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Smart contract filtration in a wireless communication system

Abstract

In a wireless communication system, wireless communication devices filter smart contract data. The wireless communication devices generate source smart contract outputs. The wireless communication devices select some of the source smart contract outputs. The wireless communication devices select at least one target smart contract. The wireless communication devices transfer the selected source contract outputs to the ones of the selected target smart contracts. The selections that comprise this filtering may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors.

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Background/Summary

TECHNICAL BACKGROUND

(1) Wireless communication systems provide wireless data services to wireless user devices. For example, wireless communication systems serve mobile internet-access to phones, vehicles, and other devices. The wireless user devices execute user applications that consume the wireless data services. For example, a phone may execute a social-networking application that communicates with a content server over a wireless communication system. The wireless communication systems have wireless access nodes that exchange wireless signals with the wireless user devices over wireless communication links. The wireless access nodes also exchange this user data with user-plane elements like User Plane Functions (UPFs) and data gateways that are often connected to the internet. The wireless communication systems may also include satellites in earth orbit that wirelessly communicate with the wireless user devices and ground stations. For example, a wireless user device may access the internet over a satellite and a ground station.

(2) The wireless communication systems include distributed ledgers and smart contracts. The distributed ledgers comprise processing circuitry in the user devices, access nodes, satellites, and ground stations that execute smart contact software. The smart contract software processes smart contract inputs to generate and store smart contract outputs in an immutable blockchain format. To generate a smart contract output, the smart contracts execute the same smart contract input based on predetermined terms and conditions to generate a proposed smart contract output. The smart contracts in the distributed ledger then compare their proposed smart contract output to build a consensus on the correct output. When a consensus is reached, the smart contracts store their smart contract output in a blockchain format. The blockchain format comprises data blocks that are stored in the distributed ledger nodes. A data block stores the smart contract output and a hash of the previous data block. Thus, the data blocks are linked by the hashes that represent all previous smart contract outputs.

(3) In some examples, the smart contact outputs are directed as input to other smart contracts. Thus, multiple smart contacts may be sequentially linked in this manner with the output of the “source” smart contracts forming the input to the “target” smart contracts. Unfortunately, this type of smart contract linkage is typically implemented manually and becomes cumbersome. Moreover, a large set of linked smart contracts generates a massive amount of data that may not be warranted.

TECHNICAL OVERVIEW

(4) In some examples, wireless communication devices filter smart contract data. The wireless communication devices generate source smart contract outputs. The wireless communication devices select some of the source smart contract outputs. The wireless communication devices

select at least one target smart contract. The wireless communication devices transfer the selected source contract outputs to the selected target smart contract(s). The selections that comprise this filtering may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors.
(5) In some examples, wireless communication devices filter smart contract data. The wireless communication devices execute source smart contracts and responsively generate source smart contract outputs. The wireless communication devices determine values for the source smart contract outputs and responsively select some of the source smart contract outputs based on the values. The wireless communication devices select target smart contracts for the selected source smart contract outputs. The wireless communication devices transfer the selected source smart contract outputs for input into the selected target smart contracts. The selections that comprise this filtering may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors.
(6) In some examples, a wireless distributed ledger system filters smart contract data. In the wireless distributed ledger system, wireless communication devices execute source smart contracts and responsively generate source smart contract outputs. The wireless communication devices determine values for the source smart contract outputs and responsively select some of the source smart contract outputs based on the values. The wireless communication devices select target smart contracts for the selected source smart contract outputs. The wireless communication devices transfer the selected source smart contract outputs for input into the selected target smart contracts. The selections that comprise this filtering may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors.

Description

DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** illustrates an exemplary wireless communication system that filters smart contract data in wireless communication devices.
(2) FIG. **2** illustrates an exemplary operation of the wireless communication system to filter smart contract data in the wireless communication devices.
(3) FIG. **3** illustrates an exemplary operation of the wireless communication system to filter smart contract data in the wireless communication devices.
(4) FIG. **4** illustrates an exemplary wireless communication system to filter smart contract data in user equipment, wireless access nodes, application servers, satellites, and ground stations.
(5) FIG. **5** illustrates an exemplary wireless user equipment to filter smart contract data in the wireless communication system.
(6) FIG. **6** illustrates an exemplary wireless access node to filter the smart contract data in the wireless communication system.
(7) FIG. **7** illustrates an exemplary application server to filter the smart contract data in the wireless communication system.
(8) FIG. **8** illustrates an exemplary satellite to filter the smart contract data in the wireless communication system.
(9) FIG. **9** illustrates an exemplary ground station to filter the smart contract data in the wireless communication system.
(10) FIG. **10** illustrates an exemplary operation of the wireless communication system to filter smart contract data.

