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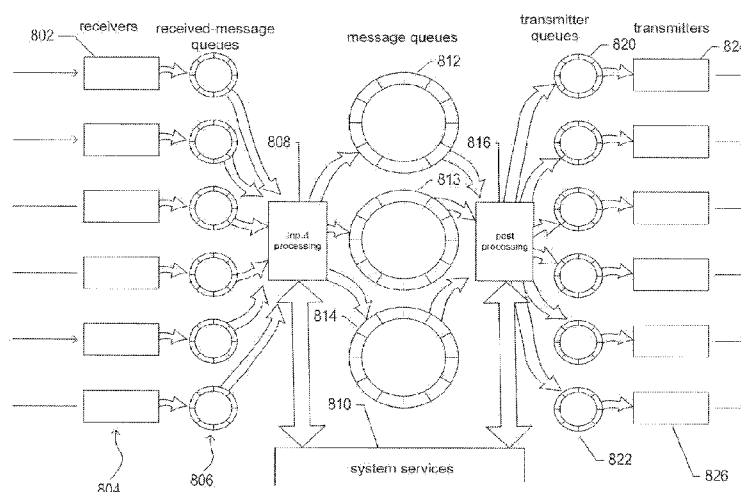
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(54) Title: AUTOMATED COMMUNICATIONS SYSTEM

FIG. 8A



(57) Abstract: Embodiments of the present invention are directed to automated systems for organizing and facilitating information exchange between members of an organization. Automated systems that represent embodiments of the present invention allow for creation and administration of hierarchical groupings of members of the organization to facilitate efficient dissemination of information among members of groups. Embodiments of the present invention provide for automated and intelligent routing of information and communications among many different types of communications media and devices through which members of the organization can distribute and exchange information with one another. Embodiments of the present invention additionally provide for sophisticated logging, tracking, and monitoring of information distribution and management within the organization.

AUTOMATED COMMUNICATIONS SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Provisional Application No.
5 61/309,317, filed March 1, 2010.

TECHNICAL FIELD

The present invention is related to communications and, in particular,
to an automated communications system that allows for flexible and efficient
10 interpersonal communications, through many different types of communications
media and communications devices, between members of an organization.

BACKGROUND

Electronic communications has rapidly developed and evolved over
15 the past 150 years. The development of telephonic voice communications in the latter
1800's revolutionized society and communications within organizations, including
businesses, commercial offices, and governmental and educational institutions. For
many years, the telephone and hand-delivered mail were the primary forms of
communications used within organizations. However, with the advent of computer
20 technology, beginning in the 1950's, and with later development and
commercialization of mobile telephones and other technologies, a wide array of
various types of communications media and devices are now commonly available.
These various different types of communications media and devices provide for
distribution and exchange of many different types of information to individuals in
25 various geographical locations. As a result, people today have an enormous range of
communications capabilities at their disposal with which to communicate with one
another. However, because of the number of and variety of different types of
communications media and devices, organizing and managing systematic information
distribution among the members of an organization is currently a vastly more
30 complex undertaking than in earlier times. While efforts have been undertaken to
provide technological bridges between different types of communications media and

devices, there are few organization-level communications systems that address the emerging complexities of interpersonal communications within organizations. Individuals, organizations, and designers and manufacturers of communications systems continue to seek new methods and systems for organizing and managing
5 information exchange and distribution within organizations in order to take full advantage of the enormous capabilities of modern communications technologies.

SUMMARY

Embodiments of the present invention are directed to automated
10 systems for organizing and facilitating information exchange between members of an organization. Automated systems that represent embodiments of the present invention allow for creation and administration of hierarchical groupings of members of the organization to facilitate efficient dissemination of information among members of groups. Embodiments of the present invention provide for automated
15 and intelligent routing of information and communications among many different types of communications media and devices through which members of the organization can distribute and exchange information with one another. Embodiments of the present invention additionally provide for sophisticated logging, tracking, and monitoring of information distribution and management within the
20 organization.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1-3 illustrate traditional information distribution and information exchange within organizations prior to the revolution in interpersonal
25 communications brought about by the development and commercialization of personal computers, mobile telephones, and other relatively recently emerging technologies.

Figure 4 illustrates one dimension of the complexities of modern interpersonal communications.

30 Figure 5 illustrates, as an example, a time-of-day dimension of intra-organizational communications complexity.

Figure 6 illustrates additional dimensions of intra-organizational communications complexity.

Figure 7 shows an example organization chart for a small organization with respect to a particular member of the organization.

5 Figures 8A-B illustrate, at a schematic level, an automated communications system that represents one embodiment of the present invention.

Figure 9 illustrates certain types of stored data that represent organizations and organizational structures according to one embodiment of the present invention.

10 Figure 10 illustrates, in more detail, the mapping of groups into group hierarchies within data stored in a database sub-system of an automated communications system that represents one embodiment of the present invention.

Figure 11 illustrates hierarchical group structures that may be used to define complex structural features of an organization within data stored in a database sub-system of an automated communications system that represents one embodiment of the present invention.

Figure 12 illustrates portions of the fundamental data structures stored within the database and database-interface subsystem of an automated communications system that represents one embodiment of the present invention.

20 Figure 13 illustrates additional device-type and communications-media information stored by the database and database-interface subsystem of an automated communication system that represents an embodiment of the present invention.

Figure 14 illustrates a hierarchical group structure for an organization for which intra-organizational communications is provided by an embodiment of the present invention along with an associated addressing scheme that allows users to transmit messages and other information into the automated communications system for distribution by the automated communications system to other members of the organization.

25 Figures 15A-B illustrate two different operational modes for automated communications systems that represent embodiments of the present invention.

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Figure 16 illustrates a typical hardware platform for an automated communications service that represents an embodiment of the present invention.

Figure 17 illustrates a distributed automated communications system that represents an embodiment of the present invention.

5 Figure 18 provides a control-flow diagram for the input-processing subsystem of an automated communications system that represents an embodiment of the present invention.

 Figure 19 provides a control-flow diagram for the routing and message-forwarding subsystem of the system services component of an automated
10 communications system that represents an embodiment of the present invention.

 Figure 20 is a control-flow diagram for the routing routine called in step 1910 of Figure 19 according to one embodiment of the present invention.

 Figure 21 provides a control-diagram for the post-processing subsystem of an automated communications system that represents one embodiment
15 of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention are directed to automated systems for facilitating information distribution and information exchange among
20 members of organizations. As mentioned above, these automated communications systems are motivated by the rapidly increasing complexities of intra-organizational communications resulting from the rapidly evolving personal-communications technologies, from personal-computer-based information exchange to mobile phones and even more recently emerged communications technologies.

25 Figures 1-3 illustrate traditional information distribution and information exchange within organizations prior to the revolution in interpersonal communications brought about by the development and commercialization of personal computers, mobile telephones, and other relatively recently emerging technologies. Figure 1 illustrates 18 members of a small organization, such as a
30 commercial office or business. In Figure 1, each member of the organization is represented by a rectangular record, such as rectangular record 102 that includes the

member's name, shown in Figure 1 as a pair of initials, the member's phone extension, and the member's mail stop, or intra-organization mail address, including initials "A. J." 104, phone extension "3901" 106, and mail stop "MS 10/B" 108 for member 102. Prior to development of modern computer systems and other processor-driven
5 communications devices, telephones and hand-delivered mail messages were the primary methods for communication within organizations.

Figure 2 shows an organizational chart for the organization represented in, and discussed with respect to, Figure 1. As shown in Figure 2, the organization includes a president 202, two vice presidents 204 and 206, and four multi-member
10 departments 208-211. In traditional organizations, at the time that telephones and hand-delivered mail were the only practical intra-organization communications methods, the organizational structure was generally relatively static and monolithic. The organizational simplicity and the simplicity in choice of available intra-organizational communications means allowed for relatively efficient information
15 exchange.

Figure 3 illustrates several different information-distribution scenarios in the traditional organization described with reference to Figures 1 and 2. In a first scenario, the president 302 (202 in Figure 2) needs to announce a policy change to members of the engineering group 310, 314, 318, and 320 (208 in Figure 2). The
20 president first decides whether the announcement requires telephone distribution of the information or whether, instead, the announcement can be printed and distributed by hand delivery. Assuming that, as a result of delivery-time considerations, the president elects to distribute the announcement by telephone, the president 302 calls 304 an administrator 306 whom the president directs to distribute the announcement,
25 by telephone, to the engineering group. The administrator 306 next calls 308 the manager of the engineering group 310 who, in turn, calls 312 a senior member of the engineering group 314 and instructs this senior member of the engineering group to inform other members of the engineering group. The senior member of the engineering group 314 then calls 316-317 the remaining members of the engineering
30 group 318 and 320, respectively. In a second scenario, a vice president 330 decides to use telephone messaging to announce quarterly sales figures to the members of the

sales division (210 in Figure 2). The vice president calls 332 the director of the sale division 334 and instructs the director of the sale division to inform the other members of the sales division. The director 334 then calls 336 the lead member 338 of the eastern sales group and instructs the lead member of the eastern sales group to
5 notify the remaining members of the eastern sales group by telephone. The director next calls 340 the only member of the western sales division 342. Meanwhile, the director of the eastern sales division calls 344-345 the remaining members of the eastern sales division 346 and 348, respectively. Unfortunately, the director is unable to reach the member of the western sales division 342 by telephone. Therefore, the
10 director places a call 350 to the administrator 306 to contact the member of the western sales division. The administrator 306 calls 352 an administrative assistant 354 who determines that the sole member of the western sales division is currently traveling, and reachable at a hotel, and then directly calls 356 member 342 at the hotel.

15 The traditional office communications, discussed above with reference to Figure 3, work reasonably well due to the simplicity of the structure of the organization as well as the limited choices for communicating with organization members. However, even in this simple example, certain deficiencies can be observed. First, because of the hierarchical nature of the structure of the organization,
20 and because of the one-to-one mode of communications provided by traditional telephone calls, disseminating information within the hierarchical organization structure is accompanied by a hierarchy of individual telephone calls and attendant delays in information transmission. Another deficiency is that, in many cases, one or a very few members, such as the administrator 306, becomes a bottleneck or hub for
25 communications, since the administrator is often the first person called in order to distribute information by telephone. Yet another deficiency is that, when a party cannot be directly reached by telephone, a relatively time-intensive and expensive alternative communications strategy must be employed, such as that represented by telephone calls 350, 352, and 356 in Figure 3. However, for many years, intra-
30 organization communication generally followed this approach.

By contrast to the traditional organization and traditional communications methods discussed above with reference to Figures 1-3, current technologies provide a wealth of different communications capabilities as well as a forest of complexities associated inter-personal communications within an organization. Figure 4 illustrates one dimension of the complexities of modern inter-personal communications. In Figure 1, each member of the organization is associated with two communications addresses: a telephone extension and a mail stop. By contrast, consider the number of different communications devices, associated with different communications addresses, available to a particular member of an organization currently, shown in Figure 4. The company president A. J. 402 may receive information and transmit information through many different communications media and devices, including: (1) a home landline telephone 404; (2) voice communications via a home cell phone 406; (3) text messaging via a home cell phone 408; (4) email via a home computer 410; (5) instant messaging via a home computer 412; (6) voice communications via an office landline telephone 414; (7) voice communications via an office cell phone 416; (8) text messaging via an office cell phone 418; (9) email via an office computer 420; (10) instant messaging via an office computer 422; (11) voice communications via an office mobile-computing device 424; (12) text messaging via an office mobile-computing device 426; (13) instant messaging via an office mobile-computing device 428; (14) email via an office mobile computing-device 430; (15) hand-delivered office mail 432; (16) contacting an office administrative assistant who then contacts the company president by any of various different means shown in Figure 4 434; (17) contacting a secondary contact for the president, such as the president's husband, by any of various means 436; and (18) home postal delivery 438.

In fact, the various communications media and devices, shown in Figure 4, may actually be only a subset of the communications media and devices available to the company president. Whereas, in traditional organizations of simpler times, one needed to consider only essentially two different types of communications by which to distribute information to, or exchange information with, a particular member of the organization, in current organizations, there is a bewildering array of

different possibilities for communicating with a member of the organization at any particular point in time. Just keeping track of all these different types of communications media and devices and their communications addresses represents a significant problem. However, the large diversity of possibilities for contacting a particular member, when compounded over all of the members of an organization, creates a very difficult problem for anyone seeking to distribute information, since so many different possibilities need to be considered on a member-by-member basis.

There are, however, many more dimensions to the complexity of modern communications than the number and types of communications media and devices through which members of an organization can be reached. Figure 5 illustrates, as an example, a time-of-day dimension of intra-organizational communications complexity. In Figure 5, the availability of each of the different communications medium/devices shown in Figure 4 for the company president is plotted with respect to time of day. In Figure 5, the time of day is represented by the horizontal axis 502 and the availability for each communications medium/device is plotted along vertical axis 504. Double-headed arrows show the availability of the company president through a particular communications medium/device at each point during the day. For example, the company president can be reached by home landline telephone for a short period in the morning 506 and a somewhat longer period 508 in the evening. By contrast, the president can be reached by office email throughout most of the day 510 and 512, although with delays during late evenings and early mornings, with the exception of a period in the evening 514 during which the company president would be more effectively reached by home telephone, home email, or by other means. Not only does a member of the organization seeking to transmit information to another member of the organization need to consider which communications medium and device or communications media and devices through which to transmit the information, the member of the organization also needs to consider which of the communications media and devices are most appropriate for any particular time of day, particularly when timely receipt of the information by the recipient is important.

