US 20150227404A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2015/0227404 A1

(43) Pub. Date: Aug. 13, 2015

Rajagopal et al.

(54) **SYSTEMS AND METHODS FOR SMART SERVICE MANAGEMENT IN A MEDIA NETWORK**

(71) Applicants: **Harish Nair Rajagopal**, Trivandrum (IN); **Gowrishankar Subramaniam Natarajan**, Chennai (IN)

(72) Inventors: **Harish Nair Rajagopal**, Trivandrum (IN); **Gowrishankar Subramaniam Natarajan**, Chennai (IN)

(73) Assignee: **WIPRO LIMITED**, Bangalore (IN)

(21) Appl. No.: **14/228,827**

(22) Filed: **Mar. 28, 2014**

(30) **Foreign Application Priority Data**

Feb. 11, 2014 (IN) 647/CHE/2014

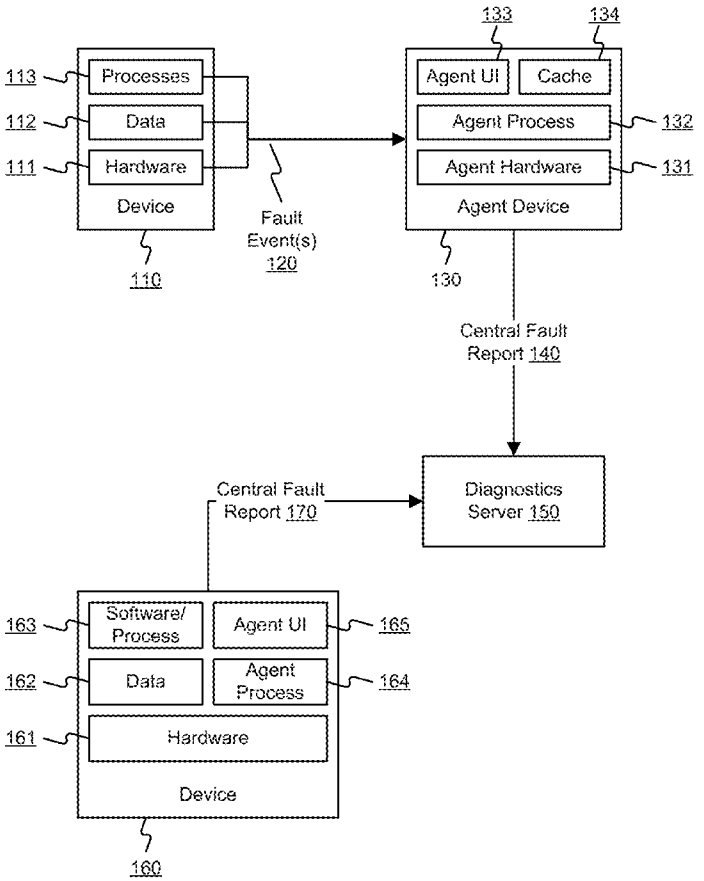
Publication Classification

(51) **Int. Cl.**
G06F 11/07 (2006.01)

(52) **U.S. Cl.**
CPC *G06F 11/079* (2013.01)

(57) **ABSTRACT**

This disclosure relates generally to network service management, and more particularly to systems and methods for smart service management in a media network. In one embodiment, a smart diagnostic system is disclosed, comprising: a hardware processor; and a memory storing processor-executable instructions comprising instructions for: receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network; aggregating one or more relevant fault reports related to the agent fault report; obtaining one or more fault classification rules; identifying one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.



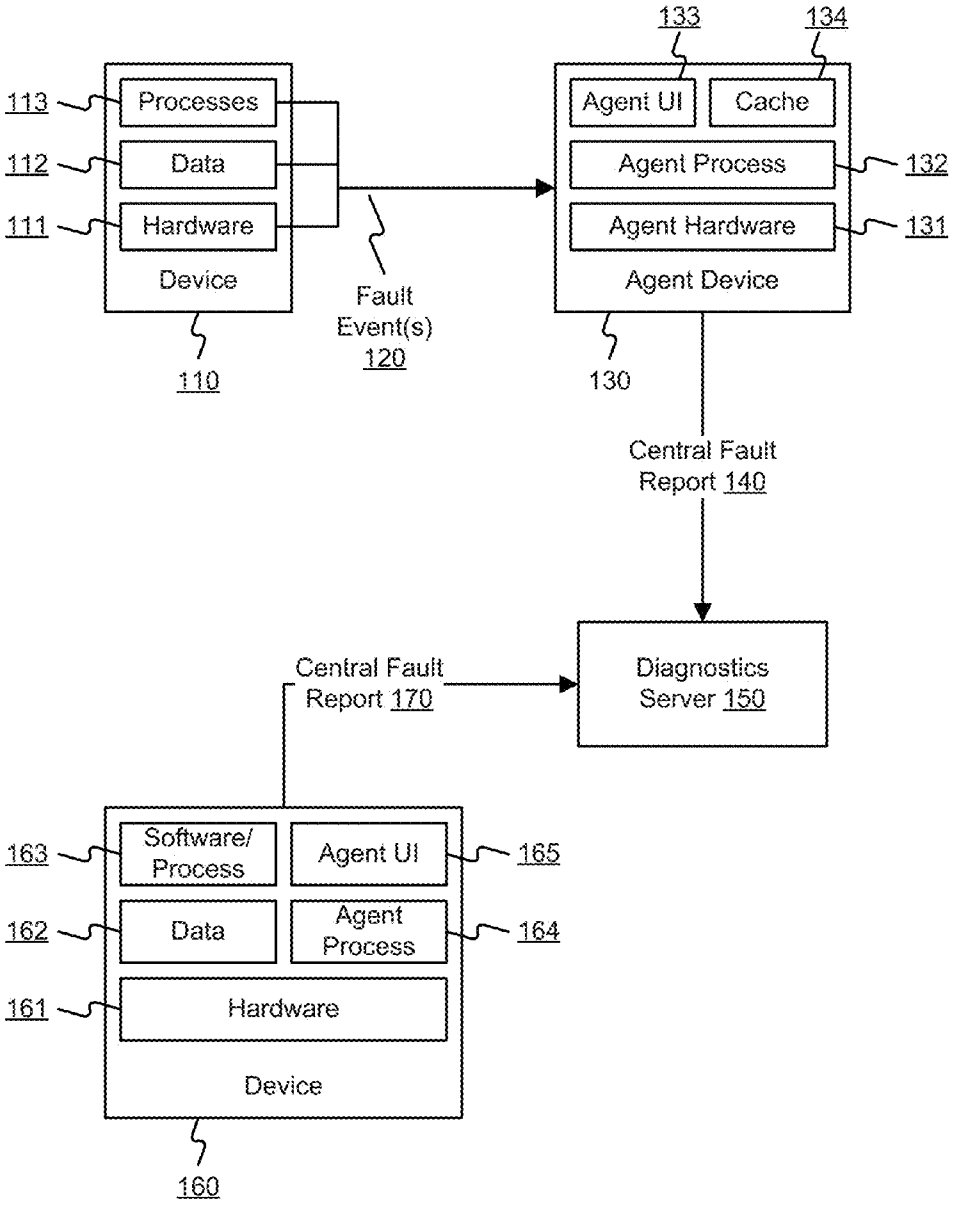

133
134
113
Processes
112
Data
111
Hardware
Device
110
Fault
Event(s)
120
Agent UI
Cache
Agent Process
132
Agent Hardware
131
Agent Device
130
Central Fault
Report 140
Central Fault
Report 170
Diagnostics
Server 150
163
Software/
Process
Agent UI
165
162
Data
Agent
Process
164
161
Hardware
Device
160

FIG. 1A

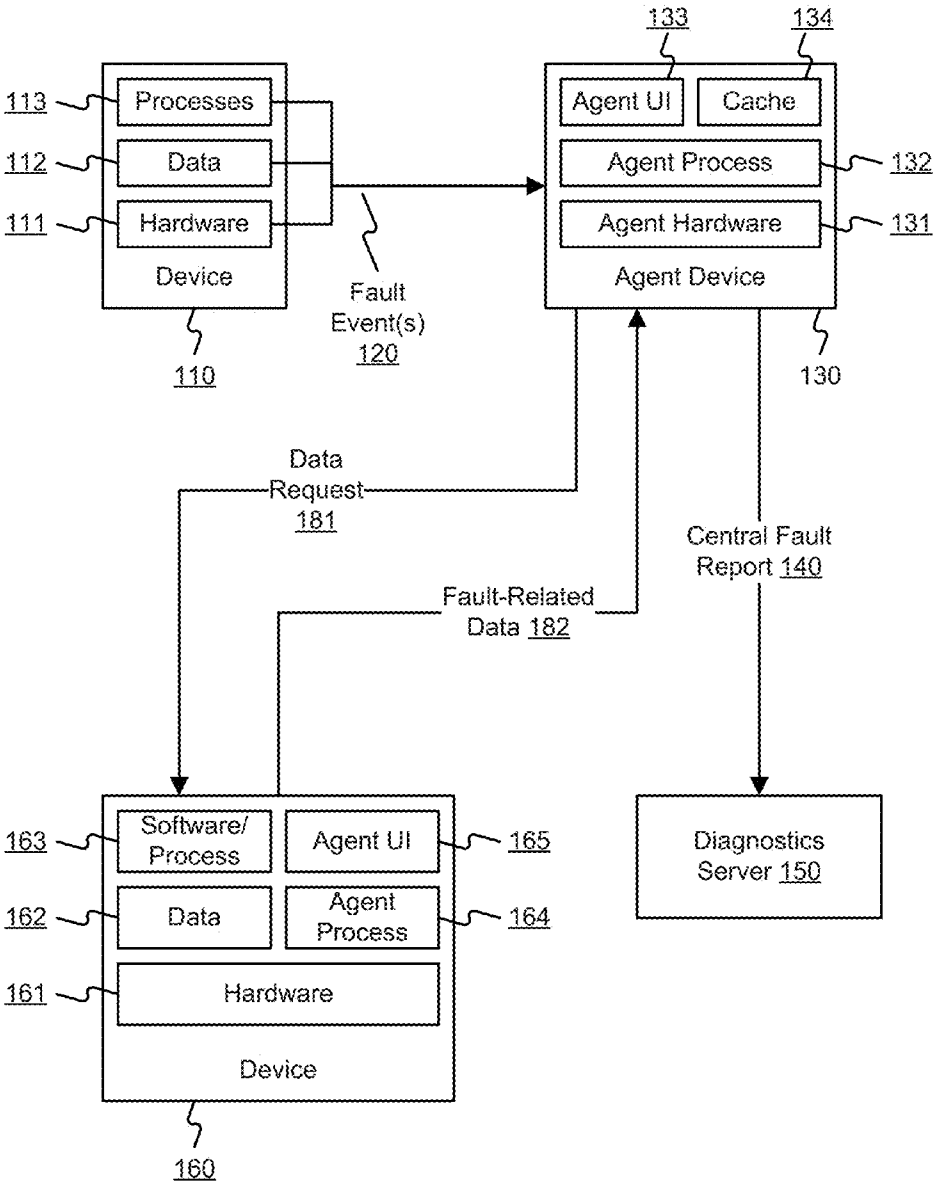

133
134
113
Processes
112
Data
111
Hardware
Device
110
Fault
Event(s)
120
Agent UI
Cache
Agent Process
132
Agent Hardware
131
Agent Device
130
Data
Request
181
Central Fault
Report 140
Fault-Related
Data 182
163
Software/
Process
Agent UI
165
162
Data
Agent
Process
164
161
Hardware
Device
160
Diagnostics
Server 150

FIG. 1B

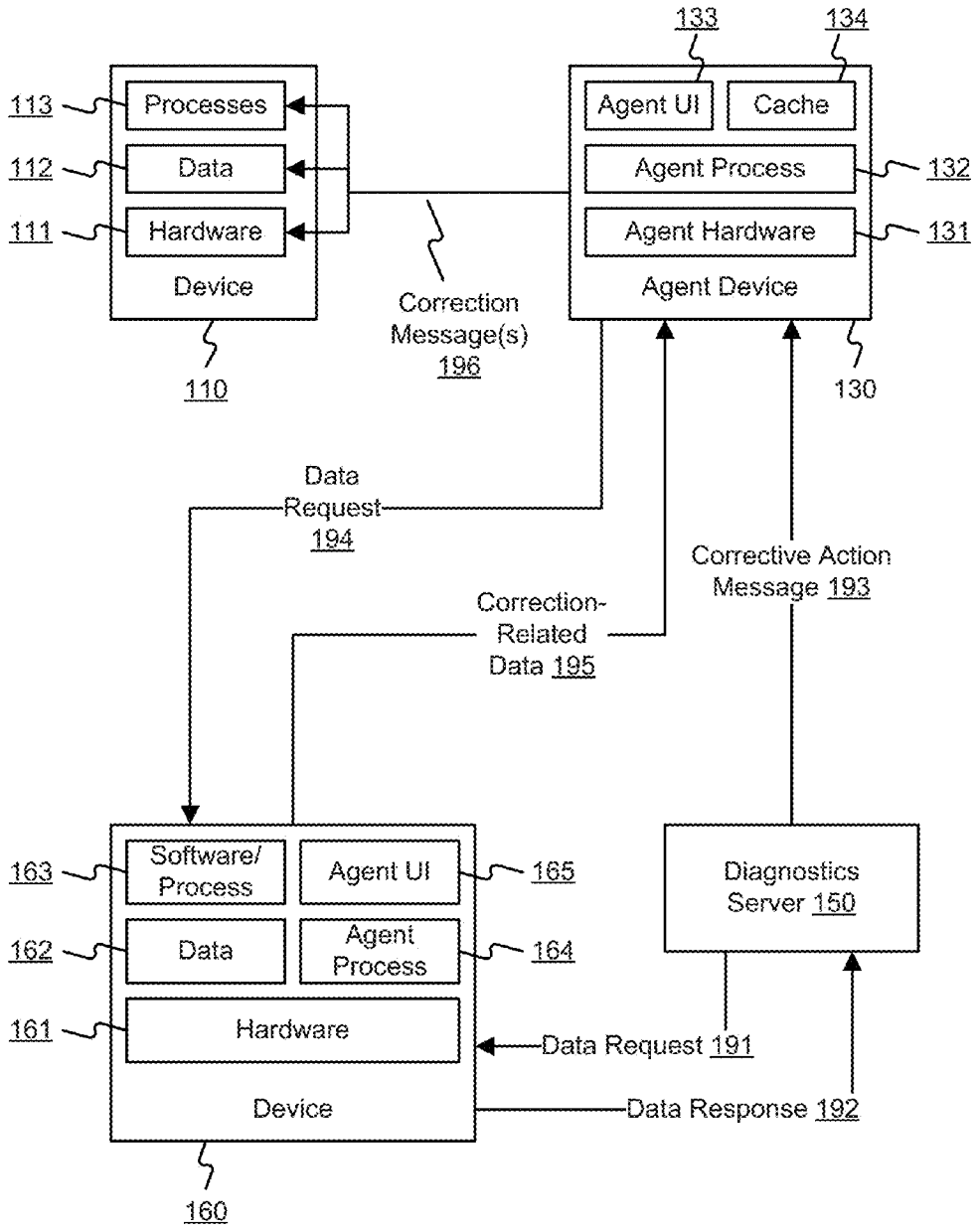

133
134
113
Processes
112
Data
111
Hardware
Device
110
Agent UI
Cache
Agent Process
132
Agent Hardware
131
Agent Device
130
Correction Message(s) 196
Data Request 194
Corrective Action Message 193
Correction-Related Data 195
163
Software/ Process
Agent UI
165
162
Data
Agent Process
164
161
Hardware
Device
160
Diagnostics Server 150
Data Request 191
Data Response 192