(11) FIG. **11** illustrates an exemplary operation of the wireless communication system to filter the smart contract data.
(12) FIG. **12** illustrates an exemplary operation of the wireless communication system to filter the smart contract data.
(13) FIG. **13** illustrates an exemplary operation of the wireless communication system to filter the smart contract data.
DETAILED DESCRIPTION
(14) FIG. **1** illustrates exemplary wireless communication system **100** to filter smart contract data in wireless communication devices **101-103**. Wireless communication system **100** comprises wireless communication devices **101-103**. Wireless communication devices **101-103** comprise phones, computers, access nodes, satellites, ground stations, or some other apparatus with wireless communication circuitry. Wireless communication device **101** comprises source smart contracts **111-113** and target smart contract selector **121**. Wireless communication device **102** comprises source smart contracts **114-116** and target smart contract selector **122**. Wireless communication device **103** comprises source smart contracts **117-119** and target smart contract selector **123**. For clarity, the amount of wireless communication devices and smart contracts that are shown on FIG. **1** has been restricted.
(15) Various examples of system operation and configuration are described herein. In some examples, wireless communication devices **101-103** generate and/or wirelessly receive source smart contract inputs. In wireless communication devices **101-103**, source smart contracts **111-119** process the source smart contract inputs to generate source smart contract outputs. Source smart contracts **111-119** transfer their source smart contract outputs to target smart contract selectors **121-123** in their own wireless communication devices **101-103**. For example, in wireless communication device **102**, source smart contract **115** transfers its smart contract outputs to target smart contract selector **122**.
(16) Target smart contract selectors **121-123** filter the smart contract outputs by selecting only some of these outputs to forward to target smart contracts **131-133**. Target smart contract selectors **121-123** further filter the selected smart contract outputs by selecting only some of target smart contracts **131-133** to receive the forwarded outputs. The selections that comprise this filtering may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors. Target smart contract selectors **121-123** transfer the selected source smart contract outputs to their selected target smart contracts **131-133**. Target smart contracts **131-133** process these smart contract outputs as inputs to their own smart contracts which generate their own smart contract outputs. Groups of source smart contracts **111-119** may comprise distributed ledgers. Wireless communication devices **101-103** may comprise wireless User Equipment (UEs), wireless access nodes in Radio Access Networks (RANs), satellites in earth orbit, satellite ground stations, and/or some other communication apparatus with wireless communication circuitry.
(17) Wireless communication devices **101-103** comprise radios that wirelessly communicate using wireless protocols like Institute of Electrical and Electronics Engineers 802.11 (WIFI), Fifth Generation New Radio (5GNR), Long Term Evolution (LTE), Low-Power Wide Area Network (LP-WAN), Near-Field Communications (NFC), Code Division Multiple Access (CDMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), and Sixth Generation (6G) satellite communications. Wireless communication devices **101-103** comprise microprocessors, software, memories, transceivers, bus circuitry, and/or some other data processing components, The microprocessors comprise Digital Signal Processors (DSP), Central Processing Units (CPU), Graphical Processing Units (GPU), Application-Specific Integrated Circuits (ASIC), and/or some other data processing hardware. The memories comprise Random Access Memory (RAM), flash circuitry, disk drives, and/or some other type of data storage. The memories store software like operating systems, smart contracts, applications, and functions. The microprocessors

retrieve the software from the memories and execute the software to drive the operation of wireless communication system **100** as described herein.

(18) FIG. **2** illustrates an exemplary operation of wireless communication system **100** to filter smart contract data in wireless communication devices **101-103**. The operation may differ in other examples. In wireless communication devices **101-103**, source smart contracts **111-119** generate source smart contract outputs (**201**). In wireless communication devices **101-103**, target smart contract selectors **121-123** select some of the source smart contract outputs (**202**). In wireless communication devices **101-103**, target smart contract selectors **121-123** select individual target smart contracts **131-133** for the selected source smart contract outputs (**203**). In wireless communication devices **101-103**, target smart contract selectors **121-123** transfer their selected target smart contract outputs to individual target smart contracts **131-133** (**204**). The selection of the smart contract outputs and the smart contract targets may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors.

(19) FIG. **3** illustrates an exemplary operation of wireless communication system **100** to filter smart contract data in wireless communication devices **101-103**. The operation may differ in other examples. Source smart contract **111** in wireless communication device **101** receives a source smart contract input. Source smart contract **111** reaches a consensus with other smart contracts on a source smart contract output. Source smart contract **111** transfers the source smart contract output to target smart contract selector **121** in wireless communication device **101**. Target smart contract selector **121** generates a value for the source smart contract output based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors. In this example, the value is low, and as a result, target smart contract selector **121** does not select any target smart contracts **131-133** to receive the source smart contract output.

(20) Source smart contract **111** then receives another source smart contract input. Source smart contract **111** reaches a consensus with other smart contracts on another source smart contract output. Source smart contract **111** transfers the other source smart contract output to target smart contract selector **121**. Target smart contract selector **121** generates another value for the other source smart contract output. In this example, the value is high, and as a result, target smart contract selector **121** selects target smart contract **131** to receive the source smart contract output. The selection of target smart contract **131** may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors. Target smart contract selector **121** transfers the selected source smart contract output to target smart contract **131**.

(21) Source smart contract **111** then receives another source smart contract input. Source smart contract **111** reaches a consensus with other smart contracts on a source smart contract output. Source smart contract **111** transfers the source smart contract output to target smart contract selector **121**. Target smart contract selector **121** generates a value for the source smart contract output. In this example, the value is high, and as a result, target smart contract selector **121** selects source smart contract **114** in wireless communication device **102** to receive the source smart contract output. Target smart contract selector **121** transfers the selected source smart contract output to source smart contract **114**.

(22) Source smart contract **114** receives the source smart contract input and reaches a consensus with other smart contracts on a source smart contract output. Source smart contract **114** transfers the source smart contract output to target smart contract selector **122**. Target smart contract selector **122** generates a value for the source smart contract output. In this example, the value is high, and as a result, target smart contract selector **122** selects target smart contract **132** to receive the source smart contract output. Target smart contract selector **122** transfers the selected source smart contract output to target smart contract **132**.