However, even the added complexity of time-of-day considerations is relatively slight compared to the overall complexity of current intra-organizational communications. Figure 6 illustrates additional dimensions of intra-organizational communications complexity. In Figure 6, each of the various dimensions, or considerations, for transmitting information to one or more members of an organization is represented as a two-dimensional plane, such as the two-dimensional plane 602 representing the time-of-day consideration discussed above with reference to Figure 5. Similar, complex considerations for selecting a communications medium and device or communications media and devices include considerations with respect to: (1) the date 604; (2) the type of message or communications to be transmitted 606; (3) the presence of, and nature of, any types of attachments to the message, such as photographs, spreadsheet data, and other such attachments 608; (4) the nature of the group of recipients to which the information is to be transmitted 610; (5) various characteristics and parameters associated with the sender of the information 612; (6) the subject matter of the information to be transmitted 614; (7) the native language in which the information is presented 616; (8) the role of the sender with respect to the organization 618; (9) the urgency with which the information needs to be delivered 620; (10) the location of the sender 622; (11) the location of the intended recipient or recipients of the information 624; and (12) many other such considerations, as represented by curved arrow 626. In essence, the choice of which communications medium and device to use to send or exchange information within an organization may be profoundly complicated, and involve a very difficult, hyper-dimensional optimization task. Clearly, no member of an organization can possibly make even near-optimal decisions for choosing communications media and devices for distributing information to a group of members within an organization.

Another aspect of the difficulty of intra-organization communications in current organization environments is the fact that, unlike in traditional organizations, as discussed above with reference to Figure 2, the structure of modern organizations tends to be far more complex and dynamic. Figure 7 shows an example organization chart for a small organization with respect to a particular member of the organization. The particular member of the organization is represented by a cross-

hatched disk 702, and other members of the organization are represented by numerically labeled disks, such as disk 704, with the numerical label referring to a particular group of members. Members of the organization may be represented by multiple disks in Figure 7, other than the particular member 702. As shown in Figure 5 7, the particular member of the organization 702 is a member of each of six different hierarchical groups within the organization. The particular member is the head, or root-node member, of group 4 (706 in Figure 7) and occupies various intermediate positions within each of groups 1 (708 in Figure 7), 2 (710 in Figure 7), 3 (712 in Figure 7), 5 (714 in Figure 7), and 6 (716 in Figure 7). Were the president to decide 10 to distribute an announcement to a particular group of members of the organization, it would be difficult for any member of the organization to determine to which particular members of the organization the information should be distributed. First, there are many different overlapping groups, as in the example shown in Figure 7, so that many different lists of members of the organization would need to be maintained. 15 Moreover, in modern organizations, the membership in the various groups tends to change quite rapidly, and new groups may be constantly formed and current groups removed with relatively high frequency.

Consider the complexity of the first information-distribution scenario discussed above with reference to Figure 3. In the first step, the company president 20 302 would need to make a relatively complex decision with regard to possible trade-offs in distributing the message or announcement through different communications media and devices. Or, not wishing to undertake such a complex task, the company president may instead direct the administrator 306 to distribute a particular announcement to the members of a particular group under various time-of-delivery 25 and other constraints. The administrator would need to first determine who the members of the group are and then, for each member, consider all the possible different communications media and devices by which the member can receive information and attempt to select the most appropriate communications medium and device or communications media and devices for the member with respect to the form 30 of the announcement and many other considerations. The task would clearly be

overwhelming, particular when requested frequently with respect to different types of information and groups.

In many cases, features and capabilities of modern communications technologies may somewhat collapse the problem space discussed above with reference to Figures 4-7, but they do not systematically and efficiently collapse the problem domain to a point of feasibility. For example, it is currently possible to link different types of devices to one another so that a message sent to one device is automatically forwarded to others. However, problems remain. As one example, one may wish to distribute a fairly complex, lengthy text message with additional attachments, including photographs. Such information may be readily transmitted via Internet-based email, but it is essentially impossible using instant messaging or text messaging. Therefore, even though a member not able to directly receive the email message might receive indications that the email message was sent, via instant messaging or text messaging, the member would still not receive the information that is intended to be distributed to the member. As another example, modern database technology can provide relatively easily administered and accessed listings of the members of each of the groups within an organization. However, even with such systems at hand, it may nonetheless be time-consuming and annoying to access such lists in order to transmit information. In certain cases, communications media and devices provide for automatic transmission of information to groups of members within an organization. For example, many email applications allow users to create or import named lists of members so that an email can be sent to each member of the list in one operation. However, the email-listing feature may still require time-consuming and expensive administration, on an organization-wide level, and does not address the many other dimensions of intra-organization communication complexities. Furthermore, such disparate technical features, when employed in an organization, may lead to security breaches and other opportunities for misuse or mischief. Because of the number of different types of communications media and devices through which each member of an organization may receive messages and other information, and the relatively high frequency at which new communications media and devices may become available for a particular member, and existing

communications media and devices may, as a result, become less desirable or even no longer available, centrally managing even the member contact information may represent a formidably complex problem. A centralized repository for contact information is needed, but, at the same time, centralized collection and management
5 of this information may represent an enormous cost and time burden to the organization.

To address the above-described problems with current intra-organization communications, and many additional problems, embodiments of the present invention provide for flexible, easily administrated, and easily monitored
10 automated systems for interconnecting members of an organization through any of many different communications media and devices. Figures 8A-B illustrate, at a schematic level, an automated communications system that represents one embodiment of the present invention. The automated system that represents an embodiment of the present invention includes a large number of different types of
15 communications receivers, such as receiver 802 in a column of receivers 804 shown on the left side of Figure 8A. The messages or other types of information received through these receivers are queued to received-message queues, shown in a column of received-message queues 806 in Figure 8A. There is at least one received-message queue paired with each receiver. Received messages are de-queued from the
20 received-message queues and processed by an input-processing component or subsystem 808. The input-processing subsystem 808 accesses various system services through interfaces provided by a system-services component 810 discussed below with reference to Figure 8B. Once the received messages have been processed by the input-processing subsystem 808, corresponding messages for forwarding to
25 other users and/or reply messages are queued to one or more internal message queues 812-814. Subsequently, a post-processing subsystem 816 de-queues messages from the internal message queues 812-814, processes these messages, and queues fully processed messages corresponding to messages queued to the internal message queues to transmitter queues, such as transmitter queue 820 in a column of transmitter
30 queues 822 shown on the right side of Figure 8A, from which the messages for

transmission are de-queued and transmitted by transmitters, such as transmitter 824 in the column of transmitters 826 shown in Figure 8A.

The receivers 804 can be any type of communications receiver, including, as examples, simple-mail-transport-protocol ("SMTP") servers connected to the Internet, voice-communications servers and modems connected to public switched telephone networks ("PSTN"), extensible-messaging-and-presence protocol ("XMPP") servers connected to the Internet, short message peer-to-peer protocol ("SMPP") servers connected to the Internet, hypertext transport protocol ("HTTP") servers connected to the Internet, transmission-control-protocol/Internet-protocol ("TCP/IP") servers connected to the Internet, and other types of message-receiving servers interconnected to wireless communications receivers, LAN devices, or other appropriate communications media. Similarly, the transmitters may be any of a wide variety of different types of transmission devices, including the various types of servers associated with physical transmission devices connected to appropriate communications media. In many cases, although the receivers and transmitters are shown as separate components in Figure 8, the receivers and transmitters may instead be collocated within a transceiver-type component, such as an SMPP server connected to a public telephone network that both receives and transmits SMS messages. The various receivers, transmitters, and transceivers can receive and transmit many different types of messages and information, including text-based email, extensible-mark-up-language ("XML") -encoded messages and information, instant-messaging messages, multipurpose-Internet-mail-extensions ("MIME") documents, multimedia-messaging-service ("MMS") messages, and even telemetry communications between various types of devices and systems via machine-to-machine ("M2M") communications. The automated communications system that represents one embodiment of the present invention can be, at a high level, considered to be a very high-bandwidth, intelligent, queue-based communications crossbar that receives messages and other information from a variety of different information sources, processes these messages according to internally stored and managed information, and either forwards the messages or transmits reply messages to a large number of different types of information sinks. The above-mentioned types

of messages and other information, communications media, and protocols are examples, but are not intended to, in any way, constrain the types of messages and other information, communications media, and protocols that are supported by automated communications systems that represent embodiments of the present invention. Automated communications systems that represent embodiments of the present invention are generally designed and implemented to allow for straightforward inclusion and adaption to receiving, transmitting, and processing of any type of information by any communications medium and protocol. Automated communications systems that represent embodiments of the present invention therefore provide a full crossbar-like interconnections between each and every communications medium, protocol, and device supported by the automated communications systems. As discussed below, it may be necessary for messages and other information received from a first communications medium according to a first protocol to be processed and adapted for transmission to a second communications medium according to a second protocol. This processing and adaptation may result in a loss of information, due to incompatibilities of certain devices, media, and protocols to transmit and/or receive certain types of messages and information. However, even when the content of a message cannot be forwarded from a first communications medium/device to a second communications device/medium, the fact that the information has been sent can generally be transmitted, so that a user or member is notified to receive the information on another of the user's compatible devices.

Figure 8B shows the systems services component 810 briefly mention with respect to Figure 8A. The systems services component 810 is a computational component that resides in, and executes on, one or more computational platforms, such as servers, distributed computer systems, and other such computational platforms. The system services component includes a routing-and-message-forwarding subsystem 830, a database and database interface 832, a number of application servers 834-837, and a management-and-configuration-services subsystem 840. All of these subsystems and application servers execute within an execution environment provided by one or more operating systems 842 that interface to one or more hardware platforms 844.

The database and database interface subsystem (832 in Figure 8B) contains a large amount of information with regard to organizations, the structures of organizations, members within organizations, communications media and devices, and many other types of stored information that allow for operation of the complex communications crossbar discussed above with reference to Figure 8A. Figure 9 illustrates certain types of stored data that represent organizations and organizational structures according to one embodiment of the present invention. The database contains one or more table entries or records for each organization for which intra-organizational communications is provided by the automated system, such as record 5 902. Similarly, the database contains records or table entries that represent groups of members within organizations, such as the group data structure 904 in Figure 9. Finally, each user or member of the organization for which communications are provided by the automated communications system is represented by a data structure, such as data structure 906 in Figure 9. These data structures, like those that represent 15 organizations and groups, may be composed of one or more records or a number of rows in various different relational-database tables. In addition, the database stores various mappings between these entities. A first mapping 908 can be implemented in the form of a table, each entry or row of which associates a group data structure with an organization data structure. For example, the first entry in the table 910 associates 20 the organization data structure 912 with group data structure 914. This first mapping table 908 thus associates each group data structure with an organization to which the group belongs. A second, similar mapping table 916 maps users to particular groups. There may be many additional such mapping tables. For example, an additional mapping table may directly map users to organizations, although this table is not 25 strictly necessary, since the same information may be obtained from mapping tables 908 and 916. Another mapping table 920 shown in Figure 9 maps groups to one another. This mapping table serves to organize groups into hierarchical group structures. In one implementation, each entry in the table, such as entry 922, represents a parent-child relationship between two groups. Entry 922, for example, 30 represents the fact that group data structure 914 is the parent of group data structure 924 in a hierarchy of groups.

Figure 10 illustrates, in more detail, the mapping of groups into group hierarchies within data stored in a database sub-system of an automated communications system that represents one embodiment of the present invention. In Figure 10, 19 group data structures are shown in a horizontal row of group data structures 1002 at the top of Figure 10, each group data structure including a numerical group number. Mapping table 1004 contains entries, each of which represents a parent-child relationship between two groups. The logical organization of groups into group hierarchies represented by the entries of the table 1004 is shown in a bottom row of group hierarchies 1006 in Figure 10. Thus, a first group hierarchy 1008 includes a broadest or root group 1010 composed of two subgroups 1012 and 1014, the latter of which is in turn composed of two subgroups 1016 and 1018, the latter of which contains an additional subgroup 1020. This hierarchical group structure is represented, in table 1004, by entries 1022-1026. Figure 11 illustrates hierarchical group structures that may be used to define complex structural features of an organization within data stored in a database sub-system of an automated communications system that represents one embodiment of the present invention. As shown in Figure 11, hierarchical group structures may be used to define complex structural features of an organization. Furthermore, these hierarchical groups structures may be modified, or evolve, over time. For example, in Figure 11, a first single-group group structure is formed that includes the set of members identified by the set of numerical member identifiers {1, 2, 10, 61, 84, and 85} 1102. Later, it may be decided to form two subgroups 1104 and 1106 within the group, and distribute a portion of the original members of the group between the subgroups and the highest-level group 1108. The highest-level group is considered to include all of the members explicitly associated with the highest-level group and any ancestor within the group hierarchy, as shown in set notation 1110 to the right of the highest-level group node. Addition of more members and a subgroup of one of the initial subgroups leads to the group hierarchy 1112 shown to the right of Figure 11. In alternative embodiments of the present invention, different types of group structures may be defined.