FIG. 1C

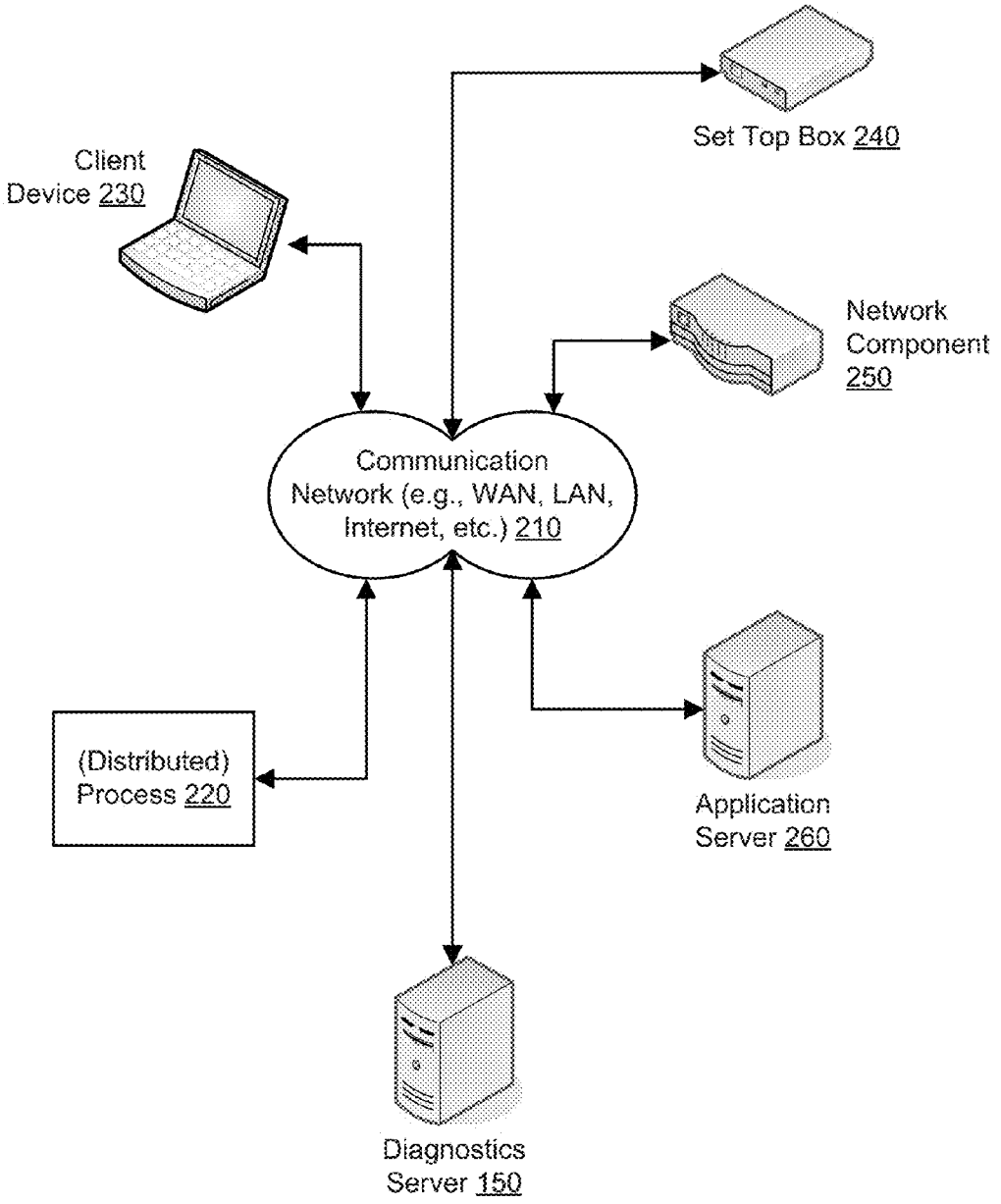

Set Top Box 240
Client Device 230
Network Component 250
Communication Network (e.g., WAN, LAN, Internet, etc.) 210
(Distributed) Process 220
Application Server 260
Diagnostics Server 150

FIG. 2

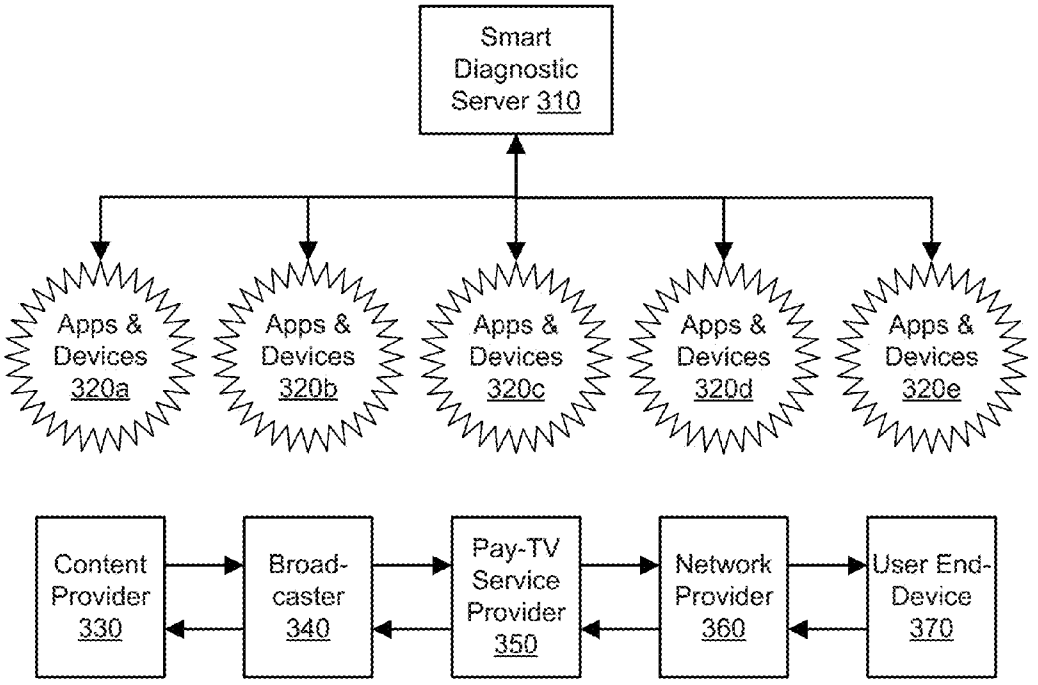

Smart Diagnostic Server 310
Apps & Devices 320a
Apps & Devices 320b
Apps & Devices 320c
Apps & Devices 320d
Apps & Devices 320e
Content Provider 330
Broad-caster 340
Pay-TV Service Provider 350
Network Provider 360
User End-Device 370

FIG. 3

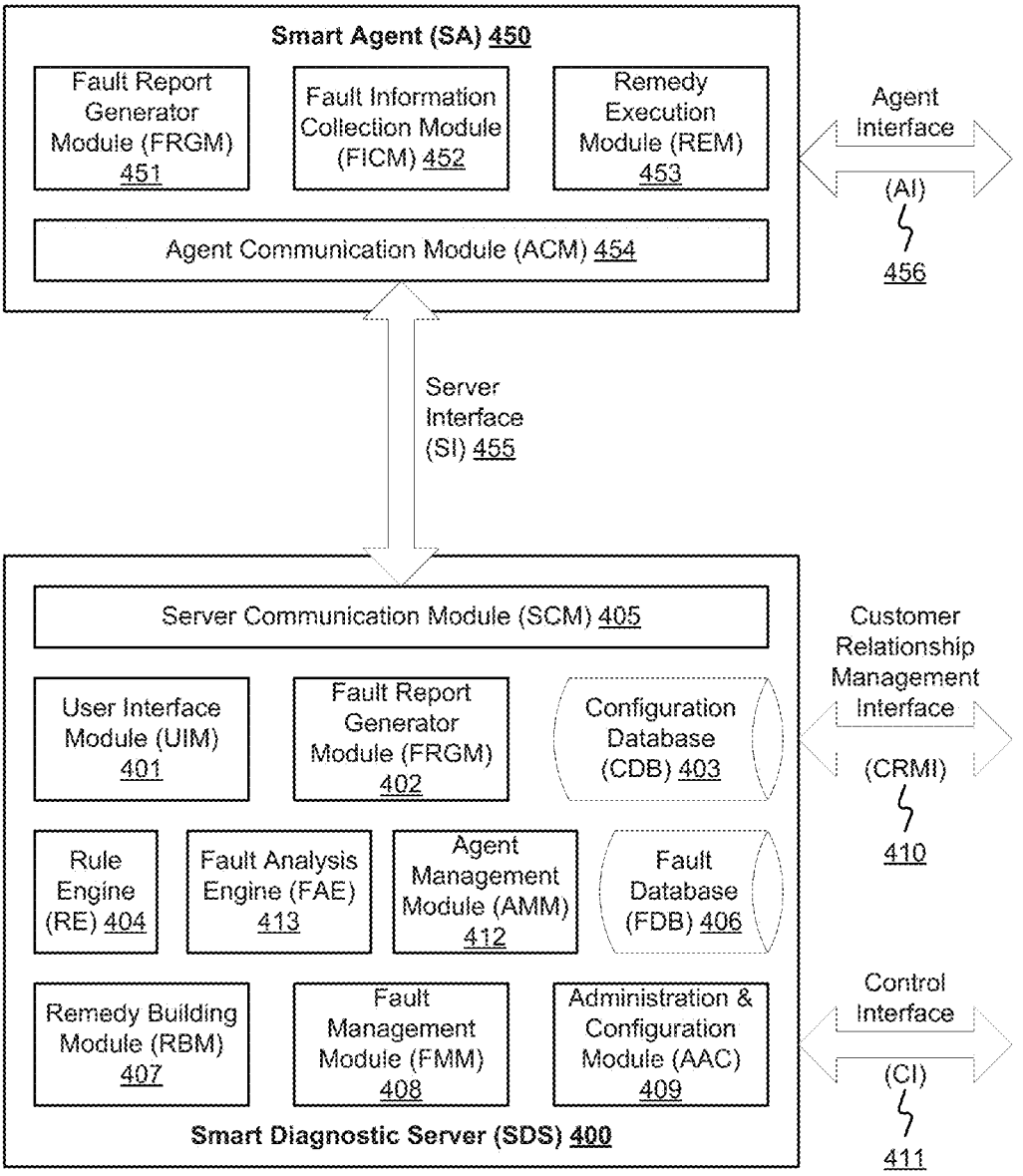

Smart Agent (SA) 450
Fault Report Generator Module (FRGM) 451
Fault Information Collection Module (FICM) 452
Remedy Execution Module (REM) 453
Agent Communication Module (ACM) 454
Agent Interface (AI) 456
Server Interface (SI) 455
Server Communication Module (SCM) 405
User Interface Module (UIM) 401
Fault Report Generator Module (FRGM) 402
Configuration Database (CDB) 403
Rule Engine (RE) 404
Fault Analysis Engine (FAE) 413
Agent Management Module (AMM) 412
Fault Database (FDB) 406
Remedy Building Module (RBM) 407
Fault Management Module (FMM) 408
Administration & Configuration Module (AAC) 409
Smart Diagnostic Server (SDS) 400
Customer Relationship Management Interface (CRMI) 410
Control Interface (CI) 411

FIG. 4A

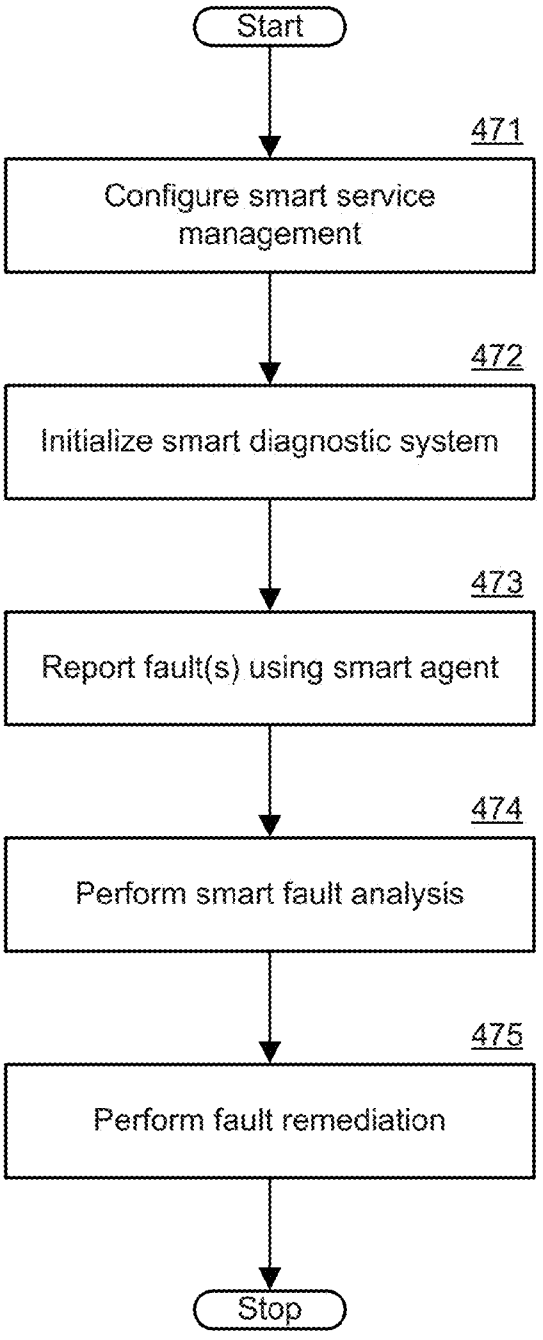

Start
471
Configure smart service management
472
Initialize smart diagnostic system
473
Report fault(s) using smart agent
474
Perform smart fault analysis
475
Perform fault remediation
Stop

FIG. 4B

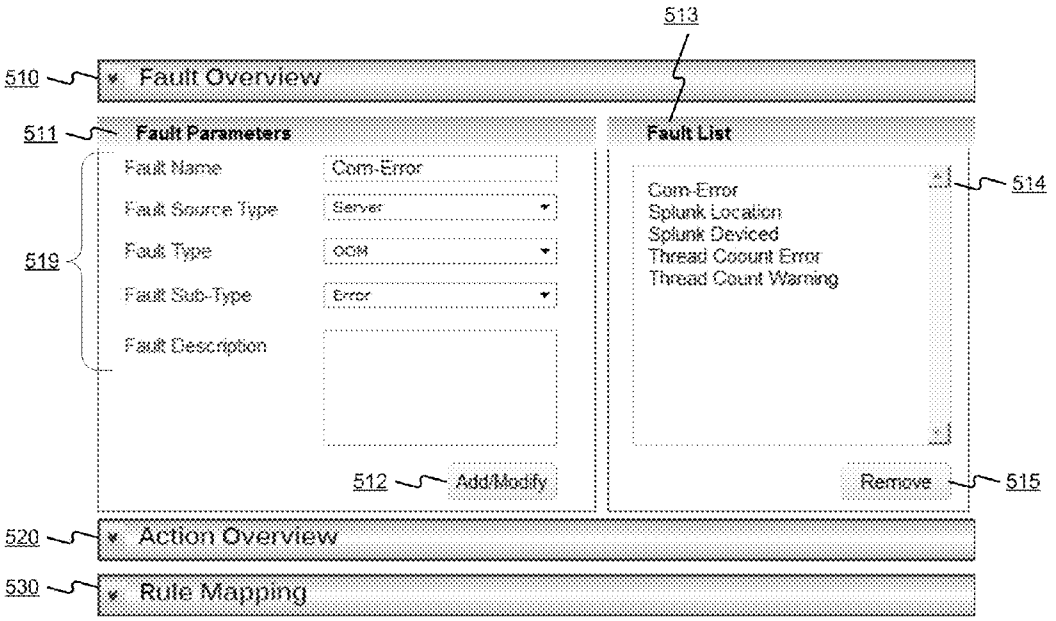

513
510
Fault Overview
511
Fault Parameters
Fault List
Fault Name
Com-Error
Fault Source Type
Server
519
Fault Type
OOM
Fault Sub-Type
Error
Fault Description
514
Com-Error
Splunk Location
Splunk Deviced
Thread Cocunt Error
Thread Count Warning
512
Add/Modify
Remove
515
520
Action Overview
530
Rule Mapping