(23) Advantageously, wireless communication system **100** intelligently links smart contracts together. Moreover, wireless communication system **100** filters the amount of transferred smart contract outputs and targets, so the amount of transferred smart contract data is warranted by the value of the smart contract outputs.

(24) FIG. **4** illustrates an exemplary wireless communication system **400** to filter smart contract data in wireless User Equipment (UEs) **401-403**, Fifth Generation New Radio (5GNR) Access Nodes (ANs) **404-405**, Application Server (AS) **409**, Sixth Generation (6G) satellites (SAT) **410-411**, and ground station (GND) **412**. Wireless communication system **400** comprises an example of wireless communication system **100**, although wireless communication system **100** may differ. For example, AS **409** could be another type of data center. Wireless communication system **400** comprises UEs **401-403**, ANs **404-405**, Access and Mobility Management Function (AMF) **406**, Session Management Function (SMF) **407**, User Plane Function (UPF) **408** AS **409**, satellites **410-411**, and ground station **412**. UEs **401-403** comprise Distributed Ledger (DL) **421** that executes Smart Contract (SC) A. ANs **404-405** comprise DL **422** that executes SC B. ANs **404-405** comprise DL **422** that executes SC B. AS **409** comprise DL **423** that executes SC C. Satellites **410-411** comprise DL **424** that executes SC D. Ground station **412** comprises DL **425** that executes SC E. External to wireless communication system DLs **426-428** execute respective SCs F, G, and H. For clarity, the number of UEs, ANs, ASs, satellites, ground stations, DLs, and SCs has been restricted on FIG. **4**.

(25) UEs **401-403** receive or generate inputs for SC A in DL **421**. In DL **421**, SC A processes the SC A inputs to build consensus and generate SC A outputs. UEs **401-403** determine values for the SC A outputs. The selected the SC A outputs that have values which exceed a threshold are forwarded—where the threshold is set to achieve the desired filtering. For example, a medical system may use thresholds to forward abnormal medical outputs like high blood pressure or body temperature while not transferring the normal medical outputs for high blood pressure or body temperature. UEs **401-403** select one or more target SCs for their selected SC A outputs. UEs **401-403** forward their selected SC A outputs to the selected target SCs. For example, UE **401** may forward a selected SC A output to SC D in satellite **410**. SC A may designate one of UEs **401-403** to perform this SC A output selection and forwarding.

(26) ANs **404-405** receive or generate inputs for SC B in DL **422**. In DL **422**, SC B processes the SC B inputs to build consensus and generate SC B outputs. ANs **404-405** determine values for the SC B outputs. The selected the SC B outputs that have values which exceed a threshold are forwarded. ANs **404-405** select one or more target SCs for their selected SC B outputs. ANs **404-405** forward their selected SC B outputs to the target SCs. For example, AN **404** may forward a selected SC B output to SC A in UE **402**. SC B may designate one of ANs **404-405** to perform this SC B output selection and forwarding.

(27) AS **409** receives or generates inputs for SC C in DL **423**. In DL **423**, SC C processes the SC C inputs to build consensus and generate SC C outputs. AS **409** determines values for the SC C outputs. The selected the SC C outputs that have values which exceed a threshold are forwarded. AS **409** selects one or more target SCs for its selected SC C outputs. AS **409** forwards its selected SC C outputs to the target SCs. For example, AS **409** may forward a selected SC C output to SC G in DL **427**.

(28) Satellites **410-411** receive or generate inputs for SC D in DL **424**. In DL **424**, SC D processes the SC D inputs to build consensus and generate SC D outputs. Satellites **410-411** determine values for the SC D outputs. The selected SC D outputs that have values which exceed a threshold are forwarded. Satellites **410-411** select one or more target SCs for their selected SC D outputs. Satellites **410-411** forward their selected SC D outputs to the target SCs. For example, satellite **410** may forward a selected SC D output to SC F in DL **426**. SC D may designate one of satellites **410-411** to perform this SC D output selection and forwarding.

(29) Ground station **412** receives or generates inputs for SC E in DL **425**. In DL **425**, SC E

processes the SC E inputs to build consensus and generate SC E outputs. Ground station **412** determines values for the SC E outputs. The selected the SC E outputs that have values which exceed a threshold are forwarded. Ground station **412** selects one or more target SCs for its selected SC E outputs. Ground station **412** forwards its selected SC D outputs to the target SCs. For example, Ground station **412** may forward a selected SC E output to SC H in DL **428**.

(30) The selection and forwarding may occur from any of SCs A-H to any other SCs A-H. The selection and forwarding may be based on device location, device identifier, digital certificates, device application identifiers, device component identifiers, alarms, messages, time, day, date, and/or some other factors. For example, UE **401** may forward SC A outputs to SC H when these outputs are generated from SC A inputs at a specific location. In another example, AN **404** may forward SC B outputs to SC C when the SC B outputs are generated from SC B inputs that have a particular digital certificate. Various different rules for selection and forwarding could be used by wireless communication system **400**.