Creation, modification, and deletion of groups, as well as the addition and deletion of members from organizations, and many other such management and configuration tasks are carried out by the management-and-configuration-services subsystem (840 in Figure 8B). The management-and-configuration-services subsystem provides a management-and-configuration interface, through each of the various application servers, to users of the automated system to enable the users to create, modify, and delete members and groups of members with respect to the organizations to which they belong. In many communications systems that represent embodiments of the present invention, the particular management-and-configuration interface provided to a user may depend on access rights and privileges granted to the user by administrative or management users associated with organizations and groups within organizations. The application servers provide suitable formatting and presentation for each of the various types of communications-medium/device-type combinations supported by the automated communications system, as well as message-sending and message-receiving user interfaces that allow users to create and send various types of messages to individual users or groups of users within an organization.

An enormous advantage to organization to which communications services are provided by automated communications systems that represent embodiments of the present invention is that the information needed to transfer messages and information to each member of an organization are stored in a logically centralized database. This ameliorates and, in many cases, entirely removes the otherwise burdensome task of managing contact information and other information needed for exchange of information between members of an organization from the organization. The information is, of course, always available for inspection, editing, and other management operations through the management and configuration interfaces provided through various application servers to members of the organization by automated communications systems that represent embodiments of the present invention. An addition, the information can be largely entered into the system and updated as needed by individual members of the organization, rather than being collected from members and then entered by an administrator or other party.

Because of the rapidly changing nature of modern communications, individual members are best positioned to ensure that their contact and other information is entered and updated to provide efficient and effective information flow. Furthermore, by providing members with the ability to specify communications devices and various parameters and constraints associated with receiving information through them, an organization can avoid the often difficult task of establishing and enforcing relatively inflexible and burdensome policies on members of the organization, although automated communications systems that represent embodiments of the present invention do support specification and distribution of intra-organizational communications policies to members, when needed and desired.

Figure 12 illustrates portions of the fundamental data structures stored within the database and database-interface subsystem of an automated communications system that represents one embodiment of the present invention. Figure 12 provides an example user or member data structure 1202, an example group data structure 1204, and an example organization data structure 1206. These data structures may be composed one or more records or one or more different entries in one or more different relational tables within various different types of databases. The example data structure shown in Figure 12 is intended to illustrate only a portion of the various types of information that may be collected and stored for users, groups, and organizations. In Figure 12, for example, the user data structure includes many different types of information to characterize a particular user, including the user's name 1208, the number of roles and indication of the types of roles performed by the user within the organization 1210, the user's age 1214, the user's gender 1216, the number of certifications and indications of which certifications are held by the user 1218, the number of communications devices through which the user can receive and transmit information to other members of the organization 1220 and a detailed list of those devices, device types, their addresses, and other information regarding the communications devices used by the user 1222, an indication of the languages with which the user can communicate 1224, and the user's home address 1226. Clearly, these are only but a few examples of the many different types of information that can be collected and stored to characterize users or members of an organization, which

may additionally include one or more numeric identifiers for the user, various types of user preferences, and other such information. Similarly, a group may be associated with a group name 1230, a group type 1232, attributes that define the criteria for membership in the group 1234, a group sponsor 1236, the number of users with administrative privileges with respect to the group 1238, and various characteristics for information exchanged among group members 1240. Again, there are many additional types of information that can be collected and stored to characterize groups, including numeric group identifiers, various communications addresses associated with groups, and other such information. Similarly, an organization may be described by the organization's name 1250, address 1252, the service type provided by the communications system to the organization 1254, and many other different types of information.

The database and database-interface subsystem (832 in Figure 8B) additionally contains stored data that describes device types and the various types of communication media through which the automated communications system can receive and transmit messages and other information. Figure 13 illustrates additional device-type and communications-media information stored by the database and database-interface subsystem of an automated communication system that represents an embodiment of the present invention. As shown in Figure 13, the database and database-interface subsystem may include a data structure for each of the different types of communications devices and associated protocols supported by the system, such as device-type data structure 1302. Similarly, the database and database-interface subsystem of an automated communications system that represents an embodiment of the present invention may store data structures, each of which represents a receiver, transmitter, or transceiver for a communications medium included within the automated communications system, such as data structure 1304. In addition, the database and database-interface subsystem stores various mapping tables, such as a mapping table 1306 that maps device types to one another to indicate the device types that are compatible or can receive and transmit information to one another via the automated communications system and mapping table 1308 that associates device types and protocols with receivers, transmitters, and transceivers

and associated with communications media that can be accessed and used by the device types.

The database and database-interface subsystem (832 in Figure 8B) of the automated communications system that represents an embodiment of the present invention additionally stores log information describing information exchanges
5 between users as well as interaction of users with the configuration-and-management interfaces provided to users by the automated communications system. The management-and-configuration subsystem provides, through each of various application services, an interface to appropriately privileged users to allow the users
10 to search for, list, and view the contents of historical records of the messages transmitted from one user to another, as well as the commands issued by users to the configuration and management subsystem. Unlike in many organizations today, the automated communications system that represents an embodiment of the present invention therefore provides a detailed record of intra-organizational information
15 transfer and communications regardless of which communications media and communications devices the information was transferred through. This logging feature can be used to recover lost information, verify information transmission at subsequent points in time, and provide useful records for various regulatory management activities within the organization.

20 There are many different ways by which the automated communications system that represent embodiments of the present invention can be accessed by users. In many embodiments of the present invention, simple, efficient, and low-overhead methods are used for routing messages from user devices into the automated communications system. Figure 14 illustrates a hierarchical group
25 structure for an organization for which intra-organizational communications is provided by an embodiment of the present invention along with an associated addressing scheme that allows users to transmit messages and other information into the automated communications system for distribution by the automated communications system to other members of the organization. In Figure 14, the
30 structural organization for company ABC is shown, including a root node 1402, or overall group, and a variety of hierarchically arranged subgroups. In Figure 14, an

email address that can be used by a user to send an email to all of the members of a particular group or subgroups is shown above each node in the hierarchical group structure. In this scheme, like pathnames for files within a hierarchical file system, a particular group or subgroup is specified by a list of subgroup and group names, separated by "." characters, in lowest-level-to-highest-level order, representing a path to the particular group or subgroup in the hierarchical structure. A user need not remember all of these group names, but may instead employ a suitable application-server interface, displayed on the user's device, to view a hierarchical representation of the groups within an organization and select a particular group to which to send a next message. The appropriate email address is then entered as the "To:" address in the email message by the application server. Similar organization and group addressing schemes are used for each of the various other types of communications media and devices supported by an automated communications service that represents an embodiment of the present invention. For an example, various groups and subgroups within an organization may be associated with different telephone numbers which a user can call, either directly or through an application-server interface, to distribute voice mails to the members of the group.

Figures 15A-B illustrate two different operational modes for automated communications systems that represent embodiments of the present invention. As shown in Figure 15A, the automated communications system, including the queue-based communications crossbar and services system shown in Figures 8A-B, can reside as a component within a mobile-operator network or mobile-operator networks to provide intra-organizational communications through ISPs and a mobile-operator network interface. Alternatively, as shown in Figure 15B, the automated intra-organizational communications system that represent embodiments of the present invention may be separate, stand-alone entities and businesses 1510 that provide intra-organizational communications services directly to ISPs and to mobile-operator networks to which user's devices are connected.

Figure 16 illustrates a typical hardware platform for an automated communications service that represents an embodiment of the present invention. The platform includes the various transmitters, receivers, and transceivers 1602-1604 for

the communications media 1606-1608 supported by the automated communications system. Messages received by these transceivers are transmitted, via a local area network 1610, to servers or other computational platforms 1612-1614 on which the queue-based crossbar system and services components are implemented.

5 Figure 17 illustrates a distributed automated communications system that represents an embodiment of the present invention. As shown in Figure 17, incoming and outgoing messages may be received and transmitted by a number of proxy servers 1702-1704 that forward messages and receive messages, through load-balancing nodes 1706 and 1708, to geographically separate clusters of application
10 servers 1710 and 1712 and geographically separate clustered database engines 1714 and 1716.

Next, control-flow diagrams are provided to illustrate the functionality embodied in each of the major subsystems of an automated communications system that represents an embodiment of the present invention, shown in Figures 8A-B.
15 Figure 18 provides a control-flow diagram for the input-processing subsystem of an automated communications system that represents an embodiment of the present invention. The input-processing subsystem is generally implemented as a continuous loop in which the input-processing subsystem waits, in step 1802, for a next input event. Input events include notification of reception and queuing of new messages
20 from any of the various different communications media and associated transceivers through which the automated communications system receives information from users. When such an event occurs, the input-processing subsystem accesses each input queue in the *for*-loop of steps 1804-1812. For each input queue, the input-processing subsystem handles each message queued to the input queue in the inner
25 *while*-loop of steps 1805-1811. For each message queued to a currently considered input queue, the input-processing subsystem dequeues the message from the queue in step 1806 and calls the routing-and-message-forwarding subsystem (830 in Figure 8B) to process the message. The routing and message-forward subsystem responds with a list of or more reply and/or forwarding messages corresponding to the received
30 message, which the input-processing subsystem processes in the innermost *for*-loop of steps 1808-1810. For each message in the list of reply and/or forwarding

messages, the input-processing subsystem queues the message to an appropriate internal message queue (1812-1814 in Figure 8A). There may be many internal message queues in an automated communications system in order to geographically distribute message-queue-based processing and/or in order to partition outgoing
5 messages in various ways, including according to time to transmission, according to the general class of communications media to which the message are to be transmitted, and according to various other criteria. Thus, the input-processing subsystem is responsible for managing incoming messages and calling the system services subsystem to generate appropriate reply and/or forwarding messages
10 corresponding to input messages that the input-processing subsystem then queues to the message queues for delivery to users.

Figure 19 provides a control-flow diagram for the routing-and-message-forwarding subsystem of the system services component of an automated communications system that represents an embodiment of the present invention. In
15 step 1902, the routing-and-message-forwarding subsystem receives a next message from the input-processing subsystem (808 in Figure 8A). In step 1904, the routing-and-message-forwarding subsystem accesses the database (832 in Figure 8B) in order to authorize the user from which the message was received and verify that the group or recipient to which the message is addressed exists, that the user is authorized to
20 send messages to the group or recipient, and to carry out other authorization and verification tasks. When the user is not authorized to send messages within the organization, when the group or recipient cannot be verified, or when other such errors are detected, in step 1906, then the routing-and-message-forwarding subsystem invokes any of various different types of error-handling procedures 1908. These may
25 include logging the unauthorized attempt to access the automated communications system and returning some type of error message to the sender of the message. Next, in step 1908, the routing-and-message-forwarding subsystem determines whether or not the message is intended to be forwarded to other users of the organization, in which case a routing routine 1910 is called to return a list of forwarding messages to
30 the input-processing subsystem in step 1912, and, when the message is instead directed to an application server as part of requesting or responding to a management

or configuration interface provided by the management-and-configuration service subsystem (840 in Figure 8B), the routing-and-message-forwarding subsystem forwards the message to the appropriate application server in step 1914 (834-837 in Figure 8B) and returns any response received from the application server, in step 5 1916, to the input-processing subsystem in step 1918.

Figure 20 is a control-flow diagram for the routing routine called in step 1910 of Figure 19 according to one embodiment of the present invention. The routing routine first determines the group to which the message is to be sent, in step 2002. Then, in the *for*-loop of steps 2004-2013, the routing routine prepares a 10 message for forwarding to each user in the group to which the sender of the message intends the message to be forwarded. In step 2005, the routing routine determines the set of devices to which the message can be forwarded for the currently considered user or member. This set of devices may be, for example, all devices owned by the member, as determined from a member data structure accessed from the database, 15 which are compatible with the device and/or communications medium from which the initial message was received by the automated communications system. Then, in an inner *for*-loop of steps 2006-2008, the routing routine applies one or more filters to the initial set of devices in order to select one or a few devices for the recipient user to which the message can be forwarded. These filters correspond to the many different 20 types of considerations discussed above with reference to Figures 5 and 6. For example, one filter may incorporate the time-of-day information for the user and the user's devices, as illustrated in Figure 5. Other filters may incorporate many other considerations, such as the type of information that is being sent, the location of the recipient, date, and many other such considerations. The filters may be implemented 25 as a set of logic propositions, complex decision trees, or in many other ways. Once the initial list of devices has been filtered to produce a final list of devices for the user, then, in the *for*-loop of steps 2009-2012, the routing routine prepares a message for each device of the recipient, including indications of the appropriate transmitter and message queue for queuing the message and adds the message to a list of 30 messages. When messages have been prepared for all devices of all users, then the

entire list of messages is returned to the routing-and-message-forwarding subsystem in step 2016.