FIG. 5A

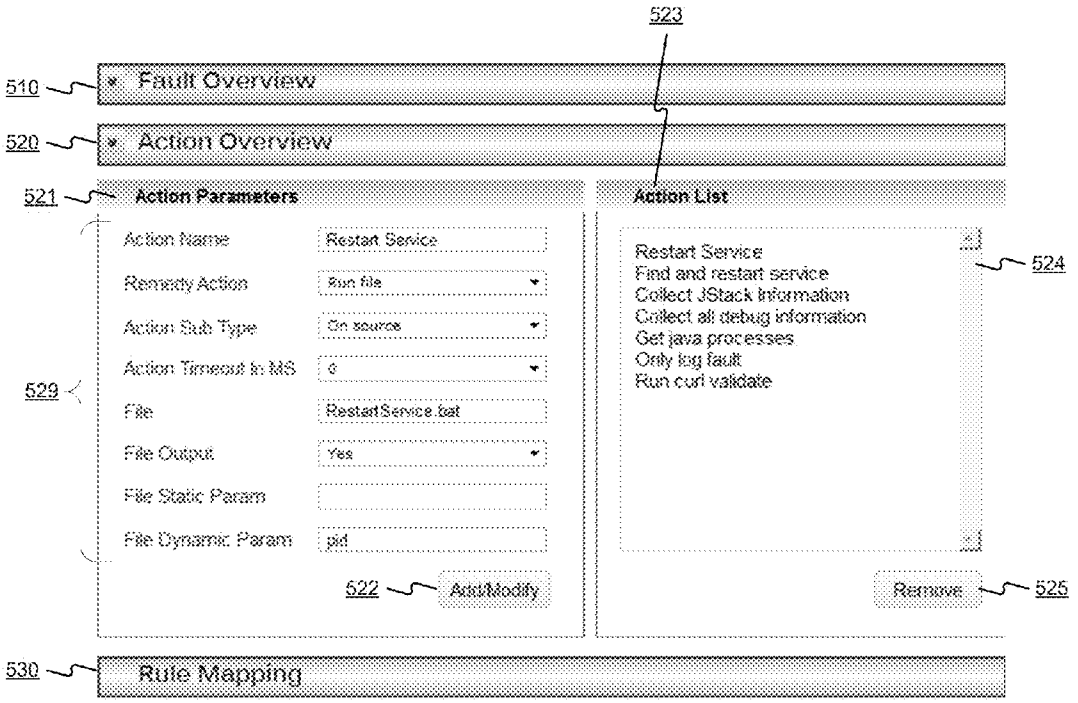

523
510
Fault Overview
520
Action Overview
521
Action Parameters
Action List
Action Name
Restart Service
Remedy Action
Run file
Action Sub Type
On source
Action Timeout in MS
0
529
File
RestartService.bat
File Output
Yes
File Static Param
File Dynamic Param
pid
522
Add/Modify
Restart Service
Find and restart service
Collect JStack Information
Collect all debug information
Get java processes
Only log fault
Run curl validate
524
Remove
525
530
Rule Mapping

FIG. 5B

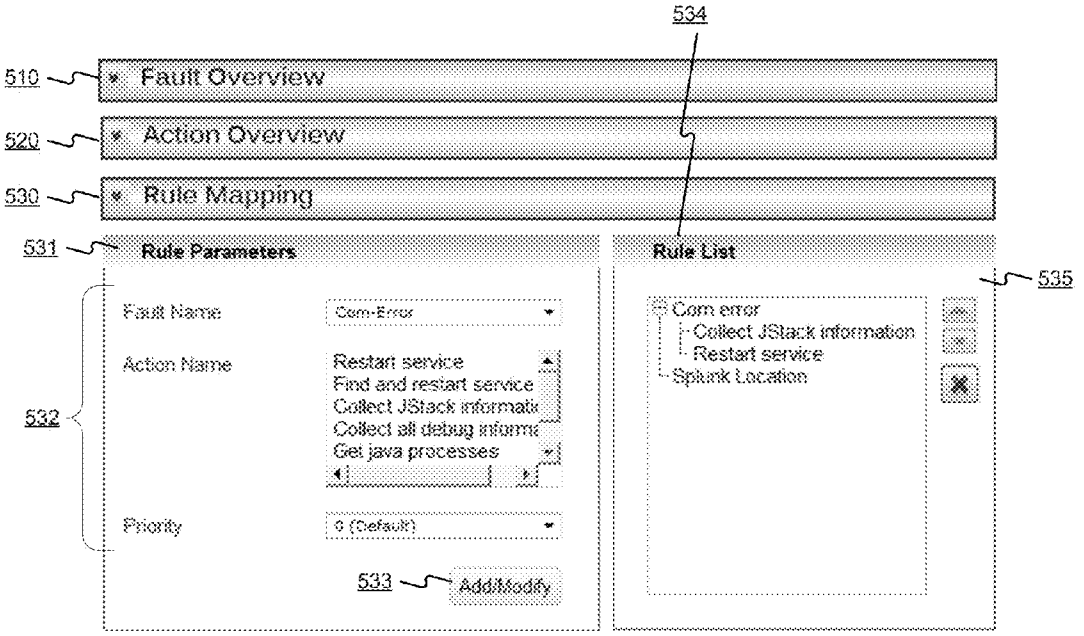

534
510
Fault Overview
520
Action Overview
530
Rule Mapping
531
Rule Parameters
Rule List
535
Fault Name:
Com-Error
Action Name:
Restart service
Find and restart service
Collect JStack informatio
Collect all debug informa
Get java processes
532
Priority:
0 (Default)
533
Add/Modify
Com error
Collect JStack information
Restart service
Splunk Location

FIG. 5C

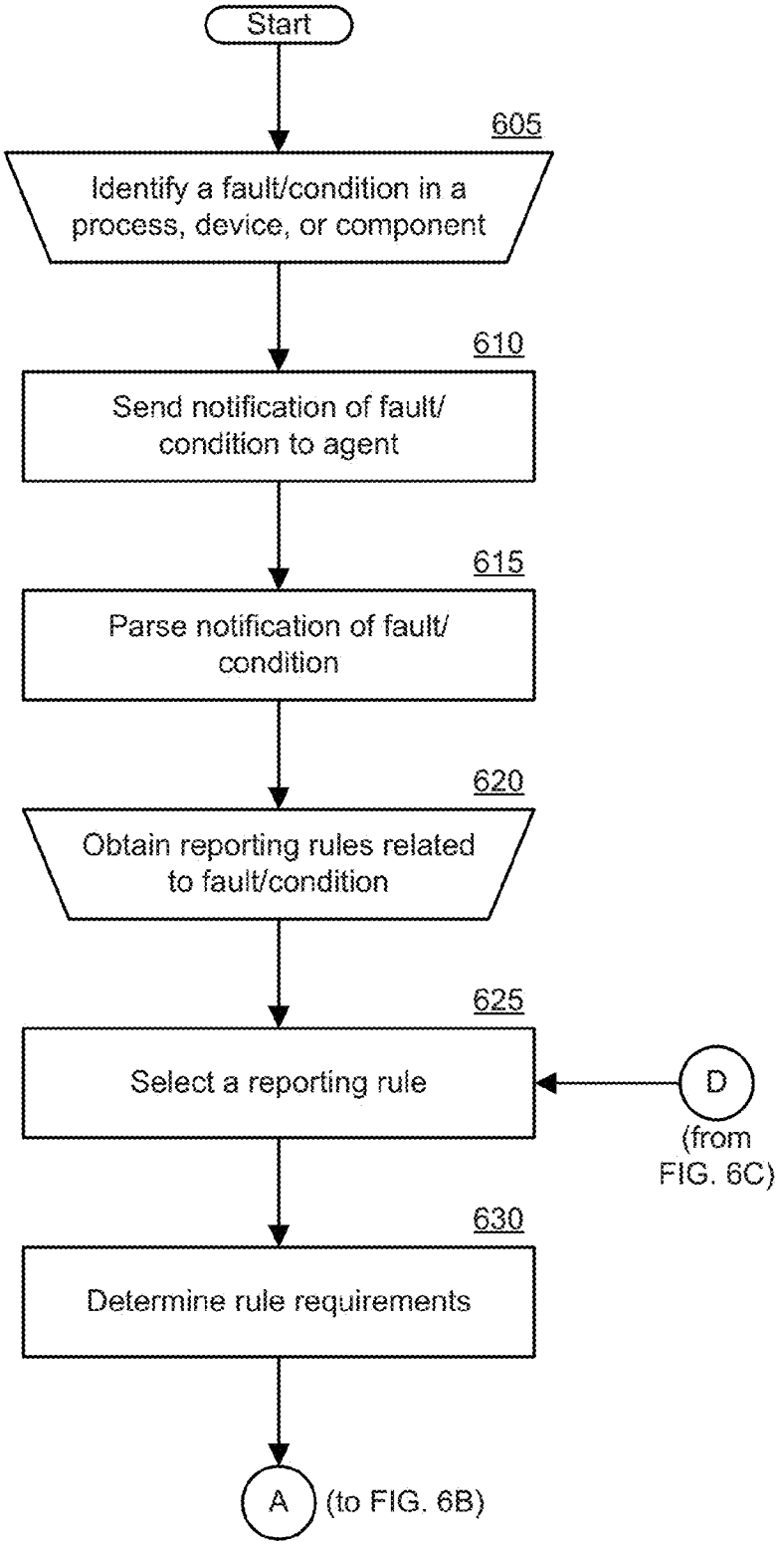

Start
605
Identify a fault/condition in a process, device, or component
610
Send notification of fault/ condition to agent
615
Parse notification of fault/ condition
620
Obtain reporting rules related to fault/condition
625
Select a reporting rule
D
(from FIG. 6C)
630
Determine rule requirements
A
(to FIG. 6B)

FIG. 6A

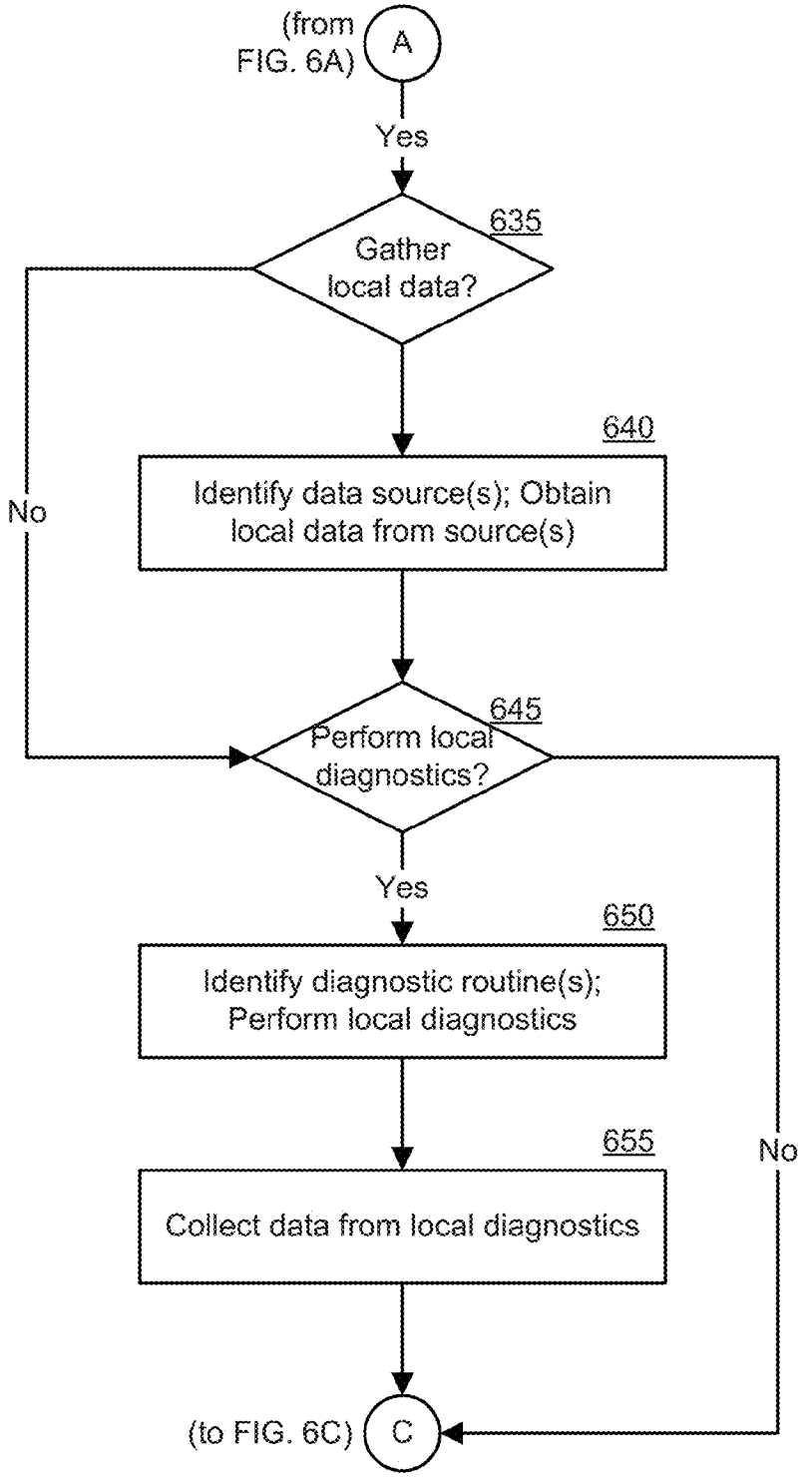

(from FIG. 6A)
A
Yes
635
Gather local data?
640
Identify data source(s); Obtain local data from source(s)
No
645
Perform local diagnostics?
Yes
650
Identify diagnostic routine(s); Perform local diagnostics
655
Collect data from local diagnostics
No
(to FIG. 6C)
C