(31) FIG. **5** illustrates exemplary UE **401** to filter smart contract data in wireless communication system **400**. UE **401** represents an example of wireless communication devices **101-103** and UEs **401-402**, although devices **101-103** and UEs **402-403** may differ. UE **401** comprises Satellite (SAT) radio **501**, Fifth Generation New Radio (5GNR) radio **502**, Wireless Fidelity (WIFI) radio **503**, and processing circuitry **504**. Radios **501-503** comprise antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSPs, memories, and transceivers (XCVRs) that are coupled over bus circuitry. Processing circuitry **504** comprises CPU, memory, and transceivers that are coupled over bus circuitry. The memory in processing circuitry **504** stores software like an Operating System (OS), 5GNR application (5GNR), satellite application (SAT), WIFI application (WIFI), user applications (APP), distributed ledger software (DL SW) **505**, and Smart Contract Forwarder (SC FWD) **506**. DL software **505** implements DL **421** and comprises Smart Contract (SC) A. SC FWD **506** comprises an example of target smart contract selectors **121-123**, although selectors **121-123** may differ.

(32) The antennas in satellite radio **501** exchange satellite signals with satellite (SAT) **410**. The antennas in 5GNR radio **502** exchange 5GNR signals with 5GNR AN **404**. The antennas in WIFI radio **503** exchange WIFI signals with user devices. Transceivers in radios **501-503** are coupled to transceivers in processing circuitry **504**. In processing circuitry **504**, the CPU retrieves the software from the memory and executes the software to direct the operation of UE **401** as described herein.

(33) UE **401** receives SC A inputs from the user devices over WIFI radio **503**. UE **401** executes the user applications to generate SC A inputs. SC A processes the SC A inputs to build consensus with UEs **402-403** (and typically other devices in DL **421**) and generates SC A outputs. In UE **401**, SC FWD **506** determines values for the SC A outputs, and when the selected the SC A outputs have values which exceed a threshold, SC FWD **506** selects target SCs and forwards the selected SC A outputs to the selected target SCs. For example, SC FWD **506** may forward a selected SC A output to SC B in 5GNR AN **404** when the selected SC A output is based on an SC A input that is accompanied by a particular digital certificate. In another example, SC FWD **506** may forward a selected SC A output to SC D in satellite **410** when the selected SC A output is based on an SC A input from a specific user device at a designated location.

(34) FIG. **6** illustrates exemplary 5GNR Access Node (AN) **404** to filter smart contract data in wireless communication system **400**. 5GNR AN **404** comprises an example of wireless communication devices **101-103** and AN **405**, although devices **101-103** and AN **405** may differ. 5GNR AN **404** comprises 5GNR Radio Unit (RU) **601**, Distributed Unit (DU) **602**, and Centralized Unit (CU) **603**. 5GNR RU **601** comprises antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSP, memory, radio applications, and transceivers that are coupled over bus circuitry. DU **602** comprises memory, CPU, user interfaces and components, and transceivers that are coupled over bus circuitry. The memory in DU **602** stores operating system and 5GNR network applications for Physical Layer (PHY), Media Access Control (MAC), and Radio Link Control

(RLC). CU **603** comprises memory, CPU, and transceivers that are coupled over bus circuitry. The memory in CU **603** stores an operating system and 5GNR network applications for Packet Data Convergence Protocol (PDCP), Service Data Adaption Protocol (SDAP), and Radio Resource Control (RRC). The memory in CU **603** also stores distributed ledger (DL) software **604**, and Smart Contract Forwarder (SC FWD) **605**. DL software **604** implements DL **422** and comprises Smart Contract (SC) B. SC FWD **605** comprises an example of target smart contract selectors **121-123**, although selectors **121-123** may differ.

(35) The antennas in 5GNR RU **601** are wirelessly coupled to UE **401** over 5GNR links. Transceivers in 5GNR RU **601** are coupled to transceivers in DU **602**. Transceivers in DU **602** are coupled to transceivers in CU **603**. Transceivers in CU **603** are coupled AMF **406** and UPF **408**. The DSP and CPU in RU **601**, DU **602**, and CU **603** execute the radio applications, operating systems, network applications, DL software **604**, and SC FWD **605** to exchange data and signaling with UE **401**, AMF **406**, and UPF **408** as described herein.

(36) AN **404** receives or generate inputs for SC B in DL software **604**. SC B processes the SC B inputs to build consensus and generate SC B outputs. SC FWD **605** determines values for the SC B outputs. The SC B outputs that have values which exceed a threshold are forwarded. SC FWD **605** selects one or more target SCs for their selected SC B outputs and forwards their selected SC B outputs to the target SCs. For example, SC FWD **605** may forward a selected SC B output to SC C in AS **409** when the selected SC B output is based on an input from UE **401** that is accompanied by a particular digital certificate. In another example, SC FWD **605** may forward a selected SC B output to SC G in DL **427** when the selected SC B output is generated by the RRC in CU **603**.

(37) FIG. **7** illustrates exemplary data center **700** to filter smart contract data in wireless communication system **400**. Network data center **700** comprises NF hardware **701**, NF hardware drivers **702**, NF operating systems **703**, NF virtual layer **704**, and NF Software (SW) **705**. NF hardware **701** comprises Network Interface Cards (NICs), CPU, RAM, Flash/Disk Drives (DRIVE), and Data Switches (DSW). NF hardware drivers **702** comprise software that is resident in the NIC, CPU, RAM, DRIVE, and DSW. NF operating systems **703** comprise kernels, modules, applications, and containers. NF virtual layer **704** comprises vNIC, vCPU, vRAM, vDRIVE, and vSW. NF SW **705** comprises AMF SW **707**, SMF SW **708**, UPF SW **709**, AS SW **710**, and SC FWD SW **711**. Data center **700** executes AS SW **710** to form AS **409**. AS SW **711** comprises DL SW **712** that forms DL **423** which executes SC C. SC FWD **711** comprises an example of target smart contract selectors **121-123**, although selectors **121-123** may differ.

