

What is claimed is:

1. A method, comprising:

storing data associated with a plurality of proportions of assets from a plurality of fungible assets in a first instance of distributed ledger database at a transaction originating communication device;

dividing, at a processor of the transaction originating communication device, a plurality of fungible tokens into a first plurality of groups of fungible tokens based on the data, each proportion of assets from the plurality of proportions of assets associated with a communication device from a first plurality of communication devices, the plurality of fungible tokens collectively representing on a distributed ledger-based network the plurality of fungible assets;

sending, via the distributed ledger-based network and based at least in part on an asymmetric cryptography key pair, each group of fungible tokens from the first plurality of groups of fungible tokens to a communication device (1) associated with that group of fungible tokens and (2) from the first plurality of communication devices, the first plurality of groups of fungible tokens being divided into a second plurality of groups of fungible tokens and received at a second plurality of communication devices that is at a different hierarchical level in an order of data transmission than the first plurality of communication devices to cause the second plurality of communication devices to send, to a designated recipient communication device, a plurality of non-fungible tokens for each group of fungible tokens from the second plurality of groups of fungible tokens, each non-fungible token from the plurality of non-fungible tokens being non-divisible and associated with an identifier (1) uniquely identifying a transaction destination from a plurality of transaction destinations and (2) from a plurality of identifiers, the second plurality of communication devices not including the transaction originating communication device.

2. The method of claim 1, wherein:

each fungible token from the plurality of fungible tokens is associated with a unit of the plurality of fungible assets.

3. The method of claim 1, wherein:

the plurality of fungible tokens does not include the identifier uniquely identifying the transaction destination.

4. The method of claim 1, wherein:

each non-fungible token from the plurality of non-fungible tokens includes ownership information associated with a transaction destination (1) associated with that non-fungible token and (2) from the plurality of transaction destinations.

5. The method of claim 1, wherein:

the identifier uniquely identifying a transaction destination from the plurality of transaction destinations is associated with at least one of a name or a location.

6. The method of claim 1, wherein:

each communication device from the second plurality of communication devices has a direct account relationship with at least one transaction destination from the plurality of transaction destinations.

7. The method of claim 1, wherein:

the plurality of non-fungible tokens is generated by the second plurality of communication devices and does not include the second plurality of groups of fungible tokens.

8. The method of claim 1, wherein:

the plurality of non-fungible tokens is converted based on the second plurality of groups of fungible tokens and includes information of the second plurality of groups of fungible tokens.

9. The method of claim 1, wherein:

the sending, via the distributed ledger-based network and based at least in part on the asymmetric cryptography key pair, each group of fungible tokens from the first plurality of groups of fungible tokens includes sending using a zero-knowledge proof protocol.

10. The method of claim 1, wherein:

the sending, via the distributed ledger-based network and based at least in part on the asymmetric cryptography key pair, each group of fungible tokens from the first plurality of groups of fungible tokens includes sending using a zero-knowledge proof protocol;

using the zero-knowledge proof protocol includes:

for each group of fungible tokens from the first plurality of groups of fungible tokens,

determining a fungible token commitment based on (1) that group of fungible tokens, (2) a public key of the asymmetric cryptography key pair associated with the transaction originating communication device, (3) a random nonce, and (4) a hash function; and

sending that group of fungible tokens by sending the fungible token commitment.

11. The method of claim 1, wherein:

the transaction originating communication device is associated with an issuer of financial instrument;

each transaction destination from the plurality of transaction destinations is associated with an owner of a subset of the financial instruments with the right to receive the subset of the financial instruments at a specified point of time.

12. The method of claim 1, wherein:

a communication device from the first plurality of communication devices is at a first hierarchical level at a first time and at a second hierarchical level at the second time.

13. The method of claim 1, wherein:

a hierarchical level of a communication device from the first plurality of communication devices is not associated with a physical connection or a geographical region of the communication device.

14. The method of claim 1, wherein:

the plurality of transaction destinations does not operate communication devices that transmit data via the distributed ledger-based network.

15. The method of claim 1, wherein:

the plurality of identifiers is a first plurality of identifiers;

each non-fungible token from the plurality of non-fungible tokens is associated with an identifier (1) from a second plurality of identifiers and (2) uniquely identifying a communication device from the second plurality of communication devices.

16. The method of claim 1, wherein:

each non-fungible token from the plurality of non-fungible tokens includes a value representing a number of the fungible tokens from that group of fungible tokens of the second plurality of groups of fungible tokens.

17. The method of claim 1, wherein:

each non-fungible token from the plurality of non-fungible tokens includes:

(1) a first value representing a number of the fungible tokens from that group of fungible tokens of the second plurality of groups of fungible tokens,

(2) characteristic information associated with a transaction destination from the plurality of transaction destinations, and

(3) a second value determined based on the first value and the characteristic information associated with that transaction destination.