FIG. 6B

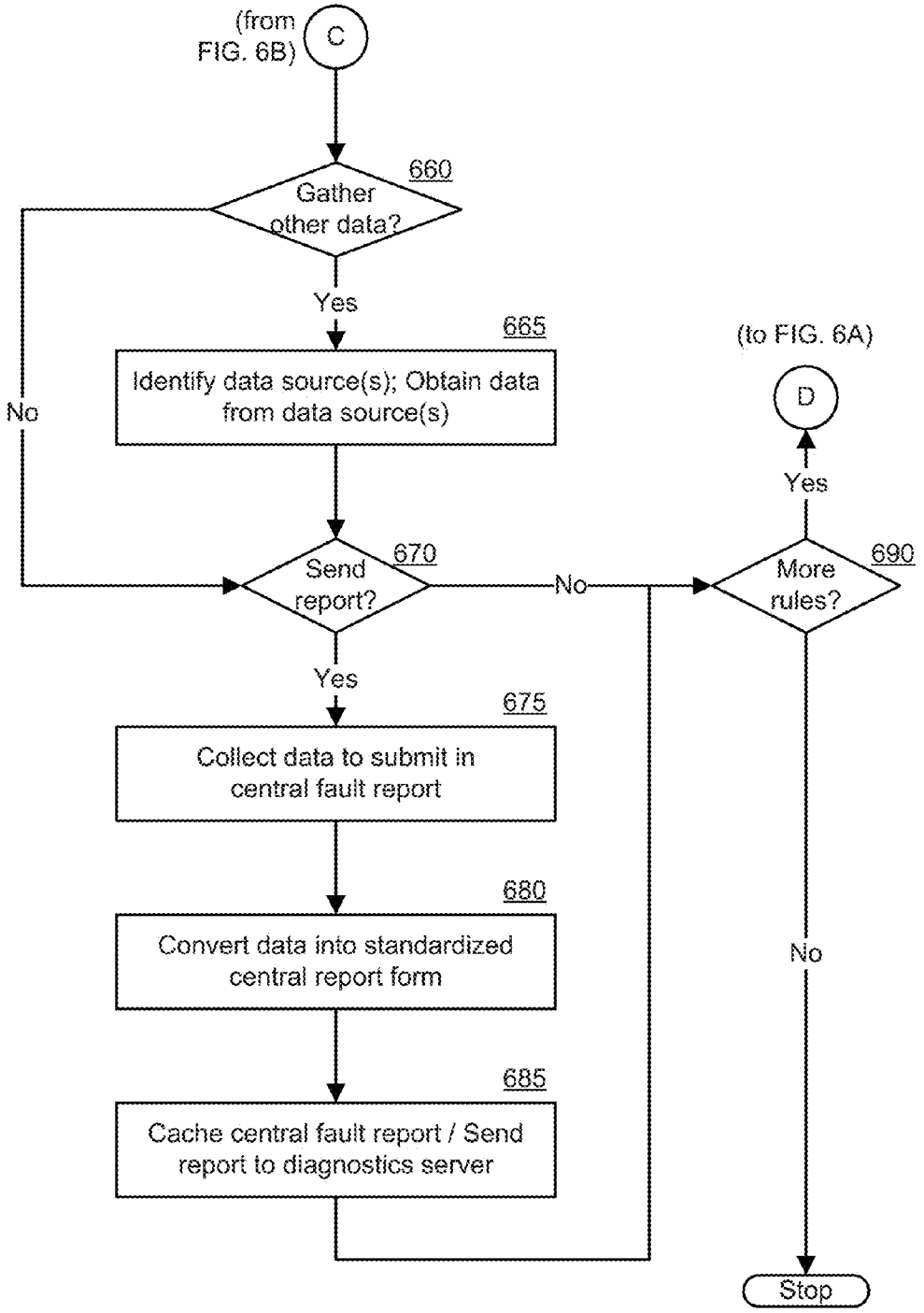

(from FIG. 6B)
C
660
Gather other data?
Yes
No
665
Identify data source(s); Obtain data from data source(s)
670
Send report?
Yes
No
675
Collect data to submit in central fault report
680
Convert data into standardized central report form
685
Cache central fault report / Send report to diagnostics server
690
More rules?
Yes
No
(to FIG. 6A)
D
Stop

FIG. 6C

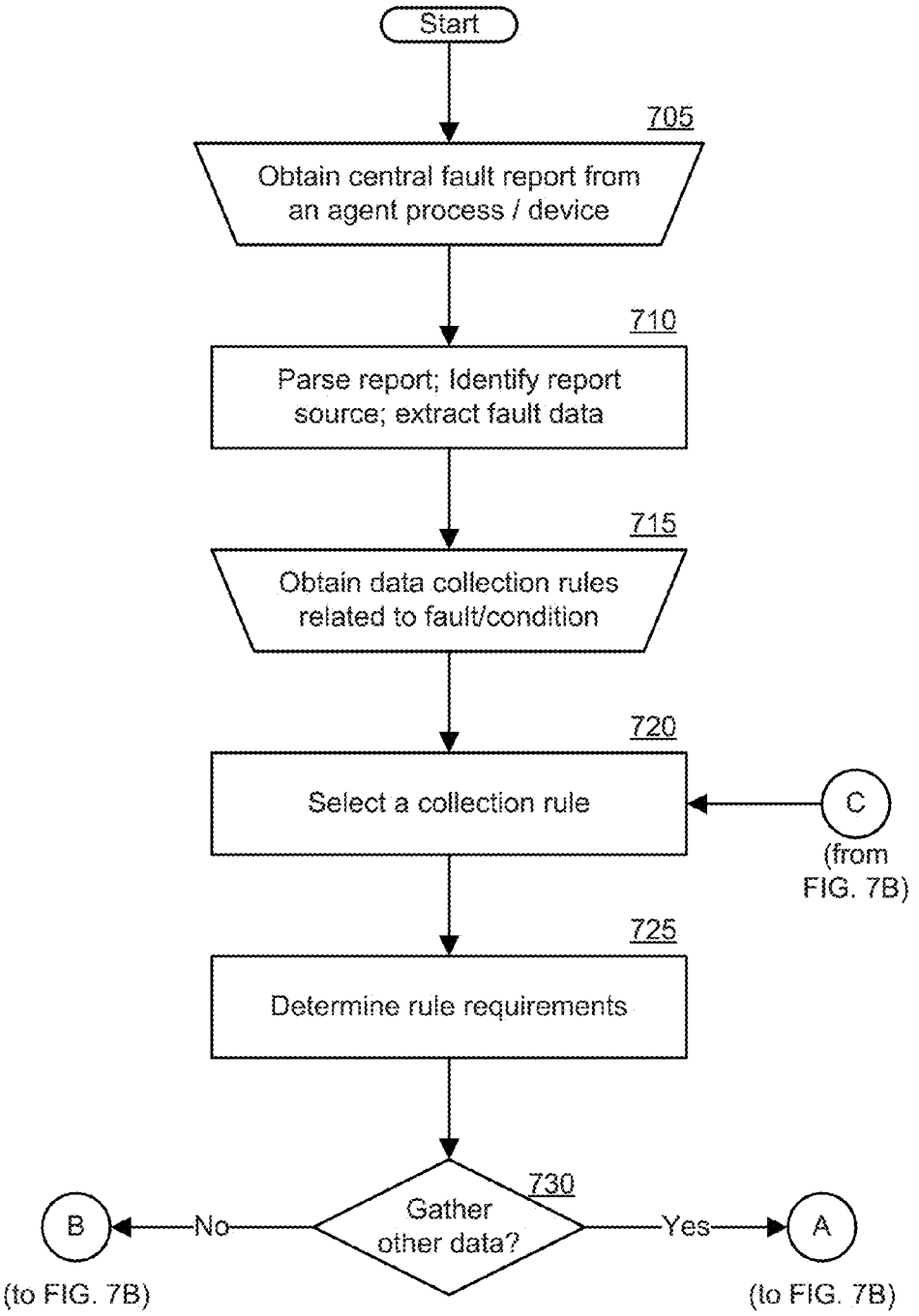

Start
705
Obtain central fault report from an agent process / device
710
Parse report; Identify report source; extract fault data
715
Obtain data collection rules related to fault/condition
720
Select a collection rule
C
(from FIG. 7B)
725
Determine rule requirements
730
Gather other data?
No
Yes
B
(to FIG. 7B)
A
(to FIG. 7B)

FIG. 7A

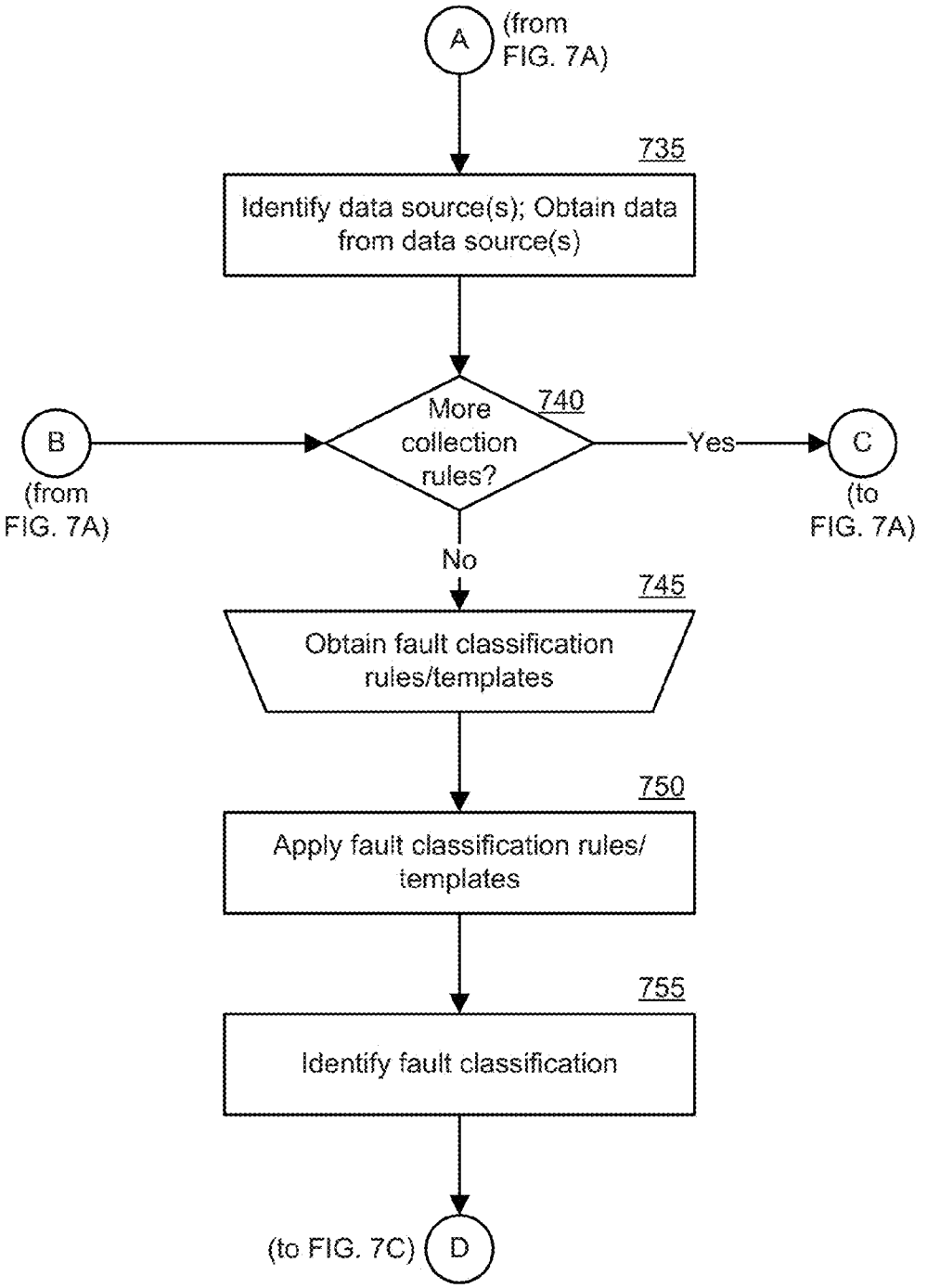

A
(from FIG. 7A)
735
Identify data source(s); Obtain data from data source(s)
740
More collection rules?
Yes
C
(to FIG. 7A)
B
(from FIG. 7A)
No
745
Obtain fault classification rules/templates
750
Apply fault classification rules/ templates
755
Identify fault classification
(to FIG. 7C)
D

FIG. 7B

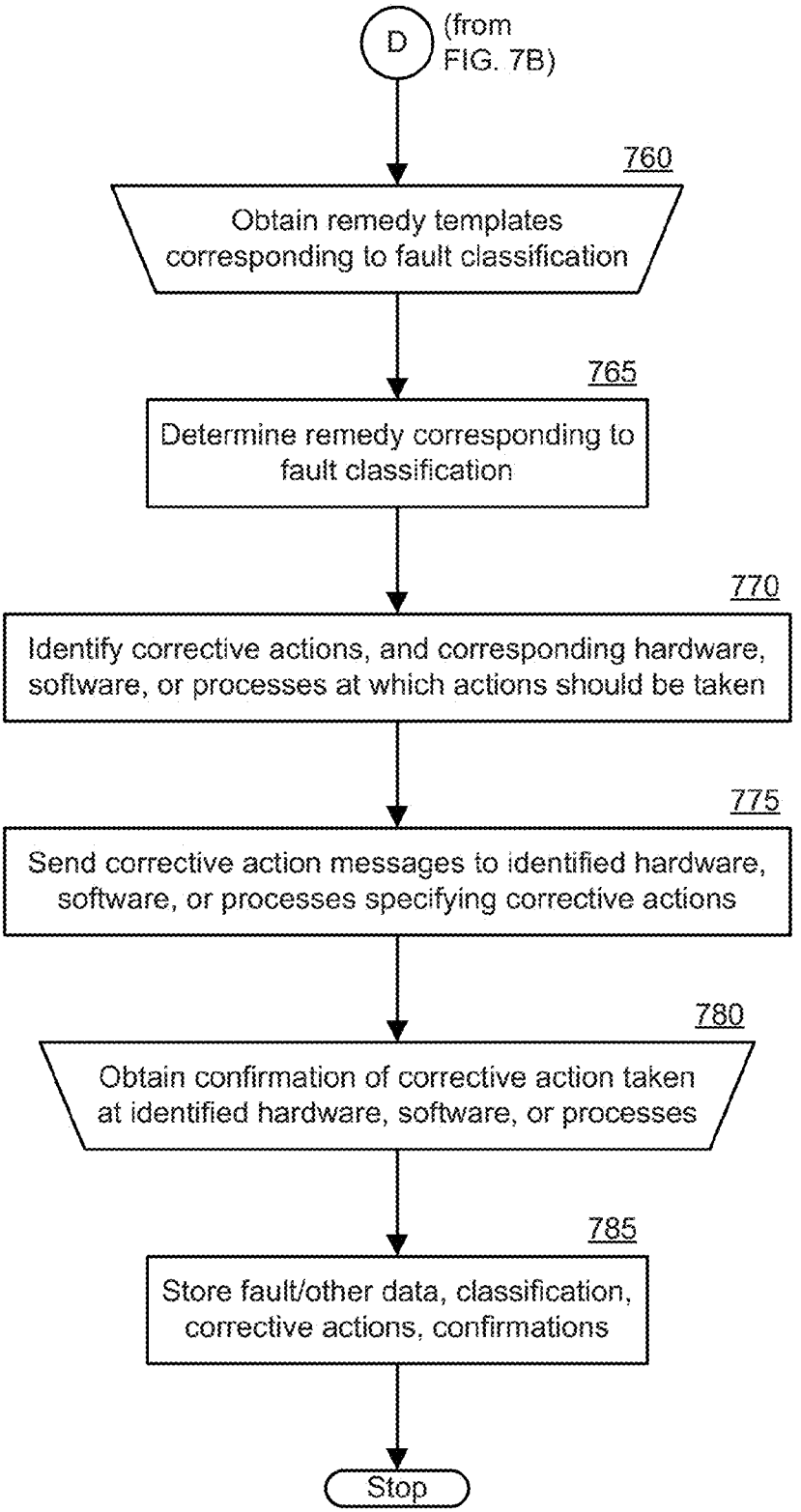

D
(from FIG. 7B)
760
Obtain remedy templates corresponding to fault classification
765
Determine remedy corresponding to fault classification
770
Identify corrective actions, and corresponding hardware, software, or processes at which actions should be taken
775
Send corrective action messages to identified hardware, software, or processes specifying corrective actions
780
Obtain confirmation of corrective action taken at identified hardware, software, or processes
785
Store fault/other data, classification, corrective actions, confirmations
Stop

