simple Blockchain structure

Even though, so far, most of the use cases for blockchain involved cryptocurrencies we can extend the way we use it in fields where it can have an even greater impact, like decision-making and social governance.
The distributed and decentralized database that the blockchain provides has 2 properties that makes it a perfect candidate to be at the base of a trust-less collaborative decision-making platform:

1) Transparency - because data is shared between all the nodes of the network
2) Incorruptibility - data stored on the blockchain cannot be altered because locally altering any unit of information on any given block would create an inconsistency between the altered blockchain and all other nodes on the network.

Decision Blockchain as Artificial DNA

The Decision Blockchain can be seen as the artificially created DNA of any Body of Governance, where each individual is the equivalent of a cell and each cell contains a full copy of the whole blockchain just like biological cells contain a full copy of the DNA. Each fork created in the decision blockchain with the purpose of defining a new institution with its own internal rules and role is equivalent to the different organs of the human body that have specialized functions useful for the whole body, thus creating a virtual delimitation between the new institution (organ) and the rest of the body. The Deciding Agents have roles that are equivalent to the different cell types the human body, each with their own well-defined purpose depending in what Institutions or Organizations they activate.

Decision Block Structure

The fundamental type of block in a decision blockchain is the **Decision Block** (Fig. 2). On top of the Decision Block, which is the primitive block type, we can have additional block types that will have their properties defined by the deciding agents through the fundamental Decision Blocks. The Decision Block

will specify the object applying a certain decision and the object that can be affected by a decision.

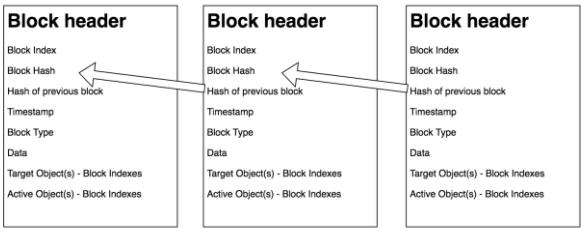

Fig 2. Basic Decision Block used in a Decision Blockchain

Through decision blocks we will store the normative, principles, constitution, legislation and deciding agent roles of the governed body and the organizations and institutions that evolve inside of it. In order to accurately model how decisions are made in real life we will need a few more block types: Definition Block, Action Blocks, Resource Block, Deciding Agent Block, Vote Block, Feedback Block

3. Case study – University Management Using the Integrated Decision-making Platform

In order to facilitate the migration from a classical decision-making governance structure based on representatives to self-representation, using the Integrated Decision-making Platform, we must assure that all existing hierarchies and roles are integrated into the new system. Also, everyone involved in the management process should be able to switch using the new system in a seamless way without any loss in productivity and efficiency.

The migration algorithm consists of the following steps:

1. Identify each of the current hierarchical management structures and the roles they contain. We will name the subdivisions that have a specific functional role inside the governed institution departments.
2. Design the horizontal and vertical governance structures in conformity to the existing management structures, following the three branched governance structure pattern.
3. Set up initial Blockchain and include the main streams: Members stream, Decision Stream, Resource Stream, Votes stream, Legislative stream, Definitions Stream.
4. Add all resources to the Resource Stream, the resources will be managed using the Universal Resource Management and Logistics Component by the

Executive branch following the budgets allocated by the Legislative branch to each institution and stored on the Legislative Stream.

5. Create the role definitions on the blockchain that will be assigned to the members in conformity to existing governance structure.
6. Manually allocate the existing roles to members so we perfectly match the existing hierarchical governance structure.
7. Provide each member in the governed body an account which is linked to his ID and stored on the blockchain. Each member and all initial deciding agents start off with 1 vote of trust which is their own.
8. Move all decision-making and management to the Integrated Decision-making Platform by allowing all members of the governed body to use the Issue Framing Component to aggregate all existing issues and prioritize them by gravity.

University Case Study

In order to fully migrate the management system of a University to using the Integrated Decision-making Platform we go through each step and describe the operations that need to take place. For the sake of simplicity we will limit our case study to only the general management of the University and not drill down into each individual Faculty Management structures.

Step 1: Identify each of the current hierarchical management structures and the roles they contain

University administrative structure

A University is organized in faculties. The main administrative council that governs the whole University is made up of one Rector, three Prorectors, one DUSC Director and one General Administrative Director.

University administrative structure roles

The administrative, executive and judicial roles will have to integrate the following existing roles:

The Rector, which is a role that combines executive, legislative and judicial powers. The rector should be elected based on direct votes from other University members. The role of Rector should be assigned to the University member that has the most votes of trust/

The Prorector, is the second role in terms of responsibility in the classic University administrative structure. In this Case study we will be having 3 Prorectors. The Prorector role is also going to be assigned based on the amount of votes of trust, the members with highest votes of trust have the first option in

choosing this role. Using the three branches of governance pattern we can give each of the three members that take the Prorector position, based on their skills, the legislative, executive and judiciary function will be assigned to them.
DUSC Director role is the head of the Doctoral University Studies Counsel (DUSC) and it's similar to the Rector role. The CSUD Director coordinates the legislative, executive and judicial branches inside the DUSC department and represents the department as a hole.
General Administrative Director
The General Administrative Director role can be used as the second in command of the executive branch, in tandem with the Prorector assigned as head of the executive branch.