Figure 21 provides a control-diagram for the post-processing subsystem of an automated communications system that represents one embodiment of the present invention. The post-processing subsystem, 816 in Figure 8A, dequeues messages from the message queues for queuing to individual transmitter queues associated with transmitters or transceivers. In the outer *for*-loop of steps 2102-2111, the post-processing subsystem continuously examines each of the internal message queues. In the inner *for*-loop of steps 2103-2110, the post-processing subsystem dequeues all messages ready for forwarding or transmission from the currently considered message queue. In step 2104, the post-processing subsystem dequeues the next message from the currently considered message queue and determines whether or not any translation is required for the message. If translation is needed, as determined in step 2105, the message is translated in step 2106 in a way appropriate for the type of device, communications medium, group, and recipient to which the message is to be transmitted. In step 2107, the post-processing subsystem determines whether any attachments need to be attached or appended to the message and, if so, adds or appends the appropriate attachments in step 2108. In step 2109, the post-processing subsystem queues the final, translated and completely post-processed message to the appropriate transmitter queue.

Automated communications systems that represent embodiments of the present invention provide a wealth of different types of features, functionalities, and services to the members of an organization. As one example, information sent by a user to a group of users can be translated and processed, according to various criteria and considerations, prior to being forwarded to the users of the group. For example, text messages contained in email sent by one user to the members of a group can be reformatted, abbreviated, or otherwise processed to allow the message to be sent to communications devices, such as to mobile phones, with limited text-display capabilities or even via instant messaging services. This type of processing may also involve translating a message from one language to another, selecting only portions of the message suitable for each recipient, and many other types of

translation and processing tasks. The automated communications system may carry out a complex set of operations and considerations to optimize information transmission. For example, when the urgency for message delivery to members of the group is relatively low, the automated communications system may delay message
5 transmission to certain recipients in order to take advantage of favorable communications rates or device availabilities with respect to particular recipients. The automated communications system that represents an embodiment of the present invention may similarly optimize message forwarding with respect to many different considerations, including selecting the most effective device or devices to reach a
10 particular user on a particular date, at a particular time of day, or with regard to many other constraints and considerations. Incorporation of multiple application servers within the system-services subcomponent of the automated communications systems allows for feature-rich, flexible management-and-configuration interfaces to be displayed to users on each of the various different types of communications devices to
15 which the user selects to access the management and configuration services.

Although the present invention has been described in terms of particular embodiments, it is not intended that the invention be limited to these embodiments. Modifications will be apparent to those skilled in the art. For example, automated communications systems that represent embodiments of the
20 present invention may be implemented in many different ways by varying any of many different implementation parameters, including programming languages, control structures, modular organization, data structures, operating-system platforms, and hardware platforms. Any of many different types of communications addressing and communications-direction schemes can be
25 employed to direct messages from users into the automated communications systems, such as the hierarchical email-address scheme discussed with reference to Figure 14. Automated communication systems that represent embodiments of the present invention can be adapted to distribute information and facilitate exchange of information by members of an organization over a wide variety of different types of
30 communications media and through many different types of communications devices. In general, the automated communications systems that represent

embodiments of the present invention are implemented in a highly modular fashion to allow for straightforward addition of communications-medium support and communications-device support for new types of communications media and devices.

- 5 The foregoing description, for purposes of explanation, used specific nomenclature to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that the specific details are not required in order to practice the invention. The foregoing descriptions of specific embodiments of the present invention are presented for purpose of illustration and description.
- 10 They are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments are shown and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various
- 15 modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents:

CLAIMS

1. An automated communications system comprising:
 - an input-processing subsystem that
 - processes the messages received from receiving components that each receives messages from a communications medium by
 - forwarding each message directed to a management-and-configuration interface to a routing-and-message-forwarding component that returns a corresponding message, and
 - forwarding each message directed to a group to the routing-and-message-forwarding component which returns a corresponding message for each member of the group, and
 - queues the one or more corresponding messages to one or more internal queues; and
 - a post-processing subsystem that
 - dequeues messages from the one or more internal message queues,
 - processes each message dequeued messages from the one or more internal message queues to generate one or more processed messages, and
 - forwards the one or more processed messages to sending components that each sends processed messages to a communications medium.
2. The automated communications system of claim 1 wherein the receiving components and sending components include:
 - SMTP servers connected to the Internet;
 - voice-communications servers and modems connected to public switched telephone networks;
 - XMPP servers connected to the Internet;
 - SMPP servers connected to the Internet;
 - HTTP servers connected to the Internet;
 - TCP/IP servers connected to the Internet; and

other types of message-receiving servers interconnected to wireless communications receivers, LAN devices, and other appropriate communications media.

3. The automated communications system of claim 1 further including a system-services component, implemented on one or more computing platforms, that includes:

a database and database interface;

application servers that each provides management, configuration, message-sending, and message-receiving user interfaces on one or more types of communications devices;

the routing-and-message-forwarding subsystem that receives messages from the input-processing component and returns corresponding messages to the input-processing by

forwarding each received message directed to a management-and-configuration interface to an application server that interacts with a management-and-configuration subsystem to return a corresponding message, and

accessing the database through the database interface to determine members of a group to which a received message directed to a group to return a corresponding message for each member of the group; and

a management-and-configuration subsystem that provides management and configuration services through applications-server-provided user interfaces to communications devices.

4. The automated communications system of claim 3 wherein the database stores data structures representing:

each organization for which intra-organization communications services are provided by the automated communications system;

each group of members defined for an organization to which messages can be sent by members of the organization; and

each member of an organization who receives and/or sends messages to other members of the organization through the automated communications system.

5. The automated communications system of claim 4 wherein the database additionally stores mappings that map:

groups to organizations;
members to groups; and
groups to nodes of a hierarchical group structure.

6. The automated communications system of claim 3 wherein the database additionally stores data structures representing:

each type of communications device and protocol through which a member of an organization receives and/or sends messages to other members of the organization through the automated communications system; and

each receiving and sending component of the automated communications system.

7. The automated communications system of claim 6 wherein the database additionally stores mappings that map:

each communications device to one or more receiving-and-sending components; and

each type of communications device and protocol to other types of communications devices and protocols with which messages and other information can be exchanged.

8. The automated communications system of claim 3 wherein the management-and-configuration subsystem provides management facilities that allow an authorized user to:

create a group of members of an organization;

add members of an organization to a group;

delete members of an organization from a group;

add a subgroup to a group;

remove a subgroup from a group;

delete a group;

edit information stored in the database that describes an organization; and

edit information stored in the database that describes a member of an organization.

9. The automated communications system of claim 3 wherein the management-and-configuration subsystem provides configuration facilities that allow an authorized user to:

add message-receiving and message-sending components to the automated communications system;

delete message-receiving and message-sending components from the automated communications system;

launch system services, including various types and levels of logging and error handling;

remove system services; and

specify operational parameters of the automated communications system.

10. The automated communications system of claim 3 wherein the routing-and-message-forwarding subsystem, upon receiving a message from the input-processing component, accesses the database through the database interface to:

authorize and verify the user from which the message was received; and

verify the group or management-and-configuration interface to which the message is directed.

11. The automated communications system of claim 3 wherein the routing-and-message-forwarding subsystem, upon receiving a message directed to a group:

determines the members of the group by the database through the database interface;

for each member,

determines an initial set of communications devices and protocols to which the received message can be forwarded,

applies one or more types of considerations to successively remove sub-optimal communications devices and protocols from the initial set of communications devices and protocols, and

prepares a corresponding message for each communications device and protocol remaining in the set of communications devices and protocols.

12. The automated communications system of claim 3 wherein the one or more types of considerations include whether a communications device and protocol:

is available at particular times of the day;

- can be used to deliver the message on a particular date;
- can render information included in, or attached to, the received message; and
- can receive the message in a particular location.

13. The automated communications system of claim 1 wherein post-processing subsystem processes each message dequeued messages from the one or more internal message queues to generate one or more processed messages by one or more of:

- translating information in the message to a form that can be rendered by the communications device and protocol to which the message is directed;
- attaching information to the message;
- translating text within the message to a different natural language; and
- selecting only portions of the message to transmit.

14. The automated communications system of claim 1 wherein post-processing subsystem dequeues a message from the one or more internal message queues at a time that allows the message to be delivered in a cost-effective manner.

15. The automated communications system of claim 1 wherein each internal message queue contains messages that are to be transmitted over different time ranges.

16. The automated communications system of claim 1 wherein each internal message queue is located in a different component automates communications system of a distributed automated communications system.

17. The automated communications system of claim 1 to which messages can be sent and from which messages can be received in the form of:

- text-based email messages;
- voice messages;
- MMS messages;
- XML-encoded documents and messages;
- MIME emails;

instant-messaging messages; and
telemetry communications between various types of devices and systems via M2M communications.