FIG. 7C

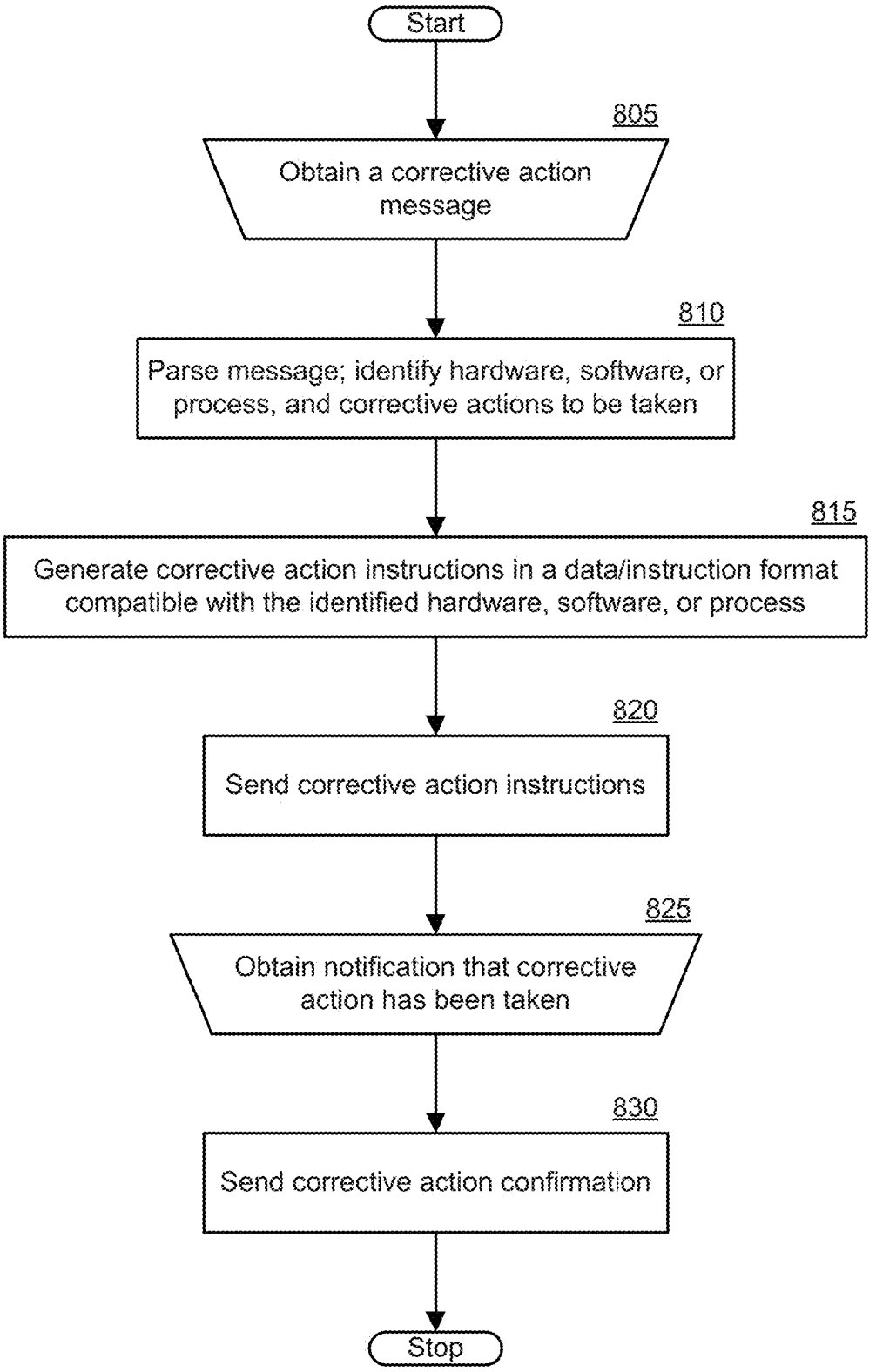

Start
805
Obtain a corrective action message
810
Parse message; identify hardware, software, or process, and corrective actions to be taken
815
Generate corrective action instructions in a data/instruction format compatible with the identified hardware, software, or process
820
Send corrective action instructions
825
Obtain notification that corrective action has been taken
830
Send corrective action confirmation
Stop

FIG. 8

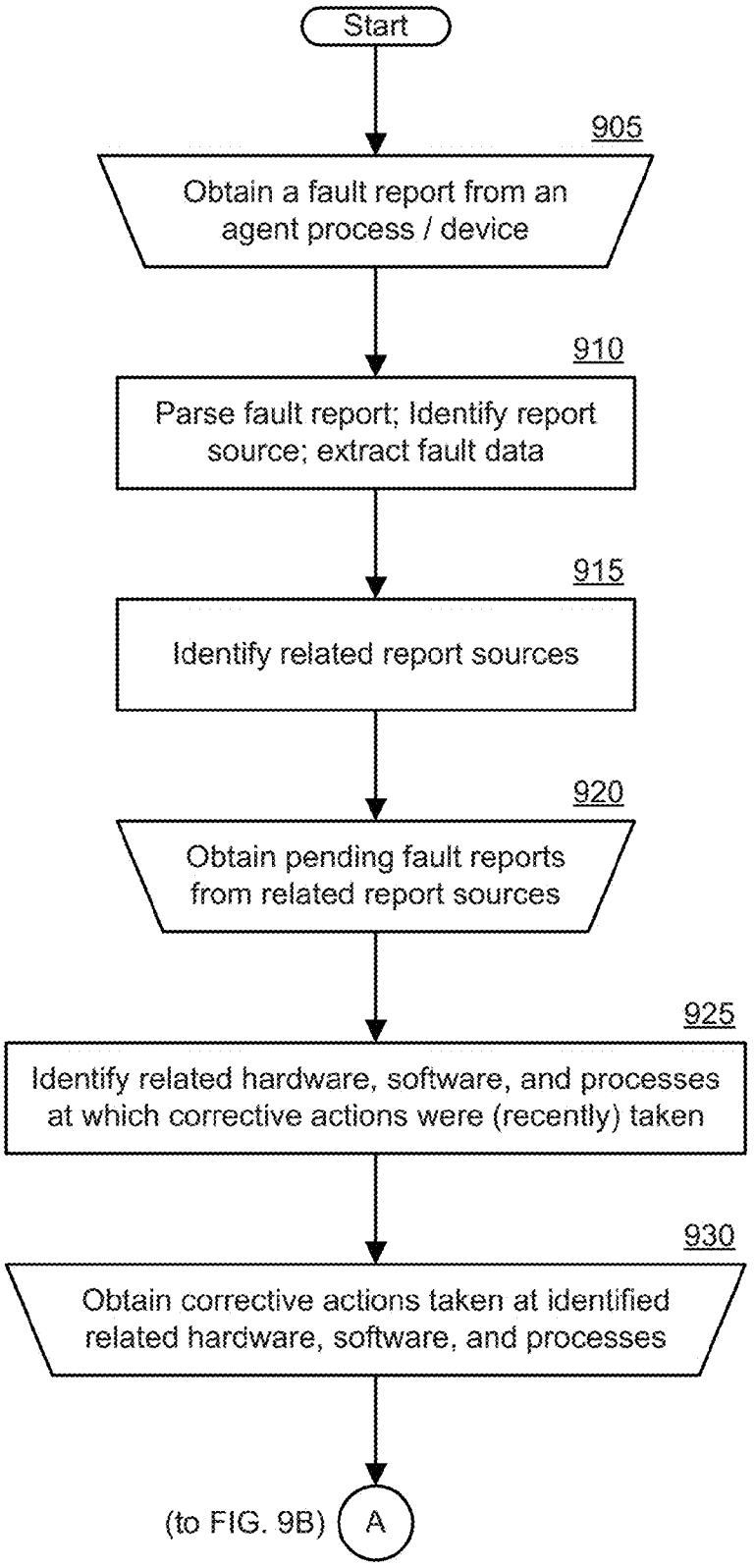

Start
905
Obtain a fault report from an agent process / device
910
Parse fault report; Identify report source; extract fault data
915
Identify related report sources
920
Obtain pending fault reports from related report sources
925
Identify related hardware, software, and processes at which corrective actions were (recently) taken
930
Obtain corrective actions taken at identified related hardware, software, and processes
(to FIG. 9B)
A

FIG. 9A

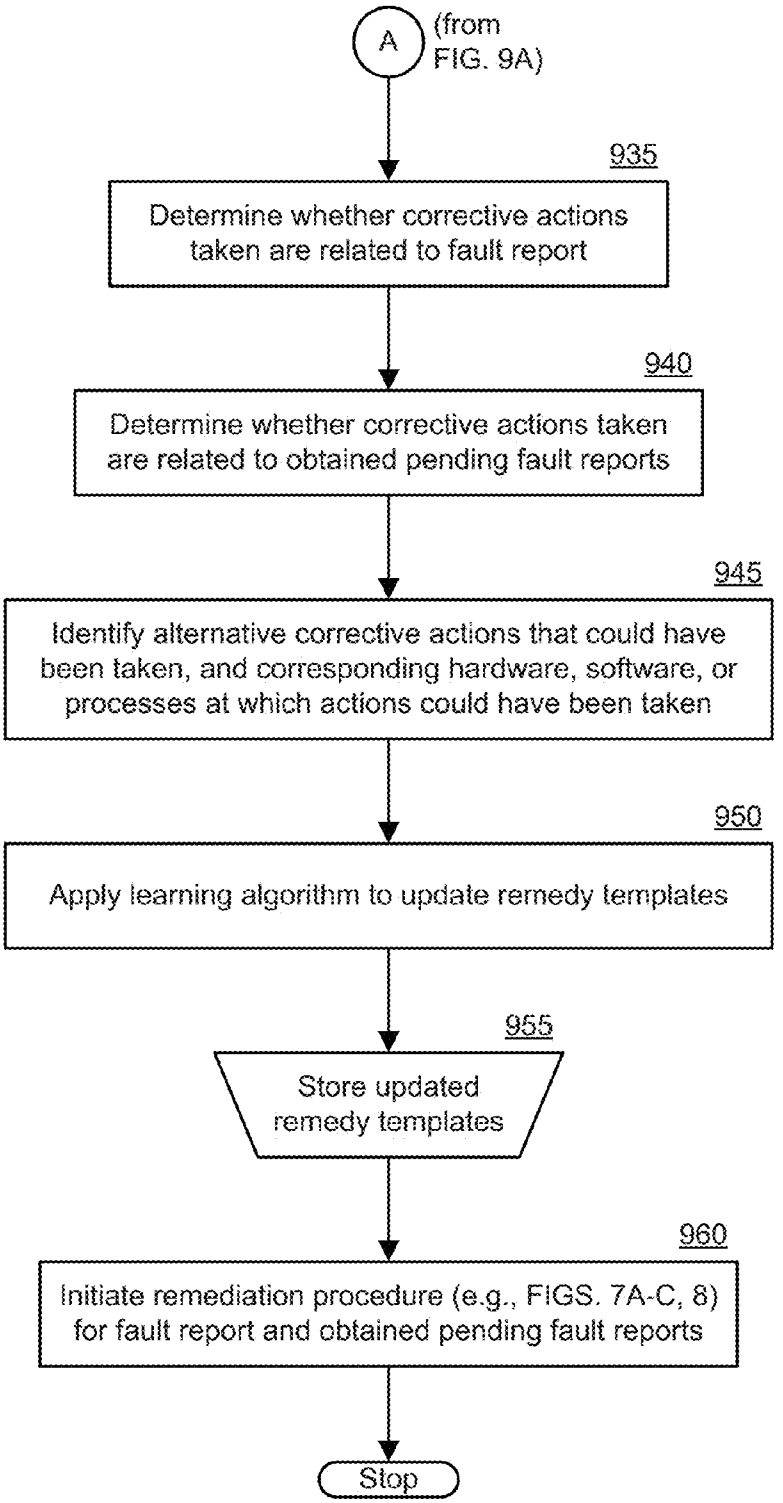

A
(from FIG. 9A)
935
Determine whether corrective actions taken are related to fault report
940
Determine whether corrective actions taken are related to obtained pending fault reports
945
Identify alternative corrective actions that could have been taken, and corresponding hardware, software, or processes at which actions could have been taken
950
Apply learning algorithm to update remedy templates
955
Store updated remedy templates
960
Initiate remediation procedure (e.g., FIGS. 7A-C, 8) for fault report and obtained pending fault reports
Stop

FIG. 9B

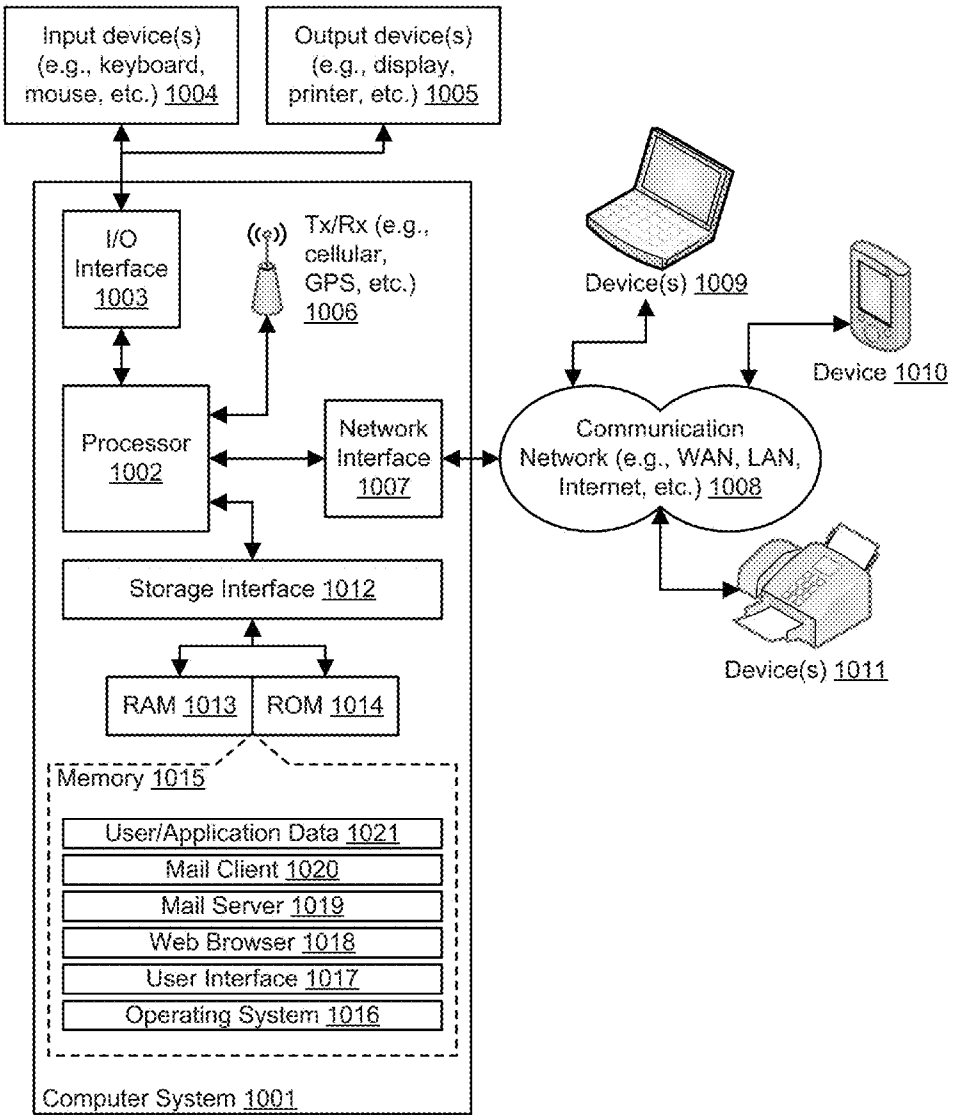

Input device(s) (e.g., keyboard, mouse, etc.) 1004
Output device(s) (e.g., display, printer, etc.) 1005
I/O Interface 1003
Tx/Rx (e.g., cellular, GPS, etc.) 1006
Processor 1002
Network Interface 1007
Storage Interface 1012
RAM 1013
ROM 1014
Memory 1015
User/Application Data 1021
Mail Client 1020
Mail Server 1019
Web Browser 1018
User Interface 1017
Operating System 1016
Computer System 1001
Device(s) 1009
Device 1010
Communication Network (e.g., WAN, LAN, Internet, etc.) 1008
Device(s) 1011

