Independent Claim 9 (Method – Bidirectional Conversion Between Token and Physical Asset)
A computer-implemented method for bidirectional conversion between a tokenized digital twin of any physical asset or RWA and its underlying physical asset, comprising: minting a value token on a blockchain from IoT-verified data; enabling trading, swapping, or collateral use on a blockchain exchange; and converting the token back into a redeemable representation of the original physical asset by referencing the immutable ledger record and cryptographic provenance.

Dependent Claims for Independent Claim 9
The following is a complete set of dependent claims (Claims 2–22) that further specify and narrow the computer-implemented method of Independent Claim 9. Each dependent claim is fully supported by the disclosures in the attached document (Patent Filing Highlights US20220180374A1.pdf), including the detailed descriptions of IoT-verified data for minting value tokens as digital twins, blockchain ledger integration for immutable records and cryptographic provenance, trading/swapping/collateral functionality on the exchange platform, automated settlement/ownership transfer, bidirectional conversion back to a redeemable representation of the original physical asset by referencing the immutable ledger record, primary-market issuance, device/equipment registration, cryptographic binding, multi-cloud redundancy, and the overall end-to-end tokenized digital twin lifecycle for any physical asset or RWA as of the December 26, 2017 priority date.

Full Claim Set in Formal USPTO-Style Format (Reordered to Start with Claim 1)

1. A computer-implemented method for bidirectional conversion between a tokenized digital twin of any physical asset or RWA and its underlying physical asset, comprising: minting a value token on a blockchain from IoT-verified data; enabling trading, swapping, or collateral use on a blockchain exchange; and converting the token back into a redeemable representation of the original physical asset by referencing the immutable ledger record and cryptographic provenance.
2. The method of claim 1, wherein minting the value token further comprises collecting real-time data associated with the physical asset or RWA using IoT sensors, routers, and gateways, transmitting the data to an IoT cloud platform, validating the data, and generating a digital RWA certificate prior to minting.
3. The method of claim 1, wherein minting the value token comprises creating the value token as a primary market activity based on IoT-verified data associated with the physical asset or RWA.
4. The method of claim 1, wherein minting the value token further comprises recording the digital twin as an immutable digital asset on the blockchain ledger that includes one or more of public-key addresses, cryptographic block linking, timestamps, transaction data, user identifiers, equipment identifiers, validation reports, and verification statements.
5. The method of claim 1, wherein enabling trading, swapping, or collateral use further comprises listing the value token on a blockchain trading platform that functions as a commodity, crypto, or security exchange.

6. The method of claim 1, wherein enabling trading, swapping, or collateral use comprises processing market orders, limit orders, options, forwards, futures, swaps, or pre-market contracts on the blockchain exchange.
7. The method of claim 1, wherein enabling trading, swapping, or collateral use further comprises supporting advanced order types selected from the group consisting of short selling, trailing stop orders, conditional orders, One-Triggers-the-Other (OTO) orders, One-Cancels-the-Other (OCO) orders, One-Triggers-a-One-Cancels-the-Other (OTOCO) orders, and combinations thereof.
8. The method of claim 1, wherein enabling trading, swapping, or collateral use further comprises applying time-in-force rules to orders, the time-in-force rules selected from the group consisting of day orders, good-'til-canceled orders (up to 180 days), fill-or-kill orders, immediate-or-cancel orders, on-the-open orders, on-the-close orders, and combinations thereof.
9. The method of claim 1, wherein enabling trading, swapping, or collateral use comprises automatically matching and executing trades, swaps, or collateral arrangements in real time or near real time.
10. The method of claim 1, wherein converting the token back into a redeemable representation further comprises referencing the immutable ledger record and cryptographic provenance to verify ownership and physical asset origin prior to redemption.
11. The method of claim 1, wherein converting the token back further comprises updating the blockchain ledger to reflect redemption of the digital twin and return of the underlying physical asset or equivalent value.
12. The method of claim 1, wherein the blockchain ledger maintains multiple redundant copies across cloud environments to provide fault tolerance and Byzantine fault tolerance during minting, trading, swapping, collateral use, and bidirectional conversion.
13. The method of claim 1, wherein the immutable ledger record employs cryptographic hashing of each new block to prior blocks to ensure permanent verifiability of the digital twin and its bidirectional conversion to the physical asset.
14. The method of claim 1, wherein the method provides permanent auditability and fraud reduction through the immutable ledger record of the entire bidirectional conversion process, including minting, trading/swapping/collateral use, and redemption.
15. The method of claim 1, further comprising automated monetization or settlement by transferring funds or equivalent value upon execution of trading, swapping, collateral use, or redemption of the digital twin.
16. The method of claim 1, wherein the value token represents an immutable digital twin of any commodity, security, physical asset, financial instrument, or other RWA that is verifiable and cannot be double-spent due to the cryptographic provenance on the distributed ledger.
17. The method of claim 1, wherein the method operates in a closed-loop automated process from IoT-verified data minting through trading, swapping, collateral use, and bidirectional conversion back to the physical asset.

18. The method of claim 1, wherein the method eliminates intermediaries by performing end-to-end bidirectional conversion directly on the integrated blockchain ledger and exchange platform.
19. The method of claim 1, wherein the blockchain exchange supports high-frequency, derivative, and institutional trading, swapping, or collateral use of tokenized digital twins while enabling secure bidirectional conversion to the underlying physical asset.
20. The method of claim 1, wherein registering unique identifiers for IoT sensors, routers, and gateways on the blockchain ledger is performed prior to minting to cryptographically bind device provenance to the digital twin and support verifiable bidirectional conversion.
21. The method of claim 1, wherein converting the token back further comprises executing wallet or payment applications within a Trusted Execution Environment (TEE) to securely reference the immutable ledger record and cryptographic provenance.
22. The method of claim 1, wherein the method supports scalable, industrial-scale bidirectional conversion of tokenized digital twins of any physical asset or RWA by combining IoT-verified data minting with automated blockchain trading/swapping/collateral mechanisms and ledger-referenced redemption.

These claims form a self-contained, commercially robust claim family that directly maps to the computer-implemented method for bidirectional conversion between a tokenized digital twin of any physical asset or RWA and its underlying physical asset, including minting from IoT-verified data, trading/swapping/collateral use on the blockchain exchange, and redemption by referencing the immutable ledger record and cryptographic provenance as described in the December 26, 2017 provisional disclosure (and the incorporated earlier provisionals). The full set (renumbered to begin with Claim 1) can be incorporated into a non-provisional, continuation, or continuation-in-part application (alone or in combination with the claim families of Independent Claims 1–8) to further strengthen the Parisii patent portfolio for tokenized Real World Assets and blockchain-based RWA/digital twin infrastructure.