(38) The NIC in NF hardware **701** are coupled to 5GNR ANs **404-405** and DLs **425-427**. NF hardware **701** executes NF hardware drivers **702**, NF operating systems **703**, NF virtual layer **704**, and NF SW **705** to form and operate AMF **406**, SMF **407**, UPF **408**, and AS **409**. Network data center **700** may be located at a single site or be distributed across multiple geographic locations.

(39) When executed by data center **700** to form AS **409**, AS SW **710** receives or generates inputs for SC C in DL **423**. SC C processes the SC C inputs to build consensus and generate SC C outputs. SC FWD **711** determines values for the SC C outputs. When the SC C outputs have values which exceed a threshold, SC FWD **711** selects target SCs and forwards the selected SC C outputs to the selected target SCs. For example, SC FWD **711** may forward a selected SC C output to SC G in DL **427** when the SC C output is based on an SC C input that was formerly a selected SC B output.

(40) FIG. **8** illustrates exemplary satellite **410** to filter smart contract data in wireless communication system **400**. Satellite **410** comprises an example of wireless communication devices **101-103** and satellite **411**, although devices **101-103** and satellite **411** may differ. Satellite **410** comprises UE radio **801**, ground radio **802**, and processing circuitry **803**. Radios **801-802** comprise antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSPs, memories, and transceivers (XCVRs) that are coupled over bus circuitry. Processing circuitry **803** comprises CPU, memory, and transceivers that are coupled over bus circuitry. The memory in processing

circuitry **803** stores software like an Operating System (OS), satellite application (SAT), distributed ledger software (DL SW) **804**, and Smart Contract Forwarder (SC FWD) **805**. DL software **804** implements DL **424** and comprises Smart Contract (SC) D. SC FWD **805** comprises an example of target smart contract selectors **121-123**, although selectors **121-123** may differ.

(41) The antennas in downlink radio **801** exchanges satellite signals with UEs **401-402**. The antennas in ground radio **802** exchange satellite signals with ground station (GND) **412**. Transceivers in radios **801-802** are coupled to transceivers in processing circuitry **803**. In processing circuitry **803**, the CPU retrieves the software from the memory and executes the software to direct the operation of satellite **410** as described herein.

(42) Satellite **410** receives SC D inputs from the UEs **401-402** over UE radio **802**. Satellite **410** executes the satellite applications to generate SC D inputs. SC D processes the SC D inputs to build consensus with other satellites and generates SC D outputs. In satellite **410**, SC FWD **805** determines values for the SC D outputs. When the selected the SC D outputs have values which exceed a threshold, SC FWD **805** selects target SCs and forwards the selected SC D outputs to the selected target SCs. For example, SC FWD **805** may forward a selected SC D output to SC E in ground station **412** when the selected SC D output is based on an SC D input that was generated by a satellite application having a particular application identifier. In another example, SC FWD **805** may forward a selected SC D output to SC H when the selected SC D output is based on an SC D input from UE **401** at a specific date and time.

(43) FIG. **9** illustrates exemplary ground station **412** to filter smart contract data in wireless communication system **400**. Ground station **412** comprises an example of wireless communication devices **101-103**, although devices **101-103** may differ. Ground station **412** comprises satellite radio **901** and processing circuitry **902**. Satellite radio **901** comprises antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSP, memory, radio applications, and transceivers that are coupled over bus circuitry. Processing circuitry **902** comprises CPU, memory, and transceivers that are coupled over bus circuitry. The memory in processing circuitry **902** stores software like an Operating System (OS), satellite application (SAT), network application (NET), distributed ledger software (DL SW) **903**, and Smart Contract Forwarder (SC FWD) **904**. DL software **903** implements DL **425** and comprises Smart Contract (SC) E. SC FWD **904** comprises an example of target smart contract selectors **121-123**, although selectors **121-123** may differ.

(44) The antennas in satellite radio **901** exchange satellite signals with satellites **410-411**. Transceivers in radio **901** are coupled to transceivers in processing circuitry **902**. In processing circuitry **902**, the CPU retrieves the software from the memory and executes the software to direct the operation of ground station **412** as described herein.

(45) Ground station **412** receives SC E inputs from satellites **410-411** over satellite radio **901**. Ground station **412** executes the satellite applications to generate SC E inputs. SC E processes the SC E inputs to build consensus with other devices and generates SC E outputs. In ground station **412**, SC FWD **904** determines values for the SC E outputs. When the selected SC E outputs have values which exceed a threshold, SC FWD **904** selects target SCs and forwards the selected SC E outputs to the selected target SCs. For example, SC FWD **904** may forward a selected SC E output to DL **428** when the selected SC E output is generated by a satellite application in response to a message from DL **428**. In another example, SC FWD **904** may forward a selected SC E output to SC G when the selected SC E output is based on an SC E input from satellite **411** at a specific location.