FIG. 10

SYSTEMS AND METHODS FOR SMART SERVICE MANAGEMENT IN A MEDIA NETWORK

PRIORITY CLAIM

[0001] This U.S. patent application claims priority under 35 U.S.C. §119 to Indian Patent Application No. 647/CHE/2014, filed Feb. 11, 2014, and entitled "SYSTEMS AND METHODS FOR SMART SERVICE MANAGEMENT IN A MEDIA NETWORK." The aforementioned application is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This disclosure relates generally to network service management, and more particularly to systems and methods for smart service management in a media network.

BACKGROUND

[0003] The media delivery chain required to deliver video and interactive services for managed devices has evolved in recent years to become a highly complex infrastructure. In a media service delivery context, multiple parties may be involved in the entire service chain. For example, the service chain may comprise content providers, broadcasters, Pay-TV service providers (PTVSP), network providers, etc. Faults may occur anywhere in the service chain. For example, an isolated fault may be detected in a node of the network, causing a particular type of service disruption for a set of end-users. In other cases, multiple isolated faults may be detected that simultaneously affect a set of end-users. Sometimes, even though there is an isolated fault, it has no impact on any end-user. In some cases, faults that affect end-users may not be reported, even though there is a service disruption. Fault detection and remediation can therefore be a complex and costly endeavor.

SUMMARY

[0004] In one embodiment, a smart diagnostic system is disclosed, comprising: a hardware processor; and a memory storing processor-executable instructions comprising instructions for: receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network; aggregating one or more relevant fault reports related to the agent fault report; obtaining one or more fault classification rules; identifying one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

[0005] In one embodiment, a smart diagnostic method is disclosed, comprising: receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network; aggregating one or more relevant fault reports related to the agent fault report; obtaining one or more fault classification rules; identifying, via a hardware processor, one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

[0006] In one embodiment, a non-transitory computer-readable medium is disclosed, storing computer-executable smart diagnostic system instruction comprising instructions for: receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network; aggregating one or more relevant fault reports related to the agent fault report; obtaining one or more fault classification rules; identifying one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

[0007] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

[0009] FIGS. **1**A-C illustrate exemplary aspects of a smart service management system;

[0010] FIG. **2** illustrates components of a smart service management system for a media network;

[0011] FIG. **3** is a block diagram depicting smart service management in a media network service chain;

[0012] FIG. **4**A is a block diagram of components of a smart service management system;

[0013] FIG. **4**B is a flowchart of a smart service management procedure;

[0014] FIGS. **5**A-C are screenshots of a user interface for fault detection and remediation in a smart service management system;

[0015] FIGS. **6**A-C are flowcharts of a fault reporting procedure for smart service management;

[0016] FIGS. **7**A-C are flowcharts of a server-side fault remediation procedure for smart service management;

[0017] FIG. **8** is a flowchart of an agent-side fault remediation procedure for smart service management;

[0018] FIGS. **9**A-B are flowcharts of a fault classification learning procedure for smart service management;

[0019] FIG. **10** is a block diagram of an exemplary computer system for implementing embodiments consistent with the present disclosure.

DETAILED DESCRIPTION

[0020] Exemplary embodiments are described with reference to the accompanying drawings. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following

detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims.

[0021] FIGS. **1**A-C illustrate exemplary aspects of a smart service management system. With reference to FIG. **1**A, in some embodiments, a device **110** may comprise hardware **111**, storing data **112**, and executing process **113**. In the event of a fault identified by device **110** in either the hardware **111**, data **112**, or process **113**, device **110** may report a fault event **120** to an agent. The agent may take the form of an agent device **130** separate from device **110**, which comprises agent hardware **131**, running agent process **132**. In some embodiments, agent device **130** may provide an agent user interface (UI) **133** via which statistics, reports, logs, activity, etc. of the agent device **130** may be visualized. Agent device may also include a cache **134** to queue central fault reports **140** to be sent to a diagnostics server **150**.

[0022] In some embodiments, the agent may not be embodies as a device separate from the device reporting the local fault, but may be implemented as part of the device. For example, a device **160** may comprise hardware **161**, storing data **162**, and executing processes **163**. Hardware **161** may also be used to execute an agent process **164** and an agent UI **165**. Using agent process **164**, device **160** may report faults in the form of a central fault report **170** to diagnostics server **150**.

[0023] With reference to FIG. **1**B, in some embodiments, before agent device **130** can report a fault to diagnostics server **150**, agent device **130** may collect information (e.g., "local context") to be reported as part of central fault report **140**. For example, agent device **130** may make a data request **181** to another agent (e.g., agent process **164**) or device (e.g., device **160**) for fault-related data **182**. Upon obtaining fault-related data **182**, agent device **130** may generate the central fault report **140**, and provide it to diagnostics server **150** for fault detection and remediation.

[0024] With reference to FIG. **1**C, in some embodiments, diagnostics server **150** may attempt to identify faults in a network of devices, applications, and services. Before diagnostics server **150** can identify a fault and appropriate remediation actions, diagnostics server **150** may collect information (e.g., "global context") for analysis. For example, diagnostics server **150** may make a data request **191** to an agent (e.g., agent process **164**) or device (e.g., device **160**) for data response **192**. Upon obtaining data response **192**, diagnostics server **150** may identify remediation actions, and generate corrective action message **193** for agent device **130**. Agent device **130**, in some embodiments, may determine that additional information is needed before the corrective action can be implemented, and may make a data request **194** (e.g., to an agent to device) for the correction-related data **195**. Upon obtaining correction-related data **195**, agent device **130** may generate a correction message **196** for device **110** with instructions to remedy the identified fault. In some embodiments, agents may convert all information obtained "locally" into a standardized format, e.g., using standardized global codes such as error codes, before communicating the information to other agents, devices, or diagnostics server **150**.

[0025] FIG. **2** illustrates components of a smart service management system for a media network. Example components in which a fault may occur include a client device **230** (e.g., desktop computer, laptop computer, smartphone, cellular phone, modem, home routers, switch, television, etc.), set top box **240**, network components **250** (e.g., servers, gateways, routers, bridges, etc.), application servers **260**, and even processes **220**. In some scenarios, processes **220** may comprise a distributed process that is implemented across a large numbers of devices. Also, any data stored on any of these devices, or manipulated by any of these "nodes" may also be considered a node where a fault can occur. All such "nodes" may communicate with diagnostics server **150** via communication network **210** (e.g., a wide/local area network, wireless network, cellular network, Internet, or combinations thereof).

[0026] FIG. **3** is a block diagram depicting smart service management in a media network service chain. In one embodiment, smart service management may be applied for fault detection and remediation in a media content delivery network. For example, the network may comprise a user end-device **370** (e.g., television, set top box, computer, smartphone, etc.) that displays content media for a user. A content provider **330** (e.g., production house) may generate media content, and a broadcaster **340** may broadcast the content via a distribution network. As part of the distribution network, a Pay-TV service provider **350** may provide on-demand TV services for the end-user via a network maintained by a network provider **360**. Each of these entities may utilize one or more applications ("apps") and/or devices (see **320***a-e*) to provide its features. These apps and/or devices **320***a-e* may interact, via one or more smart agents, with a smart diagnostic server **310**. For example, the apps and/or devices **320***a-e* may report faults and/or other information to the smart diagnostic server **310**, and may implement remediation actions as recommended or instructed by the smart diagnostic server **310**.

[0027] FIG. **4**A is a block diagram of components of a smart service management system. In one embodiment, a smart service management system may include one or more smart agents (SA) **450**, interacting with one or more smart diagnostic servers (SDS) **400**. SDS **400** may include a server communication module (SCM) **405**. SCM **405** may provide communication with SA **450** via server interface (SI) **455**. SI **455** may serve as an interface between SA **450** and SDS **400**. SI **455** may support push mode from SA **450** to push fault report to SDS **400**, and/or pull mode from SDS **400** to pull reports from SA **450**. SI **455** may provide support for configuration of SAs **450** based on fault definitions specified in SDS **400**. SI **455** may also support communication between SAs **450** to exchange information.

[0028] SCM **405** may also provide communication with a customer relationship management (CRM) system (not shown) over a customer relationship management interface (CRMI) **410**, and with a control system via control interface (CI) **411**. CRMI **410** may serve as an interface between CRM system and SDS **400**, and may facilitate associating customer reported problems with rules. CI **411** may provide a control interface to SDS **400** for configuring/administering from external applications. CI **411** may also facilitate providing views of existing system fault statistics and performance via user interface module (UIM) **401**, and allow modification of rules/remedies within SDS **400** via UIM **401**.

[0029] SDS **400** may include an administration and configuration module (AAC) **409**. AAC **409** may provide administrative capabilities for adding/deleting/managing users of the smart management service. AAC **409** may provide administrative capabilities for setting permissions for users of the smart diagnostic service. AAC **409** may also provide a configuration view to authorized users for configuring Rule Charts that link faults and remedies for use by Rule Engine (RE) **404**.

[0030] SDS **400** may include a user interface module (UIM) **401**. UIM **401** may provide a user interface to users of SDS **400** for general system configuration and administration. UIM **401** may provide a user interface to users of SDS **400** for viewing statistics and rule/remedy suggestions.

[0031] SDS **400** may include a fault database (FDB) **406**. FDB **406** may serve as a database for storing fault schema related information. For example, FDB **406** may store fault reports from SA **450**, and logs and results of remedies that are triggered by SDS **400**. FDB **406** may also store configured rules that are generated by authorized users via AAC **409** for use by RE **404**. Also, FDB **406** may store remedies that need to be triggered by rules.

[0032] SDS **400** may include a configuration database (CDB) **403**. CDB **403** may store the configuration parameters of SDS **400**, including user/administrator details, permissions for each user using SDS **400** for configuring rules, fault mappings, accessing fault information, system views and general house keeping.

[0033] CDB **403** may also store mapping information of local (device/system) specific error codes and messages to central error codes and messages, in order to create a system-wide set of standardized error codes that can used across entities and components within a complex service chain. CDB **403** may store a global fault map, which maps local fault codes (LFC) generated by system components to a unique central fault code (CFC), based on the sub-system/application/service/device component that generated the local fault. Associated with the central fault code, CDB **403** may also store an error type, error severity, and local fault code. CDB **403** may also store a fault classification map, which maps the unique central fault code to a service chain-based fault type and sub-type. CDB **403** may further store a fault investigation map, which maps the fault type and fault sub-type from the fault classification map with the associated local and global context information that is collected. Moreover, CDB **403** may store a fault scenario map, which maps the fault scenarios to be monitored. AAC **409** may obtain the fault scenarios based on inputs from the Administrator/Engineer and from fault analysis engine (FAE) **405**. Each fault scenario may comprise a list of fault groupings, including such properties as: fault property type (instance, occurrence, persistence); fault window (time window in which fault happened); fault recurrence (repetitions in time window); fault relation (logical relationship to system components); and fault grouping (family/group of faults linking to other faults in the same fault scenario).

[0034] SDS **400** may include a Rule Engine (RE) **404**. RE **404** may evaluate the rules configured by AAC **409** when fault reports are received from SA **450**. RE **404** may use fault management module (FMM) **408** to identify whether rule conditions are met, and trigger remedies when any rule configured is evaluated as true.

[0035] SDS **400** may include a remedy building module (RBM) **407**. RBM **407** may build and suggest remedies based on existing remedies configured via AAC **409**. RBM **407** may also evaluate effectiveness of configured remedies and suggest improvements.

[0036] SDS **400** may include a fault management module (FMM) **408**. FMM **408** may set up and manage fault nodes based on a rule chart configured by the user. Each node in FMM **408** may represent a fault configured as part of the rule chart and its associated conditions. In some embodiments, FMM **408** may be configured to eliminate duplicate nodes for the same fault in different rules. FMM **408** may update node information based on the fault reports provided by SA **450**, and notifies fault analysis engine (FAE) **405** on arrival of a fault report.

[0037] SDS **400** may include a Fault Analysis Engine (FAE) **405**. FAE **413** may analyze fault conditions based on the fault nodes set up by FMM **408**, and trigger relevant rules for evaluation by the RE **404**. FAE **413** may also suggest new rules or modifications to existing rules for increased effectiveness in fault correction.

[0038] SDS **400** may include an agent management module (AMM) **412**. AMM **412** may manage different SAs **450** that are there in the system. AMM **412** may allows SAs **450** to look up other SAs for requesting and gathering contextual information.

[0039] SDS **400** may interact with smart agent (SA) **450**. SA **450** may include an agent communication module (ACM) **454**. ACM **454** may handle communications between SA **450** and SDS **400** via SI **455**. ACM **454** may also facilitate communication for configuring SA **450** from SDS **400**. SA **450** may include a fault report generator module (FRGM) **451**. FRGM **451** may generate fault reports for passing to SDS **400** based on fault incident reported from fault information collection module (FICM) **452**. FRGM **451** may format fault reports for passing to SDS **400** with format as defined by SDS **400**. FRGM **451** may also add contextual information for passing to SDS **400** with format as defined by SDS **400**. FRGM **451** may determine if any additional information needs to be collected for complete fault report generation, and may use the FICM **452** to collect additional contextual information as required for a fault incident.

[0040] SA **450** may include a fault information collector module (FICM) **452**. FICM **452** may collect fault information that is reported via agent interface (AI) **456** from clients, user devices, etc. FICM **452** may collect additional information requested by the FRGM **451** via AI **456** from clients, user devices, etc. FICM **452** may also maintain a local copy of the fault information. SA **450** may also include a remedy execution module (REM) **453**. REM **452** may execute remedies specified by SDS **400**, e.g., when triggered by SDS **400**, and may send execution report and logs back to SDS **400**.