18. The method of claim 1, wherein:

the first plurality of communication devices and the second plurality of communication devices transmit data peer-to-peer via the distributed ledger-based network and are not hierarchical in network topology.

19. The method of claim 1, further comprising:

storing, in a second instance of the distributed ledger database by the designated recipient communication device, data associated with the plurality of non-fungible tokens and a subset of the plurality of fungible tokens, the second instance of the distributed ledger database transmittable among at least the first plurality of communication devices and the second plurality of communication devices.

20. The method of claim 1, wherein:

the designated recipient communication device is the transaction originating communication device.

21. The method of claim 1, wherein:

the designated recipient communication device is the transaction originating communication device;

the method further comprises determining, based on the plurality of non-fungible tokens, a chain of custody for the plurality of fungible assets, the chain of custody starting from the transaction originating communication device and ending at the second plurality of communication devices.

22. The method of claim 1, wherein:

the designated recipient communication device is the transaction originating communication device;

the method further comprises determining, based on the plurality of non-fungible tokens, a chain of custody for the plurality of fungible assets, the chain of custody starting from the transaction originating communication device and ending at the second plurality of communication devices, the chain of custody for each group of fungible tokens from the second plurality of groups of fungible tokens is stored in a third instance of distributed ledger database associated with the distributed ledger-based network.

23. An apparatus, comprising:

a memory; and

a processor operatively coupled to the memory, the processor configured to:

generate a plurality of fungible tokens associated with a plurality of fungible assets, a first fungible token from the plurality of fungible tokens being of a type same as a second fungible token from the plurality of fungible tokens, the plurality of fungible tokens

collectively representing on a distributed ledger-based network the plurality of fungible assets;

divide the plurality of fungible tokens into a first plurality of groups of fungible tokens;

send, via the distributed ledger-based network, each group of fungible tokens from the first plurality of groups of fungible tokens to a communication device (1) associated with that group of fungible tokens and (2) from a first plurality of communication devices, the first plurality of groups of fungible tokens being divided into a second plurality of groups of fungible tokens and received at a second plurality of communication devices that is at a different hierarchical level in an order of data transmission than the first plurality of communication devices; and

receive, from the second plurality of communication devices, a plurality of non-fungible tokens, each non-fungible token including an identifier (1) uniquely identifying a transaction destination from a plurality of transaction destinations and (2) from a plurality of identifiers, each non-fungible token associated with a group of fungible tokens from the second plurality of groups of fungible tokens.

24. The apparatus of claim 23, wherein:

each communication device from the second plurality of communication devices is configured to store an account identifier associated with at least one transaction destination from the plurality of transaction destinations.

25. The apparatus of claim 23, wherein:

the plurality of non-fungible tokens is converted based on the second plurality of groups of fungible tokens and includes information of the second plurality of groups of fungible tokens.

26. The apparatus of claim 23, wherein:

the processor is configured to send, via the distributed ledger-based network, each group of fungible tokens from the first plurality of groups of fungible tokens by using a zero-knowledge proof protocol.

27. The apparatus of claim 23, wherein:

the processor is configured to send, via the distributed ledger-based network, each group of fungible tokens from the first plurality of groups of fungible tokens by using a zero-knowledge proof protocol;

using the zero-knowledge proof protocol includes:

for each group of fungible tokens from the first plurality of groups of fungible tokens:

the processor is configured to calculate a fungible token commitment from a plurality of fungible token commitments based on (1) that group of fungible tokens, (2) a public key of an asymmetric cryptography key pair associated with a transaction originating communication device, (3) a random nonce, and (4) a hash function; and

the processor is configured to send that group of fungible tokens by sending the fungible token commitment.

28. The apparatus of claim 23, wherein:

the plurality of fungible tokens does not include an identifier uniquely identifying a transaction destination of the plurality of transaction destinations.

29. The apparatus of claim 23, wherein:

the first plurality of groups of fungible tokens is invalidated based on a zero-knowledge proof protocol after being sent to the first plurality of communication devices.

30. A method, comprising:

receiving, at a processor of a communication device from a plurality of communication devices, a plurality of fungible tokens, the communication device storing an account identifier associated with a transaction destination from a plurality of transaction destinations, a first fungible token from the plurality of fungible tokens being of a type same as a second fungible token from the plurality of fungible tokens;

generating, at the processor of the communication device and based on the plurality of fungible tokens, a non-fungible token having (1) the account identifier uniquely identifying the transaction destination, (2) a value representing a number of the plurality of fungible tokens, and (3) characteristic information associated with the transaction destination; and

sending, to a processor of a designated recipient communication device via a distributed ledger-based network, the non-fungible token to establish a chain of custody of the plurality of fungible tokens starting from the transaction originating communication device and ending at the plurality of communication devices, the plurality of communication devices not including the transaction originating communication device or the transaction destination.