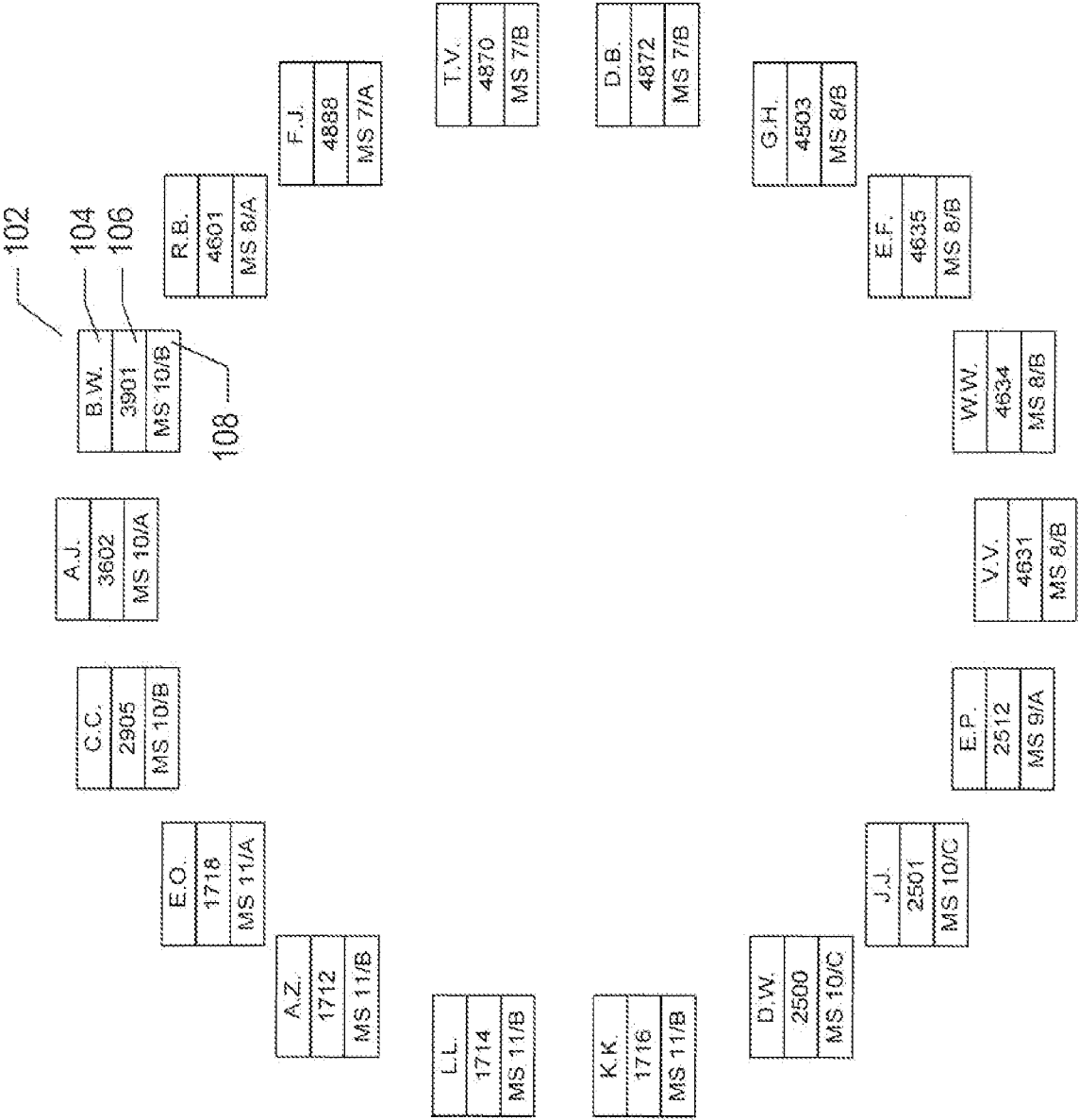


FIG. 1

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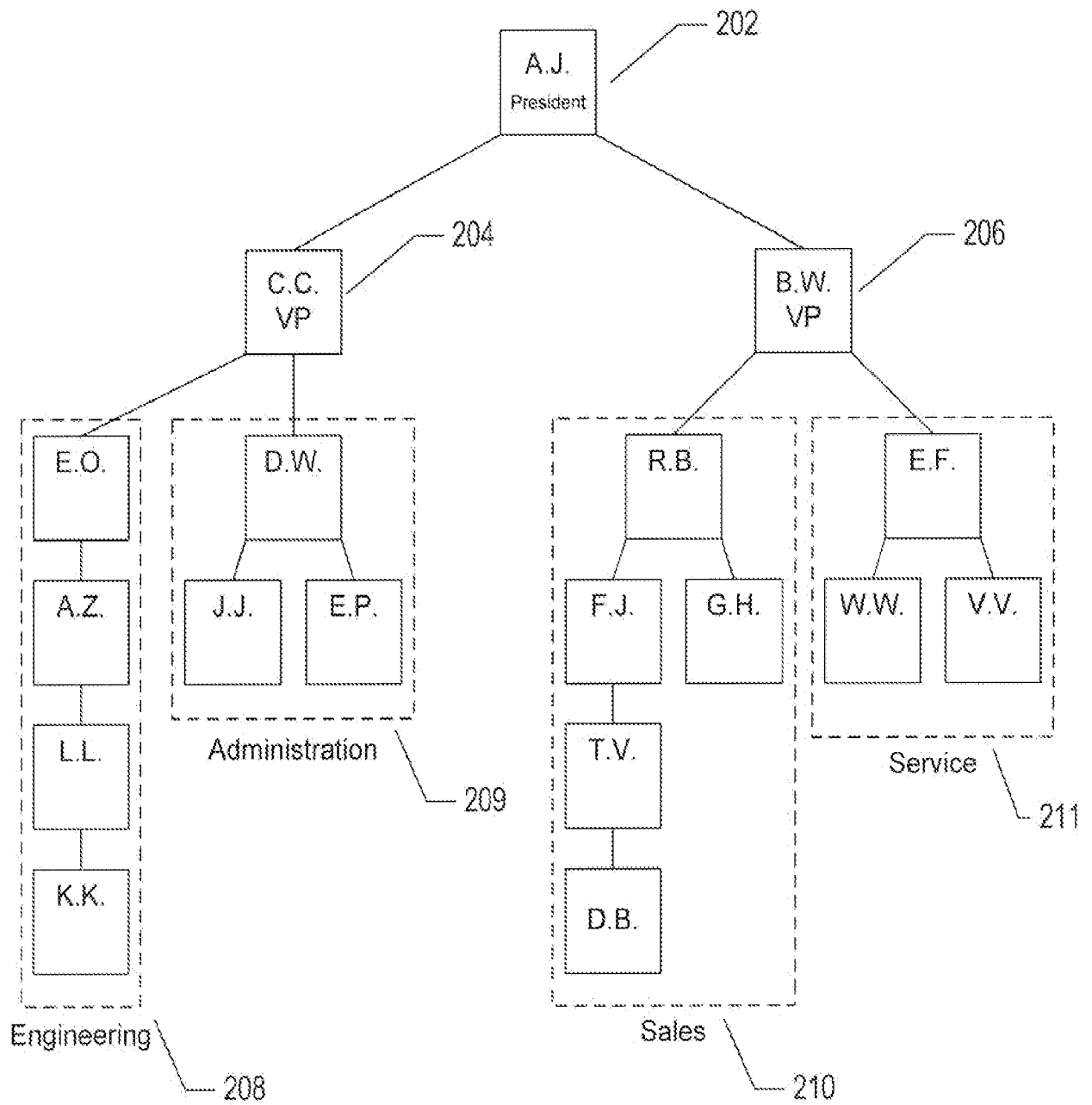


FIG. 2

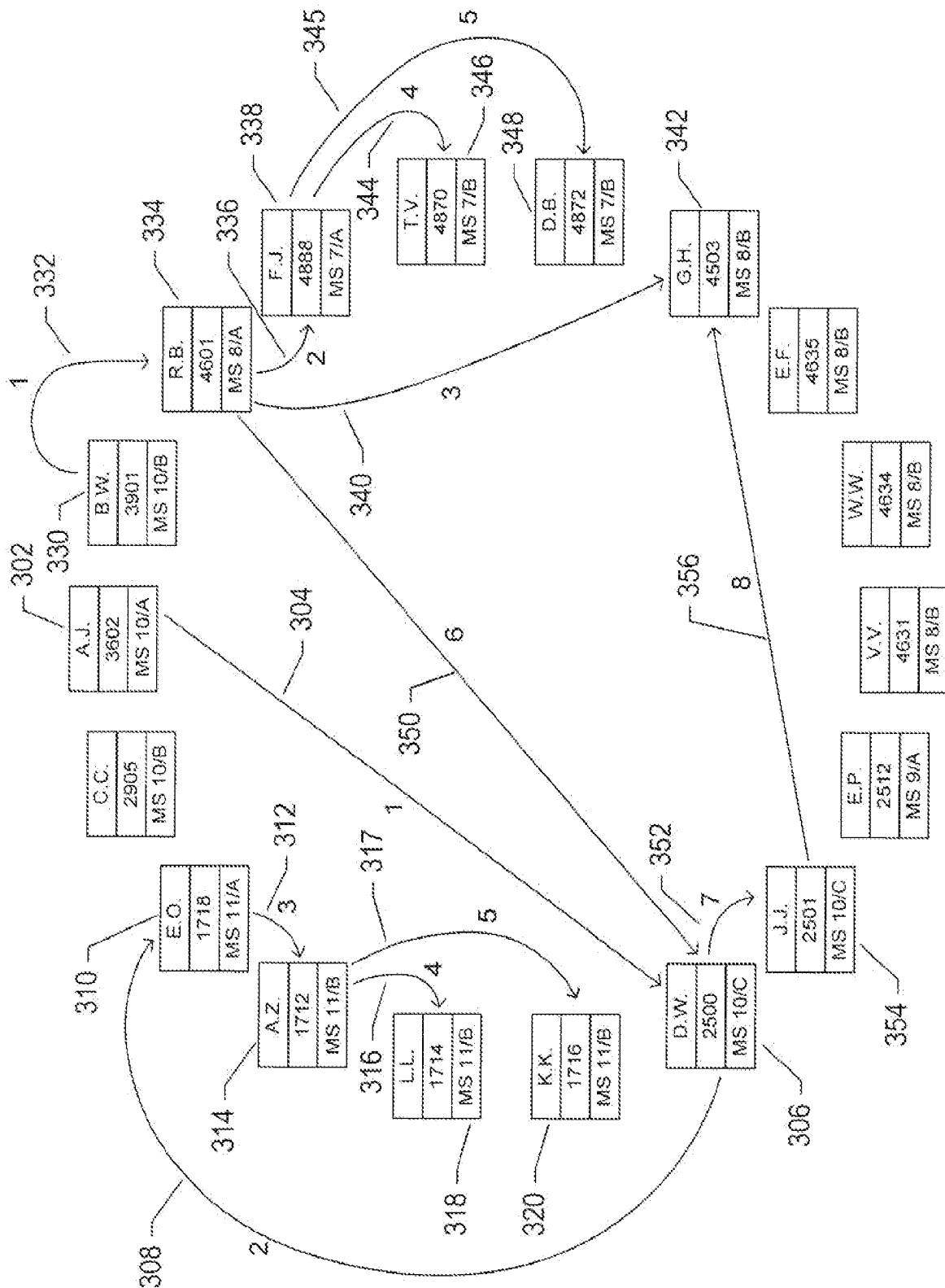


FIG. 3

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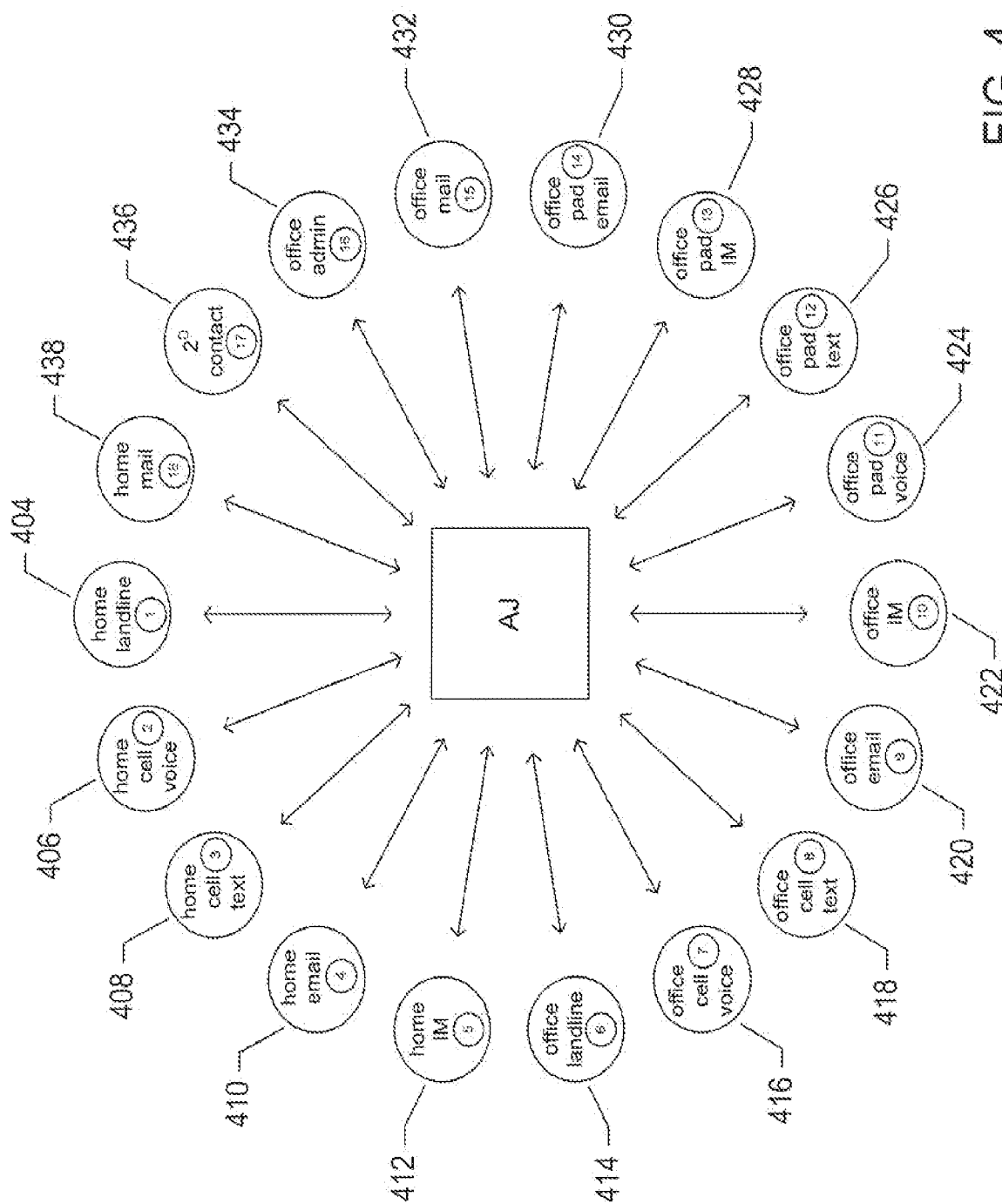