(46) FIG. **10** illustrates an exemplary operation of wireless communication system **400** to filter smart contract data. The operation may differ in other examples. Smart Contract A (SC A) in UE **401** receives an SC A input. SC A reaches a consensus with other SC A nodes in DL **421** for an SC A output. SC A transfers the SC A output to SC A Forwarder (SC A FWD) **506** in UE **401**. SC A FWD **506** generates a value for the SC A output. The value may comprise a numerical amount or a yes/no determination that is based on one or more factors. In this example, the SC A input

comprises a photograph from a user device in communication with UE **401**, and the SC A output comprises an annotated version of the photograph. The annotated photograph is designated as a "no" value by a data structure in SC A FWD **506** based on the current date, time-of-day, and location of UE **401** as applied to a data structure. This SC A output is not forwarded.

(47) SC A in UE **401** receives another SC A input. SC A reaches a consensus with other nodes in DL **421** on an SC A output. SC A transfers the SC A output to SC A FWD **506** in UE **401**. SC A FWD **506** generates a value for the other SC A output. In this example, the input comprises a carbon dioxide reading from a user device in communication with UE **401**, and the output comprises the carbon dioxide reading along with digital signature for UE **401**. The signed carbon dioxide reading is designated as a "yes" value by a data structure in SC A FWD **506** based on the identity of the user device that provided the SC A input. SC A FWD **506** selects target SC F for the SC A output based on the identity of the user device that provided the SC A input. SC A FWD **506** forwards the SC A output to SC F over 5GNR AN **404**.

(48) SC B in 5GNR AN **404** receives an SC B input. SC B reaches a consensus on an SC B output with other access nodes in DL **422**. SC B transfers the SC B output to SC B FWD **605** in AN **404**. SC B FWD **605** generates a value for the smart contract B output. In this example, the SC B input comprises a status message from a UE in communication with AN **404**, and the SC B output comprises the status message and verified location of the UE. The SC B output is designated as a "no" value by a data structure in SC B FWD **605** based on the message type and UE identity. The SC B output is not forwarded.

(49) SC B in 5GNR AN **404** receives another SC B input. SC B reaches a consensus with other nodes in DL **422**. SC B transfers the SC B output to SC B FWD **605** in AN **404**. SC B FWD **605** generates a value for the SC B output. In this example, the input comprises another message from the UE in communication with AN **404**, and the output comprises the message along with the verified location of the UE. The SC B output is scored based on message type and UE location which are normalized and summed, and in this example, the numerical score exceeds a threshold in SC B FWD **605**. SC B FWD **605** selects target SC G for the message and location by entering the UE location into a data structure. SC B FWD **605** forwards the selected message and location to SC G.

(50) FIG. **11** illustrates an exemplary operation of wireless communication system **400** to filter smart contract data. The operation may differ in other examples. SC D in satellite **410** receives an SC D input. SC D reaches a consensus on an SC D output with other nodes in DL **424**. SC D transfers the SC D output to SC D FWD **805** in satellite **410**. SC D FWD **805** generates a value for the smart contract D output. In this example, the value comprises a score where proximity to a known location and time-of-day are normalized, summed, and compared to a threshold. The score falls below the threshold, so this SC D output is not forwarded.

(51) SC D in satellite **410** receives another SC D input. SC D reaches a consensus with other nodes in DL **424** on an SC D output. SC D transfers the SC D output to SC D FWD **805** in satellite **410**. SC D FWD **805** generates a value for the SC D output. In this example, the value comprises a score where proximity to the location and time-of-day are normalized, summed, and compared to a threshold. The score exceeds the threshold, so SC FWD **805** selects a target SC H based on a data structure that indicates target SC H for the location used for the proximity determination. SC FWD **805** transfers the SC D output to SC H over ground station (GND) **412**.

(52) SC E in ground station **412** receives an SC E input. SC E reaches a consensus on a SC E output with other nodes in DL **425**. SC E transfers the SC E output to SC E FWD **904** in ground station **412**. SC E FWD **904** generates a value for the SC E output. In this example, the value comprises a yes or no designation based on a list of application identifiers for the application that provided the SC E input. The application identifier for the SC E input is not on the list, so this SC E output is not forwarded.

(53) SC E in ground station **412** receives another SC E input. SC E reaches a consensus with other

nodes on DL **425**. SC E transfers the SC E output to SC E FWD **904** in ground station **412**. SC E FWD **904** generates a value for the SC E output. In this example, the value comprises a yes or no designation based on a list of application identifiers for the application that provided the SC E input. The source application identifier is on the list, so SC E forwards the SC E output to SC G based on the satellite identifier that transferred the SC E input to ground station **412**.

(54) FIG. **12** illustrates an exemplary operation of wireless communication system **400** to filter smart contract data. The operation may differ in other examples. Smart Contract A (SC A) in UE **401** receives an SC A input. SC A reaches a consensus with other SC A nodes in DL **421** for an SC A output. SC A transfers the SC A output to SC A FWD **506** in UE **401**. SC A FWD **506** generates a value for the other SC A output. In this example, the input comprises a voice mail from another UE in communication with UE **401**, and the output comprises the voice mail along with a digitally signed location, date, and time for UE **401** when the voice mail was received. The voice mail along with the signed location, date, and time is designated as a “yes” value by a data structure in SC A FWD **506** based on the location, date, and time. SC A FWD **506** selects target SC B in AN **404** for the SC A output based on the location of UE **401**. SC A FWD **506** forwards the SC A output to SC B in AN **404**.