Step 2: Design the horizontal and vertical governance structures
In order to facilitate the migration of the existing roles to a format compatible with the recommendations of the Integrated Decision-making Platforms governance structure we created a simple design that used a convergent governance model together with the the three branches of governance.

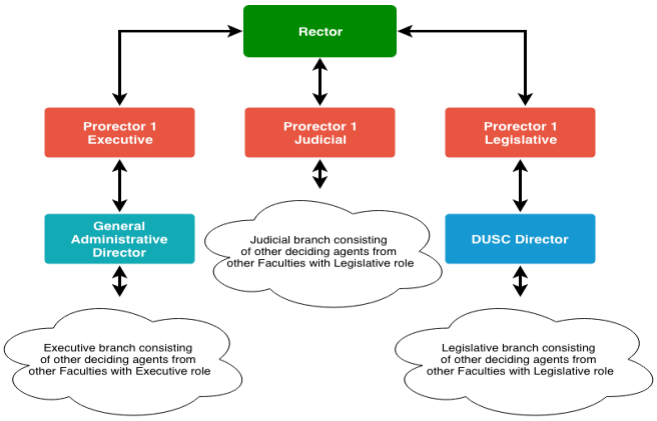

Fig 3. Existing University Management Roles

Step 3: Set up initial Blockchain
After we have the initial governance structure with all the roles we will need to set up the first Decision Blockchain Node which will act as a distributed Database for the Integrated Decision-making Platform.

The next step is to initialize the streams that enable the decision blockchain to be used as a general purpose append-only database, with the blockchain providing timestamping, notarization and immutability. A blockchain that contains multiple

streams is called a MultiChain blockchain and can contain any number of streams, where the data published in every stream is stored by every node. Like native assets, MultiChain streams can be referred to in any of three ways: An optional stream name, chosen at the time of stream creation. If used, the name must be unique on a blockchain, between both assets and streams. Stream names are stored as UTF-8 encoded strings up to 32 bytes in size and are case insensitive.

Permissions in streams

Streams are created by a special transaction output, which must only be signed by addresses which have the create permission (unless anyone-can-create is true in the blockchain parameters). This is easy to do using the create command in multichain-cli or the JSON-RPC API. The stream's creator automatically receives admin, activate and write permissions for that stream. It is not possible to create more than one stream in a single transaction, or to combine stream creation with initial or follow-on asset issuance.

In our particular case we will need to create the following streams:
Members stream - which will contain each member of the Institution and their public key, which was generated by the ID they provide, the public key can change by either the member himself or by a designated department that is given authority over member registration and management.
Decision Stream, Votes stream, Resource Stream and Legislative stream will start off completely empty and blocks will be created using the Integrated Decision-making Platform based on the activity of the members that can push signed blocks to each of these streams using their public keys.

Step 4: Add all resources to the Resource Stream

After the MultiChain streams were initialize and initial definitions were added we continue by adding all the resources the University has. The resources will be managed using the Universal Resource Management and Logistic component that uses the blockchain.
In our case we will add as resource all real estate the University has, all technical resources at its disposal, the state budget allocated to the University, as well as any Intellectual Property that the University possesses.

Step 5: Create the role definitions on the blockchain

In this step we will get the initial governance structure design and create the necessary blocks inside the Definitions Stream so that we have all the necessary roles to implement the governance structure.

As we mentioned earlier, we will have the following roles:

The Rector, which we will define as the member with most votes of trust and who is in charge of representing the University as a whole both on the inside and on the outside.

The Prorector role will require only partial responsibility as it will be attached to one of the three branches, Legislative, Executive or Judicial.

DUSC Director and **General Administrative Director** roles, together with two Prorectors constitute the top management of the Legislative and Executive branches that unfold into all the departments of the University and make up the Vertical Hierarchical Governance Structure.

Step 6: Manually allocate the existing roles to members

After the roles are defined and all existing managing members of the institutions are added to the Members Stream, we start allocating the roles to them. In this step, because we don't have access to the Ranked organic Hierarchy created by the votes of trust, we just allocate the roles manually. The initial role allocation should be kept in place for a few months until at least 50% of the managing members use their vote of trust, to either promote themselves or promote someone else.

Step 7: Provide each member in the governed body an account which is linked to his ID and stored on the blockchain

After the governance structure is in place and all roles are allocated we can start adding member accounts to all people that make up the governed body, in our case they will be faculty staff, teachers and of course students.

Whenever a new member is added the blockchain transaction needs to be signed by the member management department, which will be put in place and given its authority by the top level management made up of the Rector, Prorectors and two directors. In order for a Member Management Department to have authority over adding members it must be supported by at least a certain threshold of votes of trust coming from the top managing group.