FIG. 4

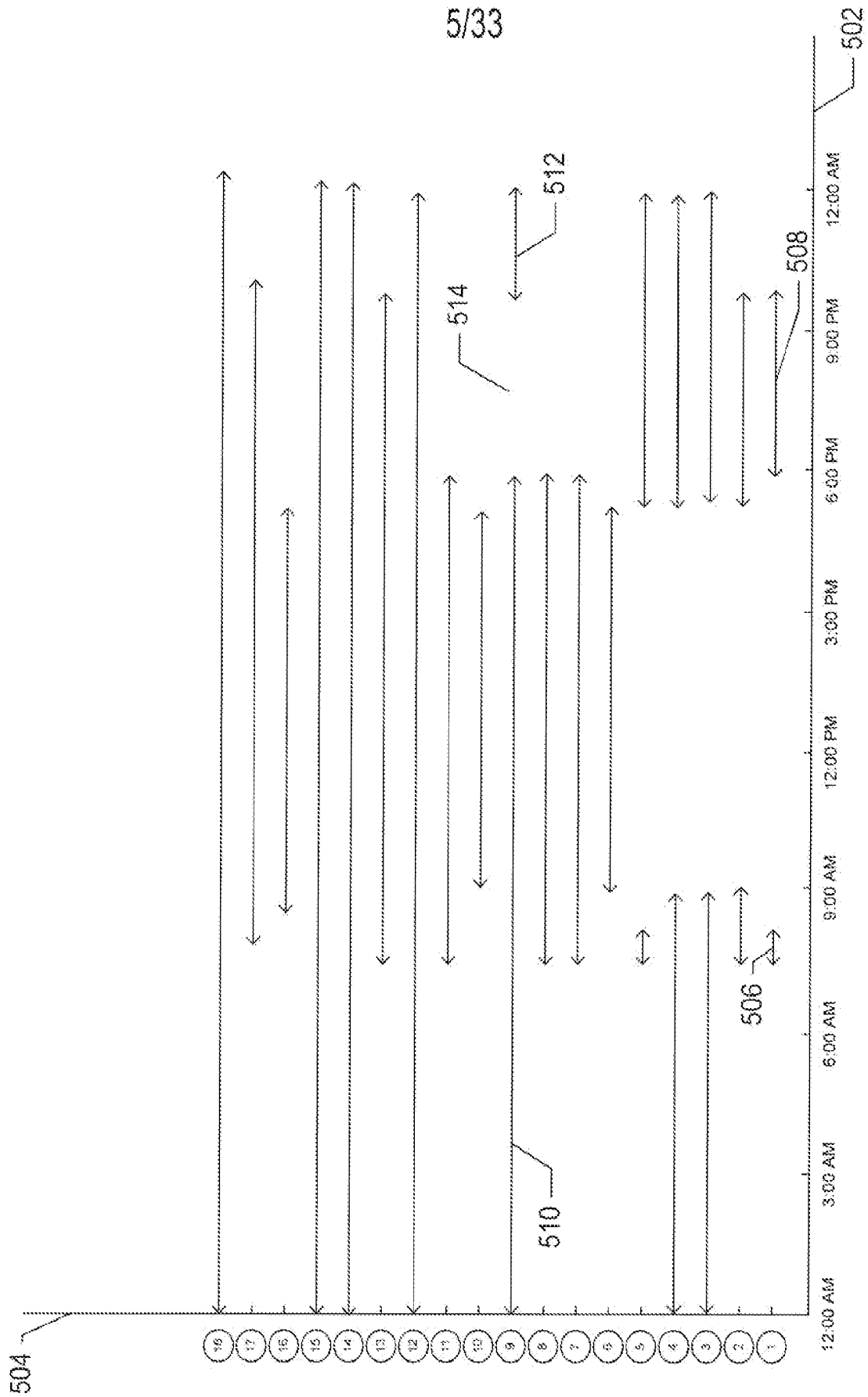
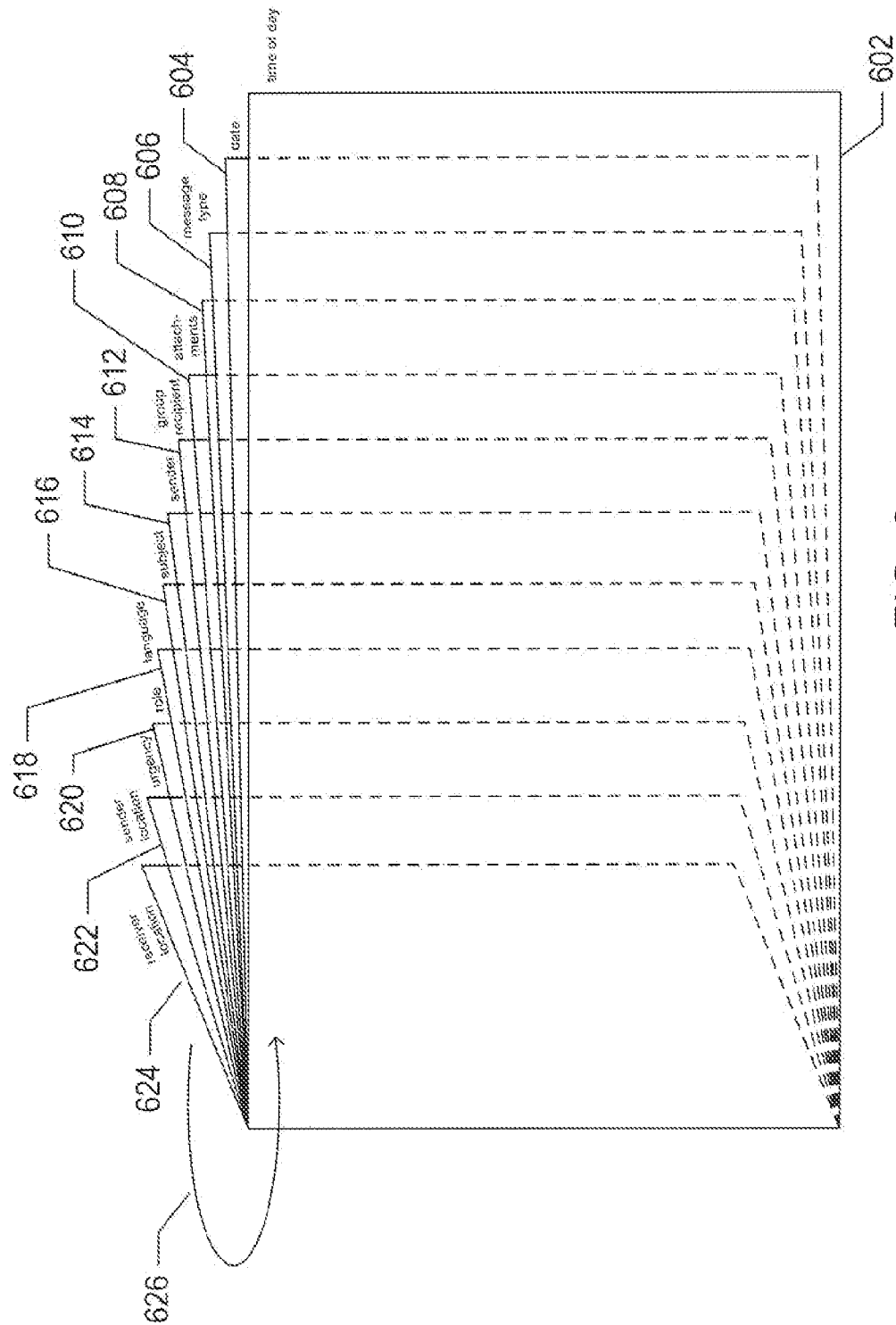


FIG. 5



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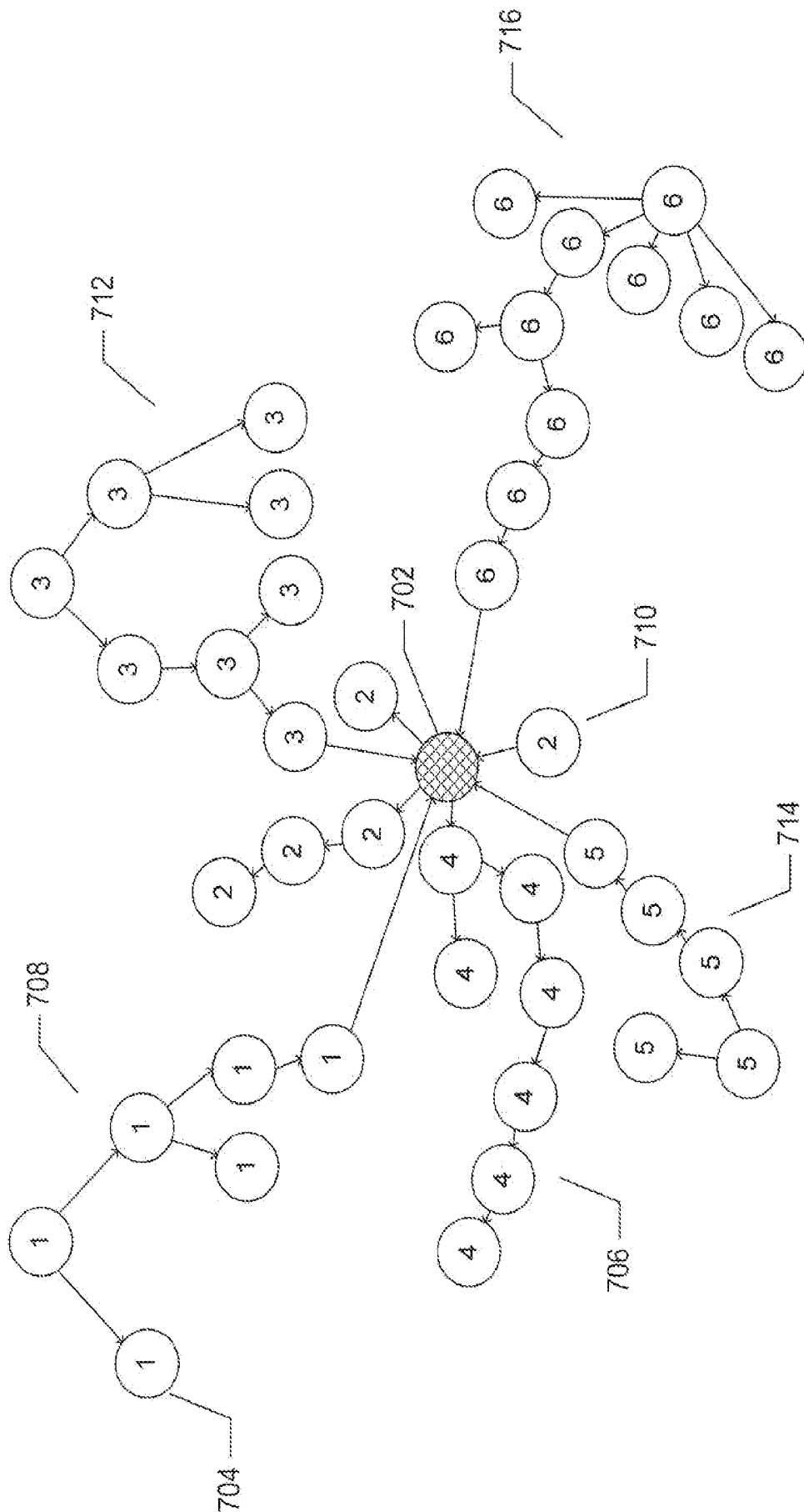