(55) SC B in AN **404** receives the SC A output as an SC B input. SC B reaches a consensus on an SC B output with other access nodes in DL **422**. SC B transfers the SC B output to SC B FWD **605** in AN **404**. SC B reaches a consensus with other nodes in DL **422**. SC B transfers the SC B output to SC B FWD **605** in AN **404**. SC B FWD **605** generates a value for the SC B output. In this example, the input comprises the voice mail along with the signed location, date, and time, and the output comprises the voice mail, signed location, date, and time along with the signed identity and location of the sending UE. The SC B output is scored as a “yes” based on the identities of receiving UE **401** and the sending UE as applied to a data structure in SC B FWD **605**. SC B FWD **605** selects target SC E for the SC B output based on the identity of UE **401** as applied to a data structure. SC B FWD **605** forwards the selected voice mail and metadata to SC E.

(56) SC A in UE **401** generates an SC A input. SC A reaches a consensus with other SC A nodes in DL **421** for an SC A output. SC A transfers the SC A output to SC A FWD **506** in UE **401**. SC A FWD **506** generates a value for the other SC A output. In this example, the input comprises a medical reading (like heart rate) that was detected by UE **401**. The SC A output comprises the medical reading along with the date and time of the medical reading. The medical reading along with the date and time is designated as a “yes” value by a data structure in SC A FWD **506** based on the type of medical reading. SC A FWD **506** selects target SC C in AS **409** for the SC A output based on the location of UE **401**. SC A FWD **506** forwards the SC A output to SC C in AS **409**.

(57) SC C in AS **409** receives the SC A output as an SC C input. SC C reaches a consensus on an SC C output with other access nodes in DL **423**. SC C transfers the SC C output to SC C FWD **711** in AS **409**. SC C FWD **711** generates a value for the SC C output. In this example, the input comprises the medical reading, date, and time, and the output comprises a medical alarm along with the medical reading, date, and time. The alarm is based on the medical reading as applied to a medical threshold. The SC C output is scored as a “yes” based on the medical reading exceeding the medical threshold-like heart rate exceeding a heart rate threshold. SC C FWD **711** selects target SC G for the SC C output based on the identity of UE **401** as applied to a data structure. SC C FWD **711** forwards the selected heart rate, date, time, and alarm to SC G.

(58) FIG. **13** illustrates an exemplary operation of wireless communication system **400** to filter smart contract data. The operation may differ in other examples. SC A in UE **401** generates an SC A input. SC A reaches a consensus with other SC A nodes in DL **421** for an SC A output. SC A transfers the SC A output to SC A FWD **506** in UE **401**. SC A FWD **506** generates a value for the other SC A output. In this example, the input comprises a vehicle velocity that was detected by UE **401**. The SC A output comprises the vehicle velocity along with the verified location of UE **401**. The vehicle velocity and location is designated as a “yes” value by a data structure in SC A FWD

506 based on the velocity and location as applied to a data structure. SC A FWD **506** selects target SC D in satellite **410** for the SC D output based on the velocity and location of UE **401**. SC A FWD **506** forwards the SC A output to SC D in satellite **410**.

(59) SC D in satellite receives the SC A output as an SC D input. SC D reaches a consensus on an SC D output with other satellites in DL **424**. SC D transfers the SC D output to SC D FWD **805** in satellite **410**. SC D FWD **805** generates a value for the SC D output. In this example, the input comprises the vehicle velocity and location, and the output comprises a UE **401** identifier along with the velocity and location. The SC D output is scored as a “yes” based on the vehicle velocity exceeding a velocity threshold for the location. SC D FWD **805** selects target SC G for the SC D output based on the identity of UE **401** as applied to a data structure. SC F FWD **805** forwards the UE **401** identity, vehicle velocity, and location to SC G over ground station (GND) **412**.

(60) SC B in AN **404** generates an SC B input. SC B reaches a consensus with other SC B nodes in DL **422** for an SC B output. SC B transfers the SC B output to SC B FWD **605** in AN **404**. SC B FWD **605** generates a value for the SC B output. In this example, the input comprises an identity and location of an aerial drone in communication with AN **404**. The SC B output comprises the identity and location along with the altitude of the aerial drone. The location, identity, and altitude is designated as a “yes” value by a data structure in SC B FWD **605** based on the altitude as applied to a threshold for the location. SC B FWD **605** selects target SC C in AS **409** for the SC B output based on the identity of the aerial drone. SC B FWD **605** forwards the SC B output to SC C in AS **409**.

(61) SC C in AS **409** receives the SC B output as an SC C input. SC C reaches a consensus on an SC C output with other access nodes in DL **423**. SC C transfers the SC C output to SC C FWD **711** in AS **409**. SC C FWD **711** generates a value for the SC C output. In this example, the input comprises the aerial drone identity, location, and altitude and the output comprises wind speed and other weather data for the area occupied by the drone along with the aerial drone identity, location, and altitude. The SC C output is scored as a “yes” based on the identity of the aerial drone. SC C FWD **711** selects target SC F for the SC C output based on the identity of the aerial drone. SC C FWD **711** forwards the identity, location, altitude, wind speed and other data for the aerial drone to SC F.

