

We claim:

1. An electronic system comprising:

an interconnected network of a plurality of computers, each including a processor executing computer instructions stored in an electronic memory of each computer for implementing and maintaining a distributed electronic ledger system implemented as a backward-linked blockchain of multiple interconnected blockchain blocks;

a first node on said network of computers, wherein the processor of the first node executes peer-to-peer software to create a first competing block or blockchain segment to be added to the blockchain;

a second node on said network of computers, wherein the processor of the second node executes peer-to-peer software to create a second competing block or blockchain segment to be added to the blockchain;

one or more network computers executing computer instructions that apply a consensus algorithm to calculate and assign a fitness value among the competing first and second blocks or blockchain segments;

a plurality of said network computers determining which of the first or second blocks or blockchain segments will be the next block or blockchain segment incorporated into said blockchain; and incorporating the next block or blockchain segment into the blockchain after such determination has been made.

2. The system of claim 1, wherein the highest fitness calculation between the competing block or blockchain segments is a function of a numerical distance between the hash of each block on the chain, and a target hash of each block, and wherein said numerical distance is determined algorithmically by a software evaluation of one or more blocks of the blockchain.

3. The system of claim 1, wherein the fitness value calculation is based on a Hash Distance formula:

$$\sum_{i=g}^n c \frac{V_i}{k + j \cdot H_i}^y$$

where V_i is an aggregate value of certain qualified tokens within block i , H_i is a hash distance for that block, and each of c , k , j and y are constants, for all blocks with heights g through n within a blockchain segment.

4. The system of claim 3, wherein V includes tokens assigned to one or more buckets via at least one bucket assignment record, and the hash distance H is determined by using a specified value with a certain bucket as the target hash, wherein a bucket refers to a set of contiguous numerical ranges that overlaps with an output range of a cryptographic hash function of the blockchain.

5. The system of claim 2, wherein the target hash is determined at least partially by a plurality of nodes sending tokens to one or more buckets, and the highest fitness is determined at least partially by minimizing a ratio of aggregate tokens sent to the one or more buckets, per hash distance.

6. The system of claim 1, wherein the evaluation process avoids a proof-of-work computational problem calculation for an authorization to create the next block or blockchain segment on the blockchain, or for determining which block or blockchain segment among the competing ones is added to the blockchain.

7. The system of claim 1, wherein the consensus algorithm implements a trust-but-verify procedure, wherein the nodes begin working to create one or more new blocks before each node has completed verifying the correctness of a preceding block to which the new block is linked.

8. The system of claim 1, wherein each blockchain block contains a Bloom filter that stores information regarding which addresses or user accounts within the system have had their state modified by one or more data records associated with the block.

9. The system of claim 8, wherein the Bloom filter of at least one preceding block is used by the first or the second nodes on the network to determine which data records may be included in a new

block that links to that preceding block, by excluding from the new block any data records that reference the same addresses or user accounts recorded in the Bloom filter of the preceding block.

10. The system of claim 1, further utilizing at least one genesis record, which record declares and defines a new user-specified token type, wherein transfers of one or more tokens sent from one address or user account to another is tracked using at least one transfer record.

11. The system of claim 10, wherein the genesis record that declares and defines at least one new user-specified token type is valid within the blockchain if it is cryptographically signed by an account or an address that has previously been authorized to declare and define at least one new user-specified token type.

12. The system of claim 11, wherein the account or address is authorized to declare and define at least one new user-specified token type via a chain of signed genesis records added to the blockchain, wherein each genesis record in said chain is cryptographically signed by an account that has been authorized to do so by a genesis record signed by a higher-authority account, extending back to a single root account.

13. The system of claim 1, further utilizing at least one trade order record that offers to exchange tokens of one type for tokens of another type, and said offer expiring if it is not matched before a deadline specified within the trade order record.

14. The system of claim 1, further utilizing at least one settlement record that matches two or more trade orders, resulting in the traded tokens being automatically transferred to the accounts or addresses specified by the trade orders.

15. The system of claim 1, further utilizing at least one proposition record associating or including a truth-state proposition and a token reward that is distributed to one or more accounts specified by a plurality of nodes that have voted in a majority when the truth-state proposition of the proposition record is decided at a point in time defined by the at least one proposition record.

16. The system of claim 15, further utilizing at least one decision record including information

about a certain number of tokens that are risked by a node when voting in favor of or against a proposition included or associated with the proposition record, and further forfeiting the risked tokens in favor of the nodes that voted in the majority.

17. The system of claim 1, further utilizing at least one transaction record that contains or references at least one of an ordered collection of individual data records or smart contracts, that must all be added to the blockchain together, or otherwise must all be discarded, and must all be processed successfully in sequence without interruption, or otherwise must all be disregarded in case of a modifications made to a system state.

18. The system of claim 1, wherein the competing nodes lock a plurality of associated tokens for a period of time in exchange for a portion of a reward, wherein the number of tokens locked increases the fitness value calculated for the block or blockchain segment within which those tokens were initially locked.

19. The system of claim 1, further utilizing at least one pattern-linkage record that links a smart contract computer instructions with a pattern definition, wherein the pattern definition may match the occurrence of one or more data records added to the blockchain, and wherein the smart contract computer instructions are invoked when at least one of the data record matching the pattern definition is incorporated into the blockchain.

20. In a computerized network of a plurality of computers, executing computer instructions stored in electronic memory for implementing and maintaining a distributed electronic ledger system, a consensus determination method comprising:

creating and maintaining in the electronic memory of at least one the plurality of networked computers the distributed electronic ledger, implemented as a backward-linked blockchain of a plurality of interconnected blockchain blocks;

utilizing a consensus process for determining which node is permitted to add a next block on said blockchain and which node is allowed to share a reward for the next block added to the blockchain;

executing by a processor of a first node on the network a peer-to-peer software to create a first

competing block or a block chain segment to be added to the blockchain;

executing by a processor of a second node on the network a peer-to-peer software to create a second competing block or a block chain segment to be added to the blockchain;

executing by one or more computer processors of a network-connected nodes computer instructions that apply a consensus algorithm to calculate and assign a fitness value among the competing first and second blocks or blockchain segments;

determining by a plurality of the network-connected nodes which of the first or second blocks or blockchain segments will be a next block or blockchain segment incorporated into said blockchain; and

incorporating the next block or blockchain segment into the blockchain after the determination.

21. The system of claim 20, utilizing a hardware acceleration operation,

wherein the fitness value calculation is based on a Hash Distance formula:

$$\sum_{i=g}^n c \frac{V_i}{k + j \cdot H_i}^y$$

where V is a unique token value for block i , determined as within the sub-chain being evaluated; H is a hash distance for block i ; c , k , j and y are constants; g is a first block within the sub-chain being evaluated; and n is the last block within the sub-chain being evaluated.