FIG. 7

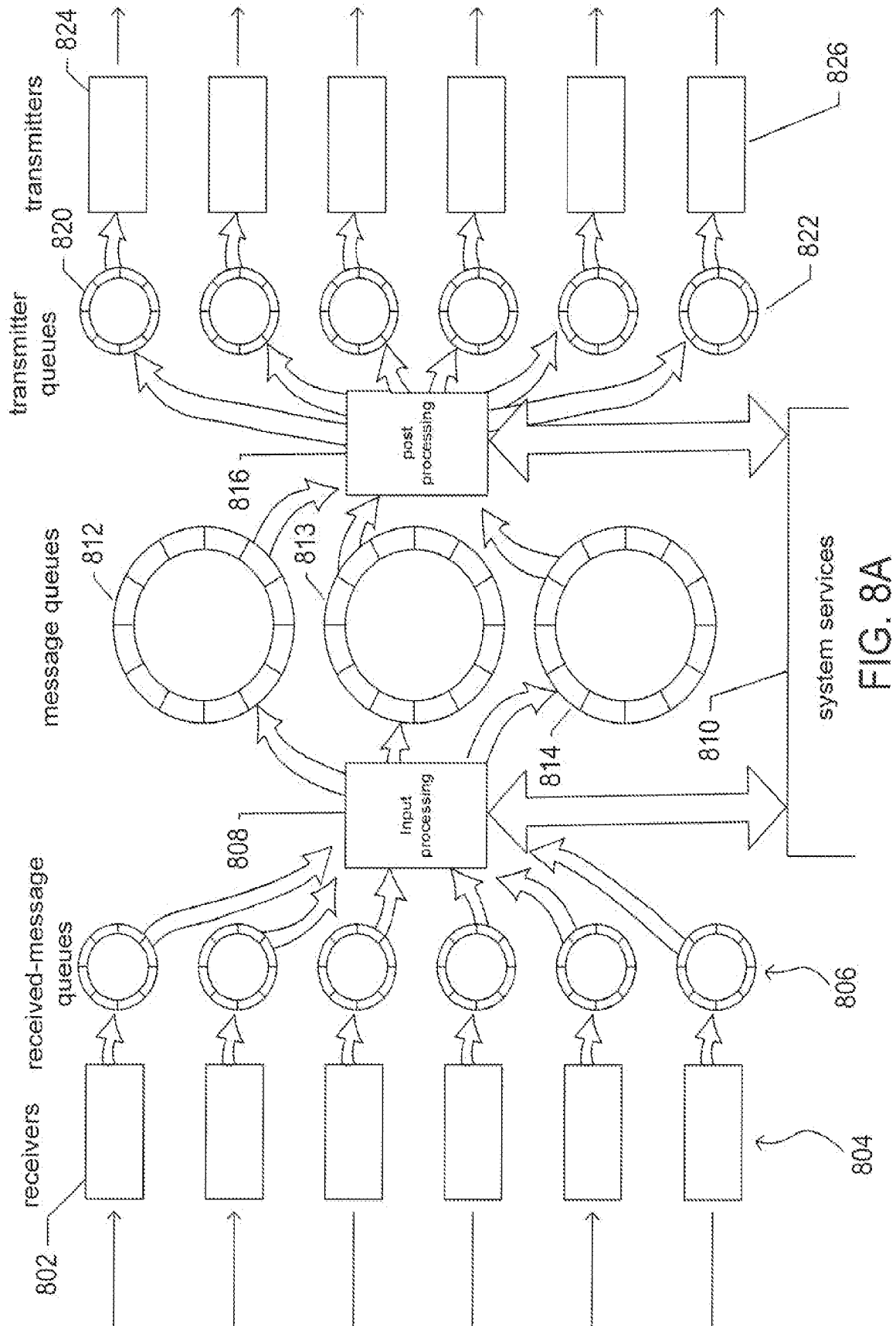


FIG. 8A

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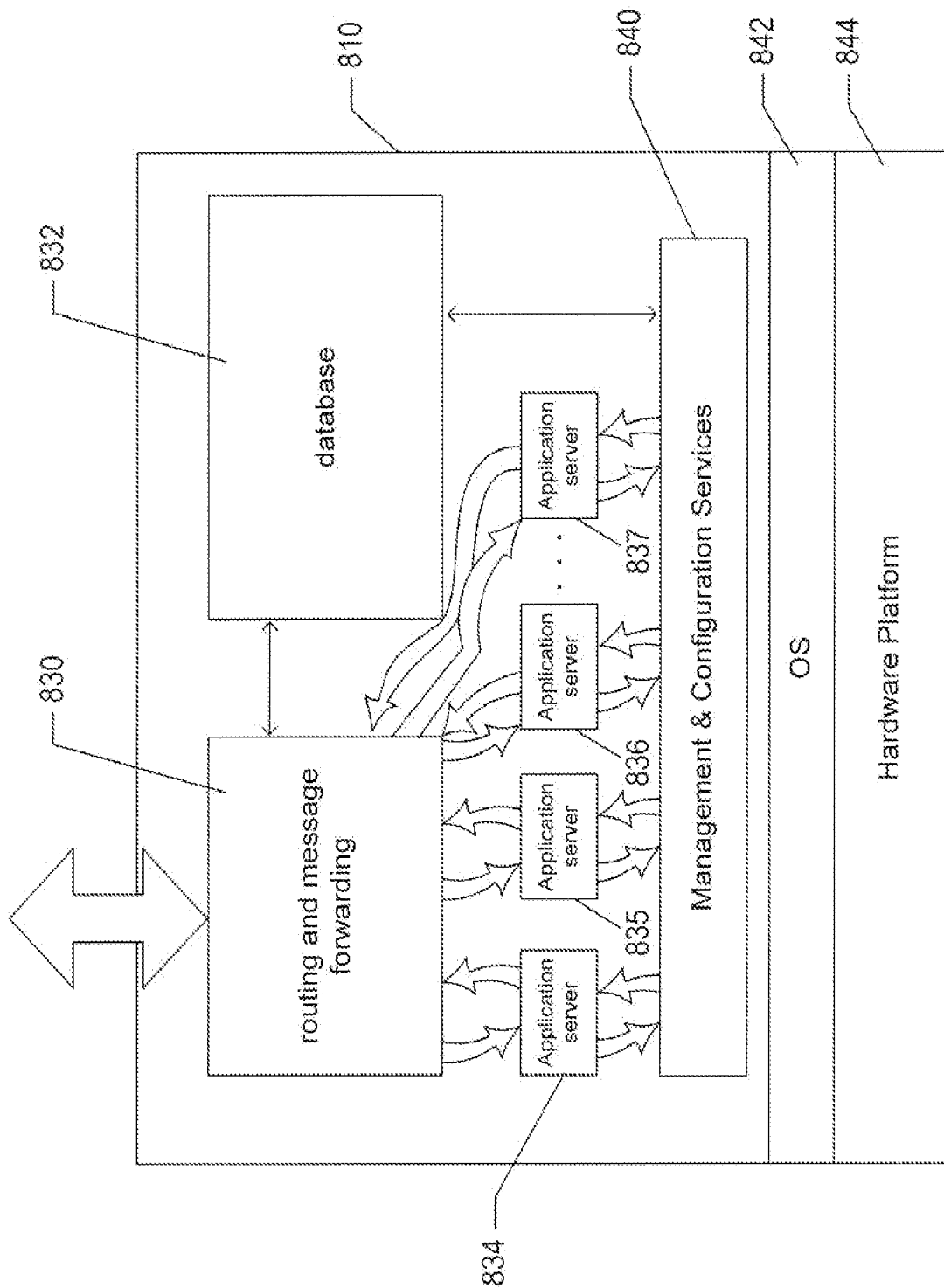


FIG. 8B

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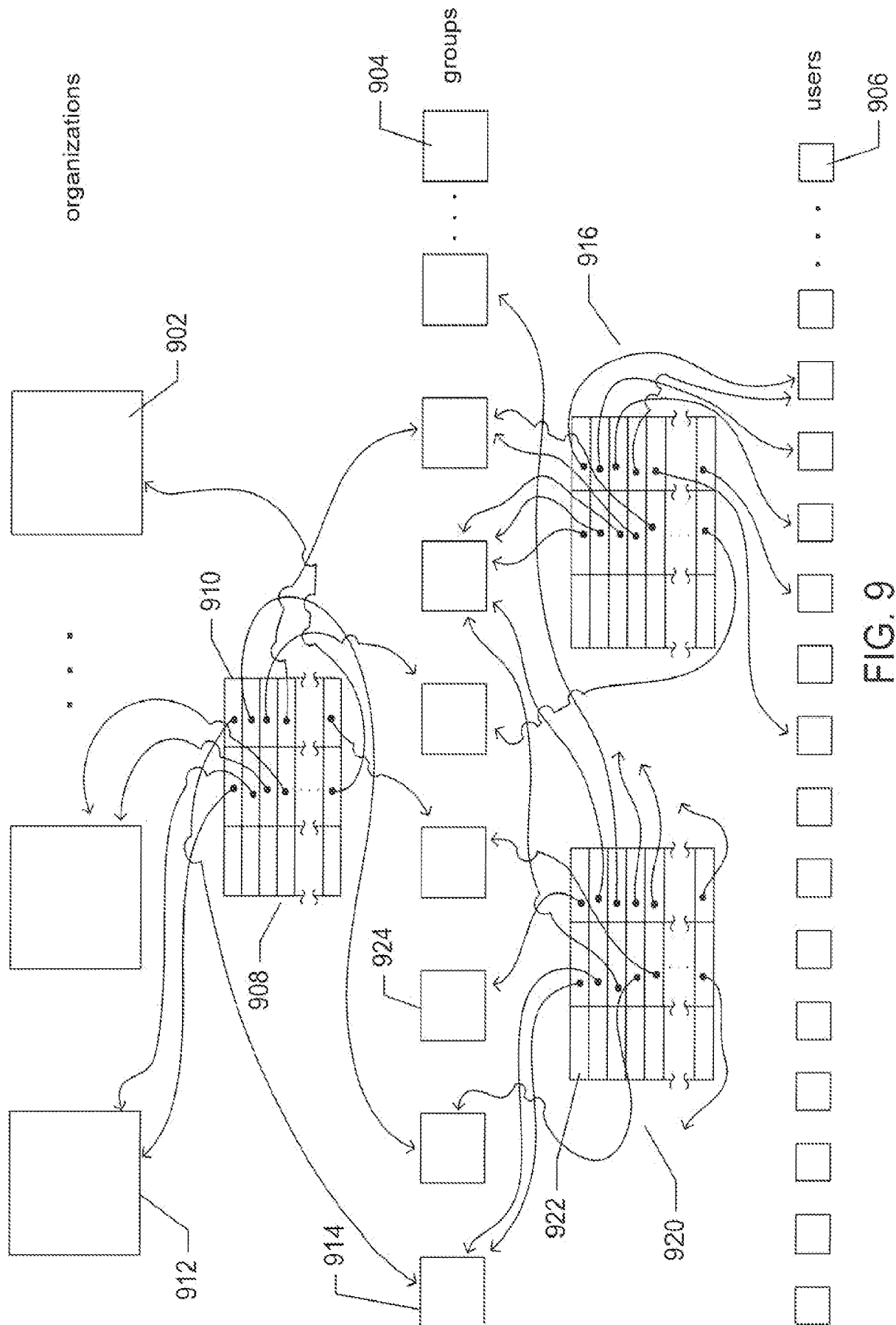