Step 8: Move all all decision-making and management to the Integrated Decision-making Platform

After all the members have access to their account and the initial constitution of the University is in place, we can start using the Integrated Decision-making Platform to interact with the system as a whole and make changes to it. The migration to the new system can be made incrementally, starting from the top up and bottom down. Students can start using the Issue Framing component to signal and aggregate issues or propose improvements, while the top managing committee made of the Rector and Prorectors can use it to adjust the laws and executive methodologies used inside the Institution such that the issues that come up will be resolved.

Technical Implementation Using Multichain Streams

MultiChain streams enable a blockchain to be used as a general purpose append-only database, with the blockchain providing timestamping, notarization and immutability. A MultiChain blockchain can contain any number of streams, where the data published in every stream is stored by every node. If a node chooses to subscribe to a stream, it will index that stream's contents to enable efficient retrieval in various ways.

Each stream is an ordered list of items, in which each item has the following characteristics:

- One or more *publishers* who have digitally signed that item.
- A *key* between 0 and 256 bytes in length.
- Some *data*, which can reach many megabytes in size.
- Information about the item's transaction and block, including its *txid*, *blockhash*, *blocktime*, and so on.

MultiChain streams can be referred to in any of three ways:

- An optional stream *name*, chosen at the time of stream creation. If used, the name must be unique on a blockchain, between both assets and streams. Stream names are stored as UTF-8 encoded strings up to 32 bytes in size and are case insensitive.
- A *createtxid*, containing the txid of the transaction in which the stream was created.

- A *streamref* which encodes the block number and byte offset of the stream creation transaction, along with the first two bytes of its txid.

Permissions in streams

Streams are created by a special transaction output, which must only be signed by addresses which have the *create* permission (unless *anyone-can-create* is *true* in the blockchain parameters). This is easy to do using the *create* command in *multichain-cli* or the JSON-RPC API. The stream's creator automatically receives *admin*, *activate* and write permissions for that stream. It is not possible to create more than one stream in a single transaction, or to combine stream creation with initial or follow-on asset issuance.

For the root stream, the creator of the chain's first genesis block automatically receives *admin*, *activate* and *write* permissions. The root stream is open for general writing if the *root-stream-open* blockchain parameter is *true*.

Streams in transaction data

For regular use of MultiChain, you can ignore the technical details below, which describe MultiChain protocol *10007* or later. They are only relevant if you want to work with the raw data within MultiChain transactions. Note that you can also use the raw transactions APIs to encode and decode this information.

Stream creation outputs

A transaction output creates a stream if it contains the following, followed by an *OP_DROP* (*0x75*) and *OP_RETURN* (*0x6a*):

Transaction Fields

Field	Size	Description
Identifier	4 bytes	*spkn* or *0x73 0x70 0x6b 0x6e*
Type	1 byte	*0x02* for a stream.
Property key	Variable	If the first byte of the key is *0x00*, it denotes a property with special meaning to MultiChain, and the second byte gives the

		property type. For now, the only possible keys are *0x00 0x01*, for the stream's name, and *0x00 0x04*, where a property value of *0x00* or *0x01* denotes whether the stream is open to all writers. If the first byte of the property key is not *0x00*, it contains the null-delimited name of a user-defined custom field, e.g. *0x75 0x72 0x6c 0x00* for *url*.
Length	1-9 bytes	Bitcoin-style variable-length integer indicating the length of the property value in bytes.
Value	Variable	The property's value as raw binary.

Examples of Resource Allocation Block in JSON format used by the University case study

```
{
        decisionID: 38,
        decisionTarget: 'self',
        objectType: 'action',
        objectName: 'ResourceAllocation;
        objectResourceAttributes: {
                canAllocateResources: true;
                resourceTypeAllowed: [ 'money', 'infrastructure' ]
        },
        objectProperties: {
                'allocateResources': ' allocates resources by type to member'
        },
        objectAction: 'define',
        objectLogicalFunction:
                `Function allocateResources( amount: number, resourceType:
string,toMembeID:number) {
                        let blockID = blockAPI.blockID;
                        let blockName = getName(blockID);
                        If (blockName === 'Rector') {
                                sendResourceByTypeTo(amount, resourceType,
                toMemberID);
                        } if (blockName === 'Prorector') {
                                If (resourceType === 'money')
                                        return false;
                                else {
```

```
                                    sendResourceByTypeTo(amount, resourceType,
                toMemberID);
                        }
                }
        }`,
```

objectDecisionText: ‘ This block allows for resources to be transferred automatically by the decision blockchain using smart contract code depending on the role type’
}

4. Conclusions

By implementing a decision-making system that’s specifically designed for us by nature itself, and use it in fields such as social governance, we take the responsibility from any small governing group of people and distribute it to each and every one of us, in accordance to our individual capabilities and predispositions.

As we observed in all natural systems that involve decision-making our integrated decision-making platform should enable all the participants to negotiate in synchrony, adapting decisions emerging before them in real-time. Deciding agents don’t express static views, but continually assess and reassess their own unique convictions with respect to each of the possible outcomes, weighing their personal confidence and preferences. With all participants doing this in parallel, the body of governance can quickly converge on solutions that reflect the collective will of the group. This is why swarms are able to efficiently capture a group’s collective wisdom. [2]

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