

CLAIMS

1.A computer-implemented method for implementing processes that include determining consensus among a plurality of consensus nodes, the method comprising:

providing a plurality of process smart contracts, in which each process smart contract is configured to execute on a first blockchain, each process smart contract includes code for implementing a process that includes two or more steps, at least one of the steps involves determining whether a consensus is reached regarding whether to approve or reject an item, and at least one of the steps involves performing an action based on the determination of whether a consensus is reached;

providing a plurality of consensus smart contracts, in which each process smart contract is configured to execute on a second blockchain, each consensus smart contract includes code for implementing a process for determining consensus among a plurality of consensus nodes according to one or more consensus rules, each consensus smart contract includes a public key, wherein a private key of the consensus smart contract corresponding to the public key is stored in a key management system associated with the second blockchain, and wherein the first blockchain and the second blockchain can be a same blockchain or different blockchains; and

executing two or more process smart contracts, including

for each process smart contract, calling one or more consensus smart contracts, in which each consensus smart contract is configured to determine whether a consensus is reached among a plurality of consensus nodes, wherein a same consensus smart contract is called by multiple process smart contracts,

wherein the consensus smart contract uses the private key of the consensus smart contract to digitally sign a message requesting a vote on whether to approve or reject an item, and sends the message that is digitally signed to the plurality of consensus nodes,

wherein the public key of the consensus smart contract enables the consensus nodes to validate the message sent from the consensus smart contract, and

performing an action based on a result of the determination of whether a consensus is reached.

2.The method of claim 1 in which at least one of the consensus smart contracts includes a consensus rule specifying that a consensus among a group of consensus nodes is reached based on a statistical function of votes associated with the consensus nodes, and the statistical

function is configured to enable the consensus to be reached after obtaining votes from less than all of the group of consensus nodes.

3.The method of claim 2 in which the consensus rule specifies that a consensus among the group of consensus nodes is reached if a percentage of the consensus nodes that give approval votes is greater than a predetermined percentage value.

4.The method of any of the preceding claims in which at least one of the consensus smart contracts includes a consensus rule specifying that after a consensus node receives a request for approval, the consensus node is deemed to have given approval vote if the consensus node does not respond within a predetermined period of time.

5.The method of any of the preceding claims in which at least one of the consensus smart contracts includes a consensus rule specifying that after a consensus node receives a request for approval, the consensus node is deemed to abstain from voting if the consensus node does not respond within a predetermined period of time.

6.The method of any of the preceding claims in which at least one of the consensus smart contracts specifies at least one of (i) circumstances in which the consensus smart contract is effective and can be called by a process smart contract, or (ii) circumstances in which the consensus smart contract is ineffective and cannot be called by a process smart contract.

7.The method of any of claims 1 to 5 in which each consensus smart contract specifies at least one of (i) a first period of time that the consensus smart contract is effective and can be called by a process smart contract, in which outside the first period of time the consensus smart contract is ineffective and cannot be called by a process smart contract, or (ii) a first range of block heights of a blockchain that the consensus smart contract is effective and can be called by a process smart contract, in which outside the first range of block heights of the blockchain the consensus smart contract is ineffective and cannot be called by a process smart contract.

8.The method of any of claims 1 to 7 in which at least one of the consensus smart contracts includes a consensus rule specifying that a consensus regarding whether to approve or reject an item is sought from a first group of consensus nodes, and if a consensus cannot

be obtained from the first group of consensus nodes, a consensus regarding whether to approve or reject the item is sought from a second group of consensus nodes.

9.The method of any of the preceding claims in which each consensus smart contract specifies a contact method for each of the consensus nodes, and upon execution the consensus smart contract sends a request for approval of the item to each consensus node using the contact method associated with the consensus node.

10.The method of any of the preceding claims in which at least one consensus smart contract is configured to accept an argument list that specifies which consensus nodes need to participate in a consensus process, and executing the process smart contract comprises passing, from the process smart contract, a list of consensus nodes as arguments to the consensus smart contract.

11.A system for implementing processes that include determining consensus among a plurality of consensus nodes, the system comprising:

one or more processors; and

one or more computer-readable memories coupled to the one or more processors and having instructions stored thereon that are executable by the one or more processors to perform the method of any of claims 1 to 10.

12.An apparatus for implementing processes that include determining consensus among a plurality of consensus nodes, the apparatus comprising a plurality of modules for performing the method of any of claims 1 to 10.

13.A computer-implemented method comprising:

executing a first smart contract on a first blockchain, wherein the first smart contract includes code for implementing a first process having a plurality of stages, one of the stages includes executing a consensus smart contract on a second blockchain, in which the first and second blockchain are same or different,

wherein executing the consensus smart contract includes executing code for implementing a consensus process for determining consensus among two or more consensus nodes according to a set of one or more consensus rules, the consensus smart contract includes information about a contact method for each of the consensus nodes, the consensus smart contract includes a public key, wherein a private key of the consensus smart contract

corresponding to the public key is stored in a key management system associated with the second blockchain;

wherein the consensus smart contract uses the private key of the consensus smart contract to digitally sign a message requesting a vote, and sends the message that is digitally signed to the two or more consensus nodes,

wherein the public key of the consensus smart contract enables the consensus nodes to validate the message sent from the consensus smart contract; and

recording a result of execution of the consensus smart contract in the first or second blockchain.

14.The method of claim 13 in which the set of one or more consensus rules specify that a consensus is reached based on a statistical function of votes associated with the consensus nodes, and the statistical function is configured to enable a consensus to be reached after obtaining votes from less than all of the consensus nodes.

15.The method of claim 14 in which the set of one or more consensus rules specify that a consensus is reached if a percentage of consensus nodes that give approval votes is greater than a predetermined percentage value.

16.The method of any of claims 13 to 15 in which the set of one or more consensus rules specify that after a consensus node receives a request for approval, the consensus node is deemed to have given approval if the consensus node does not respond within a predetermined period of time.

17.The method of any of claims 13 to 16 in which the set of one or more consensus rules specify that after a consensus node receives a request for approval, the consensus node is deemed to abstain from voting if the consensus node does not respond within a predetermined period of time.

18.The method of any of claims 13 to 17 in which the consensus smart contract specifies at least one of (i) circumstances in which the consensus smart contract is effective and can be called by the first smart contract, or (ii) circumstances in which the consensus smart contract is ineffective and cannot be called by the first smart contract.

19.The method of any of claims 13 to 17 in which the consensus smart contract specifies

at least one of (i) what period of time the consensus smart contract is effective and can be called by the first smart contract, or (ii) a range of block height of a blockchain for which the consensus smart contract is effective and can be called by the first smart contract.

20. The method of any of claims 13 to 19 in which the set of one or more consensus rules specify that a consensus regarding whether to approve or reject an item is sought from a first group of consensus nodes, and if a consensus cannot be obtained from the first group of consensus nodes, a consensus regarding whether to approve or reject the item is sought from a second group of consensus nodes.

21. The method of any of claims 13 to 20 in which the consensus smart contract is configured to accept an argument list that specifies which consensus nodes need to participate in the consensus process, and executing the first smart contract comprises passing, from the first smart contract, a list of consensus nodes as arguments to the consensus smart contract.

22. A system for implementing a process that includes determining consensus among a plurality of consensus nodes, the system comprising:

one or more processors; and

one or more computer-readable memories coupled to the one or more processors and having instructions stored thereon that are executable by the one or more processors to perform the method of any of claims 13 to 21.

23. An apparatus for implementing processes that include determining consensus among a plurality of consensus nodes, the apparatus comprising a plurality of modules for performing the method of any of claims 13 to 21.