(62) The wireless communication system circuitry described above comprises computer hardware and software that form special-purpose wireless communication device circuitry to filter smart contract data. The computer hardware comprises processing circuitry like CPUs, DSPs, GPUs, transceivers, bus circuitry, and memory. To form these computer hardware structures, semiconductors like silicon or germanium are positively and negatively doped to form transistors. The doping comprises ions like boron or phosphorus that are embedded within the semiconductor material. The transistors and other electronic structures like capacitors and resistors are arranged and metallically connected within the semiconductor to form devices like logic circuitry and storage registers. The logic circuitry and storage registers are arranged to form larger structures like control units, logic units, and Random-Access Memory (RAM). In turn, the control units, logic units, and RAM are metallically connected to form CPUs, DSPs, GPUs, transceivers, bus circuitry, and memory.

(63) In the computer hardware, the control units drive data between the RAM and the logic units, and the logic units operate on the data. The control units also drive interactions with external memory like flash drives, disk drives, and the like. The computer hardware executes machine-level software to control and move data by driving machine-level inputs like voltages and currents to the control units, logic units, and RAM. The machine-level software is typically compiled from higher-level software programs. The higher-level software programs comprise operating systems, utilities, user applications, and the like. Both the higher-level software programs and their compiled machine-level software are stored in memory and retrieved for compilation and execution. On power-up, the computer hardware automatically executes physically-embedded machine-level

software that drives the compilation and execution of the other computer software components which then assert control. Due to this automated execution, the presence of the higher-level software in memory physically changes the structure of the computer hardware machines into special-purpose wireless communication device circuitry to filter smart contract data.
(64) The above description and associated figures teach the best mode of the invention. The following claims specify the scope of the invention. Note that some aspects of the best mode may not fall within the scope of the invention as specified by the claims. Those skilled in the art will appreciate that the features described above can be combined in various ways to form multiple variations of the invention. Thus, the invention is not limited to the specific embodiments described above, but only by the following claims and their equivalents.

Claims

1. A method to filter smart contract data in wireless communication devices, the method comprising: in the wireless communication devices, generating source smart contract outputs; in the wireless communication devices, filtering the source smart contract outputs based on locations of the wireless communication devices to generate one or more filtered source smart contract outputs; in the wireless communication devices, selecting at least one target smart contract; and in the wireless communication devices, transferring the one or more filtered source smart contract outputs to the selected at least one target smart contract.
2. The method of claim 1 further comprising, in the wireless communication devices, wirelessly receiving source smart contract inputs and inputting the source smart contract inputs into the source smart contracts.
3. The method of claim 1 further comprising, in the wireless communication devices, generating source smart contract inputs and inputting the source smart contract inputs into the source smart contracts.
4. The method of claim 1 wherein the wireless communication devices comprise at least one distributed ledger.
5. The method of claim 1 wherein the wireless communication devices comprise wireless User Equipment (UEs).
6. The method of claim 1 wherein the wireless communication devices comprise wireless access nodes.
7. The method of claim 1 wherein one or more of the selected at least one target smart contract is executed in a satellite in earth orbit.
8. A method to filter smart contract data in wireless communication devices, the method comprising: in the wireless communication devices, executing source smart contracts and responsively generating source smart contract outputs; in the wireless communication devices, determining values for the source smart contract outputs based on locations of the wireless communication devices and responsively filtering the source smart contract outputs based on the values to generate one or more filtered source smart contract outputs; in the wireless communication devices, selecting target smart contracts for the one or more filtered source smart contract outputs; and in the wireless communication devices, transferring the one or more filtered source smart contract outputs for input into the selected target smart contracts.
9. The method of claim 8 further comprising, in the wireless communication devices, wirelessly receiving source smart contract inputs and inputting the source smart contract inputs into the source smart contracts.
10. The method of claim 8 further comprising, in the wireless communication devices, generating source smart contract inputs and inputting the source smart contract inputs into the source smart contracts.
11. The method of claim 8 wherein the wireless communication devices comprise distributed

ledgers.
12. The method of claim 8 wherein the wireless communication devices comprise wireless User Equipment (UEs).
13. The method of claim 8 wherein the wireless communication devices comprise wireless access nodes.
14. The method of claim 8 wherein one or more of the selected at least one target smart contract is executed in a satellite in earth orbit.
15. A wireless distributed ledger system to filter smart contract data, the wireless distributed ledger system comprising: wireless communication devices configured to execute source smart contracts and responsively generate source smart contract outputs; the wireless communication devices further configured to determine values for the source smart contract outputs based on locations of the wireless communication devices and responsively filter the source smart contract outputs based on the values to generate one or more filtered source smart contract outputs; the wireless communication devices further configured to select target smart contracts for the one or more filtered source smart contract outputs; and the wireless communication devices further configured to transfer the one or more filtered source smart contract outputs for input into the selected target smart contracts.
16. The wireless distributed ledger system of claim 15 wherein the wireless communication devices are further configured to wirelessly receive source smart contract inputs and input the source smart contract inputs into the source smart contracts.
17. The wireless distributed ledger system of claim 15 wherein the wireless communication devices are further configured to generate source smart contract inputs and input the source smart contract inputs into the source smart contracts.
18. The wireless distributed ledger system of claim 15 wherein the wireless communication devices comprise at least one wireless User Equipment (UE).
19. The wireless distributed ledger system of claim 15 wherein the wireless communication devices comprise wireless access nodes.
20. The wireless distributed ledger system of claim 15 wherein one or more of the selected at least one target smart contract is executed in a satellite in earth orbit.