[0041] FIG. **4**B is a flowchart of a smart service management procedure. At step **471**, SDS **400** may configure the smart service management. SDS **400** may first perform a standard configuration. Standard configuration may involve network configuration of services, devices, and apps. SDS **400** may discover network topology (e.g., nodes, channels, actors, connectivity, and classification) using standard auto discovery methods. If needed, AAC **409** may further modify auto-discovered network configurations based on inputs from authorized person (e.g., a network administrator). SDS **400** may identify node configuration for devices, other servers, and application/services using standard access mechanisms and protocols. If needed, AAC **409** may be used to modify the node configuration using inputs from an authorized person. SDS **400** may also perform service configuration as part of the standard configuration (e.g., configuration service specifications for each type of services end-user). AAC **409** may obtain service definition through SCM **405**, e.g., using a standard web-service interface like XML, UDDI, etc., or based on inputs from an authorized person.

[0042] Next, SDS **400** may perform agent configuration. SDS **400** may assign each SA **450** a globally unique ID that is generated by AAC **409** using the identity of the host (e.g.,

MAC address) and target application (e.g., unique name of the application). In case SA **450** is associated with a device, the agent ID may be generated using the device ID. SA **450** may configure connectivity and communication protocols for AI **456** by ACM **454** using standard discovery mechanisms. SDS **400** may configure interfaces by AAC **409** using standard discovery mechanisms, and can be updated based on AAC configuration done by an authorized Person. Interface configuration may include agent interface configuration and server interface configuration. SDS **400** may configure the behavior of SA **450** in case of fault reception and reporting by AAC **409** through SCM **405** and SI **455**. A local copy of agent configuration may be provided to SA **450** during this process. AAC **409** may select a portion of the fault classification map relevant for SA **450** and create a local copy for SA **450**. AAC **409** may also select a portion of the fault investigation map relevant for SA **450** and create a local copy for SA **450**.

[0043] SDS **400** may generate a mapping between the service chain and the system landscape. First, SDS **400** may perform a system landscape mapping. AAC **409** may use the standard configuration information (e.g., network topology, node-configuration information) to establish relationships among nodes (devices/servers/applications) to form a system landscape. AAC **409** may define a service chain using the service configuration to establish relationships between end-user services and underlying services.

[0044] AAC **409** may then perform service chain-to-system landscape mapping. AAC **409** may load manual configuration information provided by an authorized person, and obtain information about the association between services and corresponding applications/devices. AAC **409** may then obtain information for an authorized person, using UIM **401** and CI **411**, to configure the global fault map, fault classification map, and fault investigation map. These maps may be stored in CDB **403**.

[0045] AAC **409** may use service-chain information, service-association information, and the system landscape information to produce a service chain-to-system landscape mapping using FAE **413**. Specifically, FAE **413** may use centralized fault codes from the global fault map, and fault types and subtypes from the fault classification map, to identify relationships between system components and service chain components.

[0046] FAE **413** may establish links between service chain components and other system components based on the fault investigation map, by mapping between context information in the fault investigation map and service chain components. AAC **409** may use these links for (de)linking faults in fault groupings for the fault scenario map. When SA **450** reports a fault that is not yet mapped to a service chain, FAE **413** may analyze the local fault and, based on previous associations, propose new links to an authorized user for linking or delinking faults in the fault groupings for the fault scenario map.

[0047] In addition, AAC **409** may obtain mapping between fault codes (central fault and local fault) in standard form (XML, CSV for example) in specified format through SCM **405**. AAC **409** may further modify the mapping based on inputs from an authorized person. AAC **409** may obtain a list of central fault codes and a corresponding list of known remedies for each of the central fault codes, e.g., as provided by an authorized person. AAC **409** may obtain the fault scenario map based on inputs from an authorized person, and from FAE **413** in the form of fault groupings with properties such as: fault property type (instance, occurrence, persistence); fault window (time window in which fault happened); fault recurrence (repetitions in time window); fault relation; fault grouping; etc. AAC **409** may obtain the fault investigation map based on inputs from an authorized person that maps fault types and fault sub-types with associated local and global context information. The global fault map may define the fault types and sub-types. Local and global context information may be obtained from the standard configuration discussed earlier. All data generated through the above configuration steps may be stored in CDB **403**.

[0048] At step **472**, SDS **400** may initialize the smart diagnostic system. AAC **409** may load the global fault map, fault classification map, fault investigation map, and fault scenario map, as well as the standard-configuration, service-chain information, system-landscape mapping information from CDB **403** to a memory accessible to SDS **400**. SA **450** may register with AMM **412** at start-up via ACM **454** through SI **455**, by sending control messages along with its own unique ID. During registration, SA **450** may inform SDS **400** about the applications, services, and/or devices that it supports. AMM **412** may maintain the mapping between applications, services, and/or devices and SA **450** that provides the information. SDS **400** may provide relevant information about other smart agents to SA **450**, e.g., to facilitate communication between smart agents.

[0049] At step **473**, a user device, client, etc. may use SA **450** to report a fault to SDS **400**. SA **450** may receive the fault notification through FICM **452** and AI **456**. SA **450** may use a procedure for gathering all information relevant to the fault notification (e.g., local fault context from the device, service, and/or application) through AI **456**, and FRGM **451** may generate a central fault record. FICM **452** may collect a local fault report from the user device, client, etc., and provide it to FRGM **451**. FRGM **451** may parse the local fault report, and reads the local fault code from the local fault report. FRGM **451** may use the local fault code to find the appropriate centralized fault code from SA **450** local copy of the global fault map stored in local memory of the FRGM. If an appropriate centralized fault code is not found, FRGM **451** may assign a default centralized fault code corresponding to the local fault code. FRGM **451** may then create a central fault record with the local fault report and the corresponding centralized fault code. FRGM **451** may include in the central fault record a fault type and fault subtype based on the local copy of fault reclassification map stored in FRGM **451** that holds the mapping of centralized fault code to service fault type and subtype.

[0050] In some embodiments, FRGM **451** may find associations to other services/applications/devices for the fault type and sub-type classification from the local copy of the fault classification map previously stored in local memory of FRGM **451**. Based on the association list, SA **455** may find the global information that needs to be fetched via other SAs. In case information is required from other SAs, the requesting SA **450** may look up the corresponding SA that services the identified service/application/device from AMM **412** at SDS **400**, and issue a request to the SAs either directly using FRGM **451** or via proxy through AMM **412**. After the requested information is received from the other SAs, FRGM **451** may add the information to the central fault record.

[0051] FRGM **451** may also find associations to local information required for the fault type and fault subtype from the local copy of fault classification map previously stored in local memory of FRGM **451**. SA **450** may use these associa-

tions to collect information via FICM **452** and store the information in the central fault record. SA **450** may then report the central fault record to SDS **400**, using ACM **454** through SI **455**. At SDS **400**, FMM **408** may receive the central fault report, and store a copy of the central fault report in FDB **406**.

[0052] At step **474**, SDS **400** may perform smart fault analysis. When SDS **400** receives a central fault report from SA **455**, SDS **400** may perform service fault segregation to identify one or more fault nodes where a fault may have occurred, and rules to be executed by RE **404** to identify remediation measures. SDS **400** may use service chain information and other received service faults to identify the nodes. In particular, SDS **400** may be able to identify dependencies between central fault records submitted by different SAs. For example, a fault in one node (e.g., a device, application, etc.) may cause several SAs linked to nodes with which the faulty node communicates to generate and send central fault records. SDS **400** may use the segregation procedure to identify the faulty node based on the multiple central fault records from the multiple linked SAs.

[0053] When a central fault record is received via SI **455** and SCM **405**, the FMM **408** identifies the corresponding fault node (as reflected in the central fault record) in the fault scenario map, and triggers FAE **413** for fault analysis related to the specified node. When a service fault is reported (e.g., by a user) via CRMI **410** and SCM **405**, FAE **413** may use the fault classification map to identify the service chain component at issue. FAE **413** may identify fault nodes that are part of the service chain component in the fault scenario map. FAE **413** then performs fault scenario identification. FAE **413** may analyze the edges (e.g., communication links) associated with the triggered node(s) that satisfies edge conditions, and thereby attempts to identify an origin node of the fault scenarios that are linked. In the example above where a fault in one node causes several SAs linked to nodes with which the faulty node communicates to send central fault records, all nodes may be included in the fault scenario map, and FAE **413** may identify the faulty node as the origin node. When service faults are reported through CRMI **410**, FAE **413** may also isolate clusters of nodes as suggestible scenarios, with identifiers such as: nodes evaluated to be true (for persistent faults); nodes evaluated to be true in the recent time window between service faults (for transient and recurring faults); nodes historically associated together; fault scenario evaluation, etc. FAE **413** may evaluate the identified fault scenarios via edges from the origin node of the scenarios to determine if the fault scenario is satisfied. In case the FAE determines any fault scenario(s) to be satisfied, the corresponding remediation rule may be triggered at RE **404**. AAC **409** may store suggestible scenarios in the fault scenario map to be used for building recommendations to the authorized user using UIM **401**.

[0054] At step **475**, SDS **400** may perform fault remediation in conjunction with SA **450**. RBM **407** may build an appropriate remedy from a list of remedies corresponding to a given satisfied fault scenario. In case of no known remedies, RBM **407** may suggest the nearest remedy or remedies that can be used to solve a fault scenario using analysis of remedy characteristics and previous history of association with fault scenario signatures. An authorized user can add new remedies through UIM **401** and AAC **409**.

[0055] AAC **409** may build a rule chart that links the fault scenarios to one or more of the remedies. Remedies/Corrections associated with fault scenarios will also have interdependency among themselves, such as sequential, parallel, conditional executions in different combinations. The remedies chosen will carry forward these characteristics and allow only chaining or grouping of remedies that satisfy these conditions. RBM **407** may use these characteristics when suggesting remedies for fault scenarios, based on previous associations between remedy characteristics and fault scenario signatures. When RE **404** evaluates a rule as true, the remedies corresponding to that rule may be executed via SA **455**.

[0056] RBM **407** may analyze logs of the remedies and the faults of the fault scenario that was evaluated for the rule to determine the effectiveness of remedy. RBM **407** may flag in-effective remedies and quantitative ineffectiveness based on this analysis. RBM **407** may also suggest further improvements to a remedy based on characteristics of current remedy, other remedies in database and successful historical association with other fault scenarios to the service provider who defines the rule chart.

[0057] FIGS. **5**A-C are screenshots of a user interface for fault detection and remediation in a smart service management system. With reference to FIG. **5**A, a "faults" user interface screen (UI) may be provided by UIM **401** or by agent UIs **134**, **165**. The screen may include a list of faults identified **513** at the site (e.g., SA **450**, SDS **400**). A user may be able to scroll through the list using user interface elements **514**, and may be able to modify the list using additional user interface elements **515**. Each identified fault in the fault list **513** may have associated with it a number of fault parameters **511**. Examples of such fault parameters include: fault name; fault source type; fault type; fault sub-type; fault description; etc. (see **519**). A user may be able to modify parameters associated with an identified fault using user interface elements **512**. Additionally, a user may be able to view an "actions" UI and a "rules" UI using user interface elements **520** and **530**, respectively.

[0058] With reference to FIG. **5**B, an "actions" UI may be provided by UIM **401** or by agent UIs **134**, **165**. The screen may include a list of actions identified or performed **523** at the site (e.g., SA **450**, SDS **400**). A user may be able to scroll through the list using user interface elements **524**, and may be able to modify the list using additional user interface elements **525**. Each identified action in the action list **523** may have associated with it a number of action parameters **521**. Examples of such action parameters include: action name; remedy action; action sub-type; action timeout time remaining; filename; file output; file static parameters; file dynamic parameters; etc. (see **529**). A user may be able to modify parameters associated with an identified action using user interface elements **522**. Additionally, a user may be able to view a "faults" UI and a "rules" UI using user interface elements **510** and **530**, respectively.

[0059] With reference to FIG. **5**C, a "rules" UI may be provided by UIM **401** or by agent UIs **134**, **165**. The screen may include a list of rules identified or implemented **534** at the site (e.g., SA **450**, SDS **400**). A user may be able to scroll through the list using user interface elements **535**. Each identified rule in the rule list **534** may have associated with it a number of rule parameters **531**. Examples of such rule parameters include: fault name; action name; priority; etc. (see **532**). A user may be able to modify parameters associated with an identified rule using user interface elements **533**. Additionally, a user may be able to view a "faults" UI and an "actions" UI using user interface elements **510** and **520**, respectively.

[0060] FIGS. **6**A-C are flowcharts of a fault reporting procedure for smart service management. With reference to FIG. **6**A, in some embodiments, at step **605**, a node (e.g., an end-user device, network component, distributed process, etc.) may identify a fault or condition in a process, device, or component. At step **610**, the node may send a notification of the fault or condition to an associated agent device or process ("agent"). At step **615**, the agent may parse the notification of the fault or the condition. Using data extracted form the notification, at step **620**, the agent may obtain reporting rules related to the fault or condition from a database. At step **625**, the agent may select a reporting rule. At step **630**, the agent may determine the rule's requirements for further processing.

[0061] With reference to FIG. **6**B, at step **635**, the agent may determine whether the rule requires that additional data be gathered to include in a central fault report to a diagnostics server. If so, at step **640**, the agent may identify the source(s) of such data, send requests for such data, and obtain the local data from their sources. At step **645**, the agent may determine whether any local diagnostics needs to be performed to generate additional data to be included in the central fault report. If so, at step **650**, the agent may identify the local diagnostics routine(s), and performed the local diagnostics routine(s). For example, through such diagnostics routines, the agent may obtain additional data from the reporting node. Examples of such data collected include, without limitation: device firmware version, video error blocks, frame loss rate, media loss rate, sync loss, time since repair, macroblocks, video player restart count, device application crash count, local device restart time, out-of-memory exceptions, cache restart rate, stack overflow exceptions, distributed caching errors, etc. At step **655**, the agent may collect the data from local diagnostics.

[0062] With reference to FIG. **6**C, the agent may then determine, at step **660**, whether to gather any additional data for inclusion in the central fault report. If so, at step **665**, the agent may identify the sources of that data, and obtain the data from those sources. Once all the data and local diagnostics information is obtained, at step **670**, the agent may make a determination as to whether to send a central fault report to the diagnostics server. If so, at step **675**, the agent may collect the data to be submitted in the central fault report. At step **680**, the agent may convert the data into standardized form. At step **685**, the agent may cache the central fault report for transmission in an efficient manner to the diagnostics server, or may send the central fault report immediately. If any additional rules remain to be processed (see step **690**), the agent may return flow control to step **625** (FIG. **6**A) for further processing.

[0063] FIGS. **7**A-C are flowcharts of a server-side fault remediation procedure for smart service management. With reference to FIG. **7**A, at step **705**, the diagnostics server may obtain the central fault report from the reporting agent. At step **710**, the diagnostics server may parse the report, and identify the report source (e.g., agent, or the node that transmitted the fault notification to the agent in the first place). The diagnostics server may extract fault data included in the central fault report. At step **715**, the diagnostics server may obtain data collection rules related to the fault or condition. At step **720**, the diagnostics server may select a data collection rule for processing. At step **725**, the diagnostics server may determine the rule requirements. At step **730**, the diagnostics server may determine that other data should be collected.

[0064] With reference to FIG. **7**B, at step **735**, if so, at step **735**, the diagnostics server may identify the data sources from which the other data should be collected, and may collect the data from those sources. At step **740**, the diagnostics server may determine whether additional collection rules are to be processed. If so, the diagnostics server may return flow control to step **720** (FIG. **7**A). At step **745**, the diagnostics server may obtain fault classification rules/templates, and at step **750**, may apply those rules/template to the available data. Thereby, at step **755**, the diagnostic server may identify the fault classification. As part of classifying the fault, the diagnostic server may also identify one or more fault sub-classes, for example: system fault, subsystem fault, component fault, service fault, device fault, data fault, global fault, etc.

[0065] With reference to FIG. **7**C, at step **760**, the diagnostics server may obtain remedy rules/templates corresponding to the fault classification. At step **765**, the diagnostics server may determine the remedy according to the fault classification. At step **770**, the diagnostics server may identify corrective actions, and the corresponding hardware, software, data, or processes at which the corrective actions should be taken. At step **775**, the diagnostics server may send corrective action messages to the identified hardware, software, or processes specifying the corrective actions. At step **780**, the diagnostics server may obtain confirmation from the hardware, software, or processes that the corrective action has been taken. At step **785**, the diagnostics server may store the fault data, other data, fault classification, corrective actions taken, and confirmation.

[0066] FIG. **8** is a flowchart of an agent-side fault remediation procedure for smart service management. At step **805**, an agent may obtain a corrective action message from the diagnostics server. At step **810**, the agent may parse the message, and identify the hardware, software, data, or processes for which corrective actions should be taken. The agent may also identify the corrective action to be taken from the message. At step **815**, the agent may generate corrective action instructions encoded in a data/instruction format that is compatible with the identified hardware, software, or processes. At step **820**, the agent may send the corrective action instructions. At step **825**, the agent may obtain notification that the corrective action has been taken from the identified hardware, software, or processes. At step **830**, the agent may generate and send a corrective action confirmation to the diagnostics server.

[0067] FIGS. **9**A-B are flowcharts of a fault classification learning procedure for smart service management. With reference to FIG. **9**A, at step **905**, the diagnostics server may obtain a fault report from an agent process or agent device. At step **910**, the diagnostics server may parse the fault report, and may extract the report source and fault data from the report. At step **915**, the diagnostics server may identify related report sources, and at step **920**, may obtain pending (e.g., not-yet-processed) fault reports from the related report sources. At step **925**, the diagnostics server may identify the related hardware, software, and/or processes at which corrective actions were (recently) taken. At step **930**, the diagnostics server may obtain the corrective actions that were taken at the identified hardware, software, and/or processes.

[0068] With reference to FIG. **9**B, at step **935**, the diagnostics server may determine whether the corrective actions taken at the identified hardware, software, and/or processes are related to the fault report from the agent process or agent device. At step **940**, the diagnostics server may also determine whether the corrective actions taken at the identified hard-

ware, software, and/or processes are related to the pending related fault reports. At step **945**, the diagnostics server may identify alternative corrective actions that could have been taken, and corresponding hardware, software, and/or processes at which those alternative actions could have been taken. At step **950**, the diagnostics server may apply a learning algorithm to update the rules/templates and/or remedies, based on the data obtained and alternative corrective actions identified. The learning algorithm adopted may be supervised (e.g., using decision trees, Bayesian methods, artificial neural networks, etc.), unsupervised (e.g., using clustering, dimensionality reduction, self-organizing maps, etc.), or a combination of both supervised and unsupervised (e.g., semi-supervised, committees, experts, etc.). At step **955**, the diagnostics server may store the updated reedy rules/templates. At step **960**, the diagnostics server may initiate a remediation procedure (e.g., as described above with reference to FIGS. **7**A-C, **8**) for the fault report and the pending related fault reports.

[0069] FIG. **10** is a block diagram of an exemplary computer system for implementing embodiments consistent with the present disclosure. Variations of computer system **1001** may be used for implementing the devices and systems presented in this disclosure. Computer system **1001** may comprise a central processing unit ("CPU" or "processor") **1002**. Processor **1002** may comprise at least one data processor for executing program components for executing user- or system-generated requests. A user may include a person, a person using a device such as those included in this disclosure, or such a device itself. The processor may include specialized processing units such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc. The processor may include a microprocessor, such as AMD Athlon, Duron or Opteron, ARM's application, embedded or secure processors, IBM PowerPC, Intel's Core, Itanium, Xeon, Celeron or other line of processors, etc. The processor **1002** may be implemented using mainframe, distributed processor, multi-core, parallel, grid, or other architectures. Some embodiments may utilize embedded technologies like application-specific integrated circuits (ASICs), digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), etc.

[0070] Processor **1002** may be disposed in communication with one or more input/output (I/O) devices via I/O interface **1003**. The I/O interface **1003** may employ communication protocols/methods such as, without limitation, audio, analog, digital, monoaural, RCA, stereo, IEEE-1394, serial bus, universal serial bus (USB), infrared, PS/2, BNC, coaxial, component, composite, digital visual interface (DVI), high-definition multimedia interface (HDMI), RF antennas, S-Video, VGA, IEEE 802.11 a/b/g/n/x, Bluetooth, cellular (e.g., code-division multiple access (CDMA), high-speed packet access (HSPA+), global system for mobile communications (GSM), long-term evolution (LTE), WiMax, or the like), etc.

[0071] Using the I/O interface **1003**, the computer system **1001** may communicate with one or more I/O devices. For example, the input device **1004** may be an antenna, keyboard, mouse, joystick, (infrared) remote control, camera, card reader, fax machine, dongle, biometric reader, microphone, touch screen, touchpad, trackball, sensor (e.g., accelerometer, light sensor, GPS, gyroscope, proximity sensor, or the like), stylus, scanner, storage device, transceiver, video device/source, visors, etc. Output device **1005** may be a printer, fax machine, video display (e.g., cathode ray tube (CRT), liquid crystal display (LCD), light-emitting diode (LED), plasma, or the like), audio speaker, etc. In some embodiments, a transceiver **1006** may be disposed in connection with the processor **1002**. The transceiver may facilitate various types of wireless transmission or reception. For example, the transceiver may include an antenna operatively connected to a transceiver chip (e.g., Texas Instruments WiLink WL1283, Broadcom BCM4750IUB8, Infineon Technologies X-Gold 618-PMB9800, or the like), providing IEEE 802.11a/b/g/n, Bluetooth, FM, global positioning system (GPS), 2G/3G HSDPA/HSUPA communications, etc.

[0072] In some embodiments, the processor **1002** may be disposed in communication with a communication network **1008** via a network interface **1007**. The network interface **1007** may communicate with the communication network **1008**. The network interface may employ connection protocols including, without limitation, direct connect, Ethernet (e.g., twisted pair 10/100/1000 Base T), transmission control protocol/internet protocol (TCP/IP), token ring, IEEE 802.11a/b/g/n/x, etc. The communication network **1008** may include, without limitation, a direct interconnection, local area network (LAN), wide area network (WAN), wireless network (e.g., using Wireless Application Protocol), the Internet, etc. Using the network interface **1007** and the communication network **1008**, the computer system **1001** may communicate with devices **1010**, **1011**, and **1012**. These devices may include, without limitation, personal computer(s), server(s), fax machines, printers, scanners, various mobile devices such as cellular telephones, smartphones (e.g., Apple iPhone, Blackberry, Android-based phones, etc.), tablet computers, eBook readers (Amazon Kindle, Nook, etc.), laptop computers, notebooks, gaming consoles (Microsoft Xbox, Nintendo DS, Sony PlayStation, etc.), or the like. In some embodiments, the computer system **1001** may itself embody one or more of these devices.

[0073] In some embodiments, the processor **1002** may be disposed in communication with one or more memory devices (e.g., RAM **1013**, ROM **1014**, etc.) via a storage interface **1012**. The storage interface may connect to memory devices including, without limitation, memory drives, removable disc drives, etc., employing connection protocols such as serial advanced technology attachment (SATA), integrated drive electronics (IDE), IEEE-1394, universal serial bus (USB), fiber channel, small computer systems interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, redundant array of independent discs (RAID), solid-state memory devices, solid-state drives, etc.

[0074] The memory devices may store a collection of program or database components, including, without limitation, an operating system **1016**, user interface application **1017**, web browser **1018**, mail server **1019**, mail client **1020**, user/application data **1021** (e.g., any data variables or data records discussed in this disclosure), etc. The operating system **1016** may facilitate resource management and operation of the computer system **1001**. Examples of operating systems include, without limitation, Apple Macintosh OS X, Unix, Unix-like system distributions (e.g., Berkeley Software Distribution (BSD), FreeBSD, NetBSD, OpenBSD, etc.), Linux distributions (e.g., Red Hat, Ubuntu, Kubuntu, etc.), IBM OS/2, Microsoft Windows (XP, Vista/7/8, etc.), Apple iOS, Google Android, Blackberry OS, or the like. User interface **1017** may facilitate display, execution, interaction, manipulation, or operation of program components through textual

or graphical facilities. For example, user interfaces may provide computer interaction interface elements on a display system operatively connected to the computer system **1001**, such as cursors, icons, check boxes, menus, scrollers, windows, widgets, etc. Graphical user interfaces (GUIs) may be employed, including, without limitation, Apple Macintosh operating systems' Aqua, IBM OS/2, Microsoft Windows (e.g., Aero, Metro, etc.), Unix X-Windows, web interface libraries (e.g., ActiveX, Java, Javascript, AJAX, HTML, Adobe Flash, etc.), or the like.

[0075] In some embodiments, the computer system **1001** may implement a web browser **1018** stored program component. The web browser may be a hypertext viewing application, such as Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Apple Safari, etc. Secure web browsing may be provided using HTTPS (secure hypertext transport protocol), secure sockets layer (SSL), Transport Layer Security (TLS), etc. Web browsers may utilize facilities such as AJAX, DHTML, Adobe Flash, JavaScript, Java, application programming interfaces (APIs), etc. In some embodiments, the computer system **1001** may implement a mail server **1019** stored program component. The mail server may be an Internet mail server such as Microsoft Exchange, or the like. The mail server may utilize facilities such as ASP, ActiveX, ANSI C++/C#, Microsoft .NET, CGI scripts, Java, JavaScript, PERL, PHP, Python, WebObjects, etc. The mail server may utilize communication protocols such as internet message access protocol (IMAP), messaging application programming interface (MAPI), Microsoft Exchange, post office protocol (POP), simple mail transfer protocol (SMTP), or the like. In some embodiments, the computer system **1001** may implement a mail client **1020** stored program component. The mail client may be a mail viewing application, such as Apple Mail, Microsoft Entourage, Microsoft Outlook, Mozilla Thunderbird, etc.

[0076] In some embodiments, computer system **1001** may store user/application data **1021**, such as the data, variables, records, etc. as described in this disclosure. Such databases may be implemented as fault-tolerant, relational, scalable, secure databases such as Oracle or Sybase. Alternatively, such databases may be implemented using standardized data structures, such as an array, hash, linked list, struct, structured text file (e.g., XML), table, or as object-oriented databases (e.g., using ObjectStore, Poet, Zope, etc.). Such databases may be consolidated or distributed, sometimes among the various computer systems discussed above in this disclosure. It is to be understood that the structure and operation of any computer or database component may be combined, consolidated, or distributed in any working combination.

[0077] The specification has described systems and methods for smart service management in a media network. The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments. Also, the words "comprising," "having," "containing," and "including," and other similar forms are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items. It must also be noted that as used herein and in the appended claims, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise.

[0078] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term "computer-readable medium" should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage media.

[0079] It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

What is claimed is:

1. A smart diagnostic system, comprising:

a hardware processor; and

a memory storing processor-executable instructions comprising instructions for:

receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network;

aggregating one or more relevant fault reports related to the agent fault report;

obtaining one or more fault classification rules;

identifying one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and

providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

2. The system of claim **1**, the instructions further comprising instructions for:

updating one or more of the fault classification rules based on a learning algorithm using one or more of: the agent fault report; the relevant fault reports; the determined one or more fault nodes; the one or more fault conditions; or the agent configuration instruction.

3. The system of claim **1**, the instructions further comprising instructions for:

generating an updated map of fault conditions to agent configuration instructions.

4. The system of claim **1**, the instructions further comprising instructions for:

displaying a user interface configured to provide fault statistics and agent configuration recommendations.

5. The system of claim **1**, wherein the agent configuration instruction is based on one or more previously provided agent configuration instructions for one or more agent applications.

6. The system of claim **1**, wherein the agent configuration instruction is provided to another agent application different from the agent application from which the agent fault report was received.

7. The system of claim **1**, the instructions further comprising instructions for:

providing the agent application an instruction to query another agent application for information;

wherein the received agent fault report is based on the information.

8. The system of claim **1**, wherein the agent fault report is received via one of: a pull mode or a push mode of communication.

9. A smart diagnostic method, comprising:

receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network;

aggregating one or more relevant fault reports related to the agent fault report;

obtaining one or more fault classification rules;

identifying, via a hardware processor, one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and

providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

10. The method of claim **9**, further comprising:

updating one or more of the fault classification rules based on a learning algorithm using one or more of: the agent fault report; the relevant fault reports; the determined one or more fault nodes; the one or more fault conditions; or the agent configuration instruction.

11. The method of claim **9**, further comprising:

generating an updated map of fault conditions to agent configuration instructions.

12. The method of claim **9**, further comprising:

displaying a user interface configured to provide fault statistics and agent configuration recommendations.

13. The method of claim **9**, wherein the agent configuration instruction is based on one or more previously provided agent configuration instructions for one or more agent applications.

14. The method of claim **9**, wherein the agent configuration instruction is provided to another agent application different from the agent application from which the agent fault report was received.

15. The method of claim **9**, further comprising:

providing the agent application an instruction to query another agent application for information;

wherein the received agent fault report is based on the information.

16. The method of claim **9**, wherein the agent fault report is received via one of: a pull mode or a push mode of communication.

17. A non-transitory computer-readable medium storing computer-executable smart diagnostic system instruction comprising instructions for:

receiving an agent fault report, including one or more network-wide standardized fault codes, from an agent application executing on a remote device in a media network;

aggregating one or more relevant fault reports related to the agent fault report;

obtaining one or more fault classification rules;

identifying one or more fault nodes and associated fault conditions in the media network using the one or more fault classification rules, by analyzing the aggregated relevant fault reports; and

providing an agent configuration instruction for one or more agent applications using the identification of the one or more fault nodes and associated fault conditions.

18. The medium of claim **17**, the instructions further comprising instructions for:

updating one or more of the fault classification rules based on a learning algorithm using one or more of: the agent fault report; the relevant fault reports; the determined one or more fault nodes; the one or more fault conditions; or the agent configuration instruction.

19. The medium of claim **17**, the instructions further comprising instructions for:

generating an updated map of fault conditions to agent configuration instructions.

20. The medium of claim **17**, the instructions further comprising instructions for:

displaying a user interface configured to provide fault statistics and agent configuration recommendations.

21. The medium of claim **17**, wherein the agent configuration instruction is based on one or more previously provided agent configuration instructions for one or more agent applications.

22. The medium of claim **17**, wherein the agent configuration instruction is provided to another agent application different from the agent application from which the agent fault report was received.

23. The medium of claim **17**, the instructions further comprising instructions for:

providing the agent application an instruction to query another agent application for information;

wherein the received agent fault report is based on the information.

24. The medium of claim **17**, wherein the agent fault report is received via one of: a pull mode or a push mode of communication.

* * * * *