FIG. 9

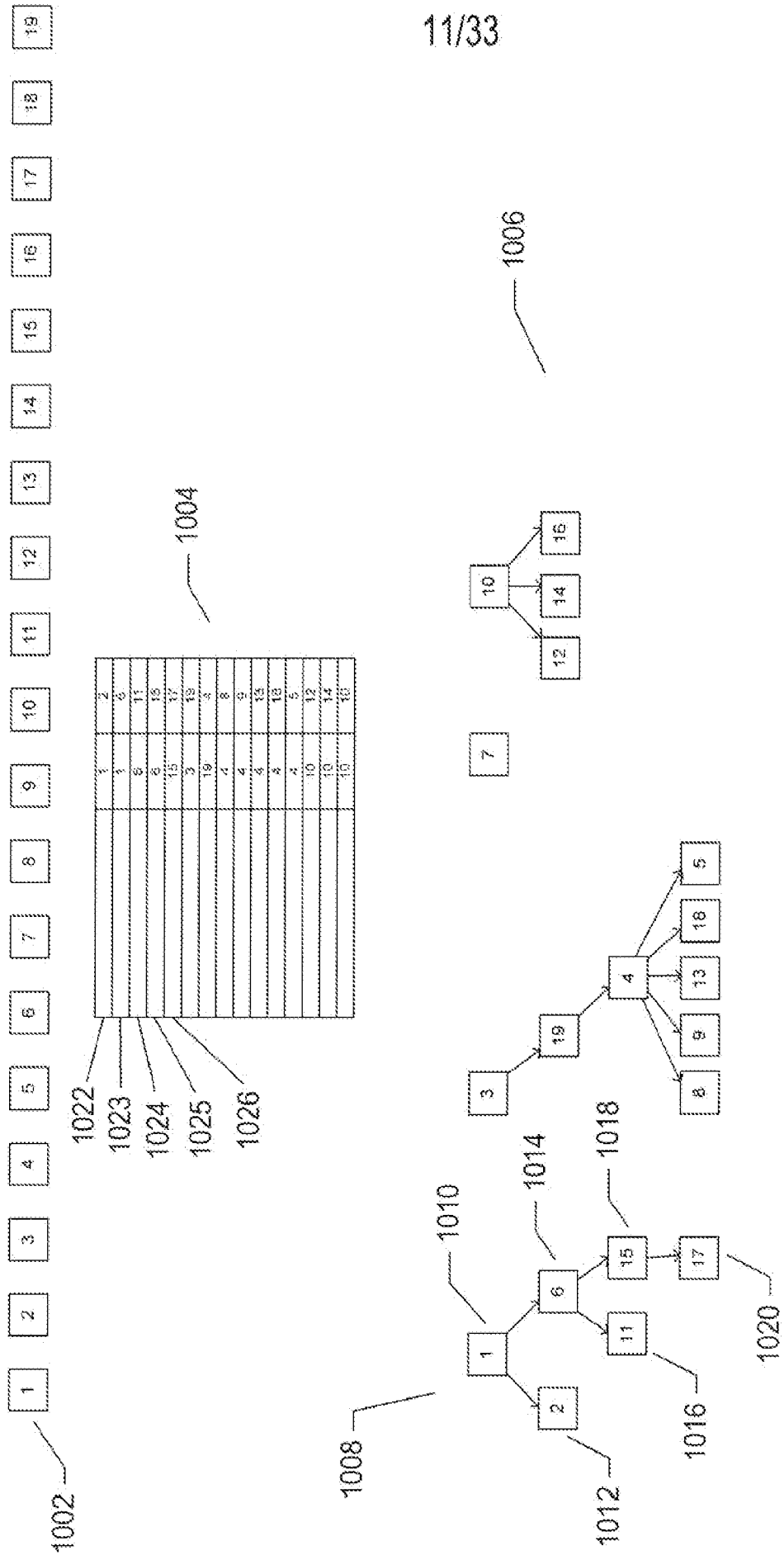


FIG. 10

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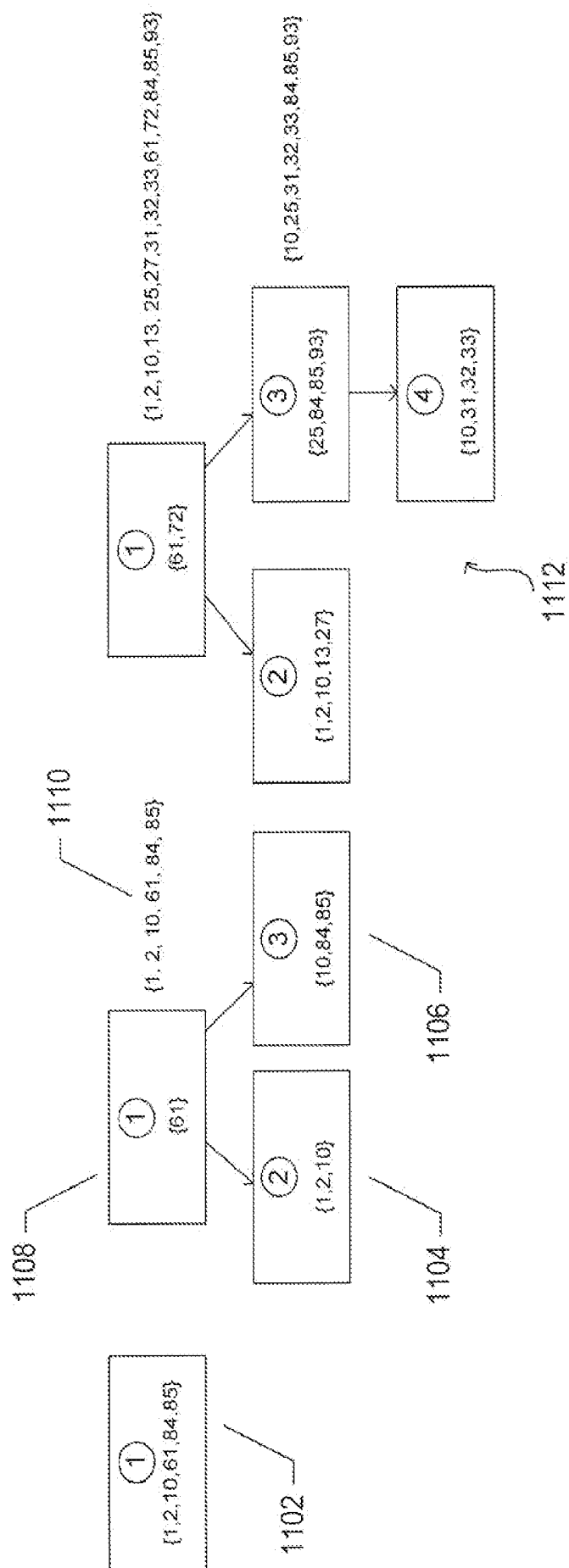
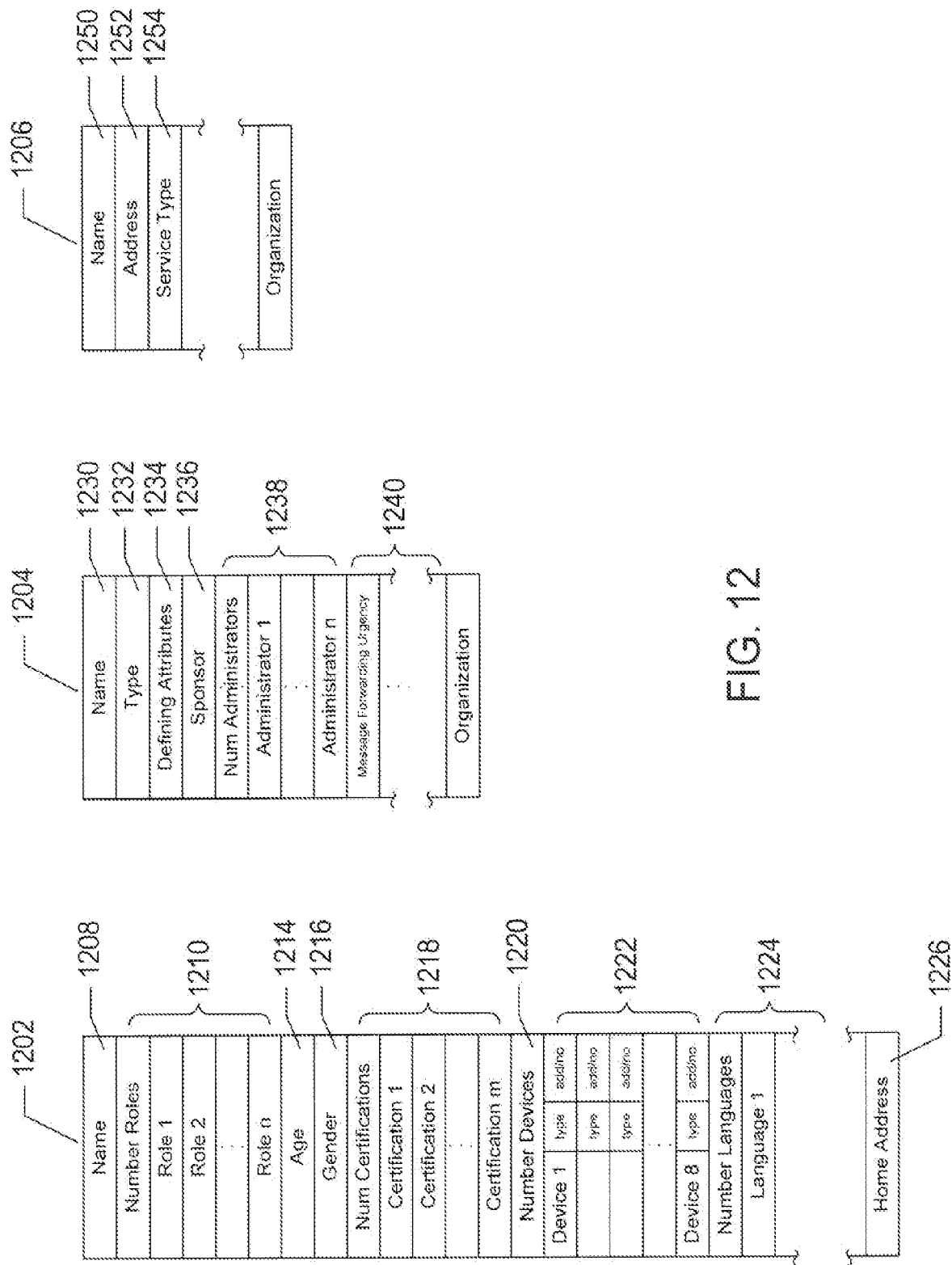


FIG. 11



14/33

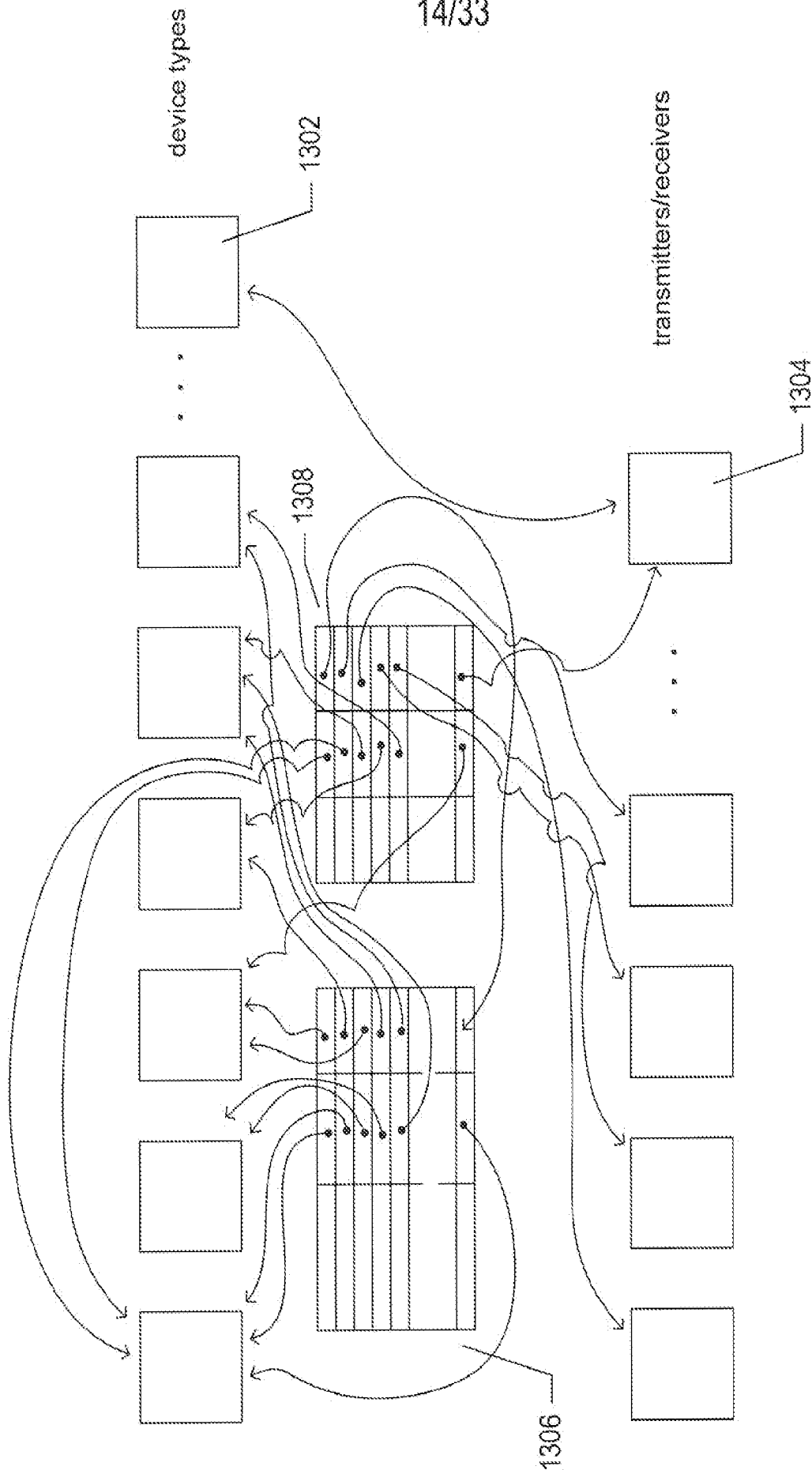


FIG. 13

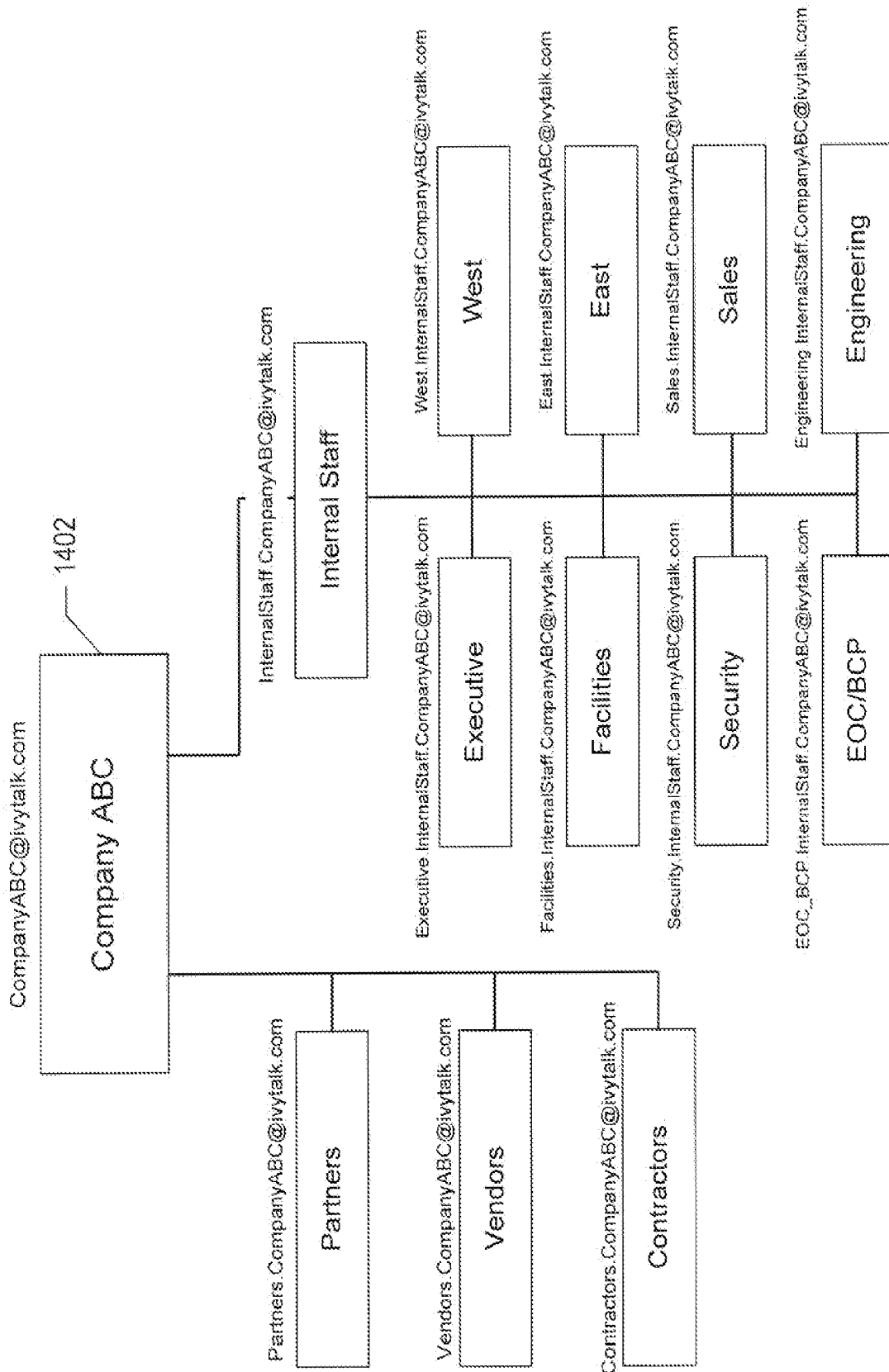
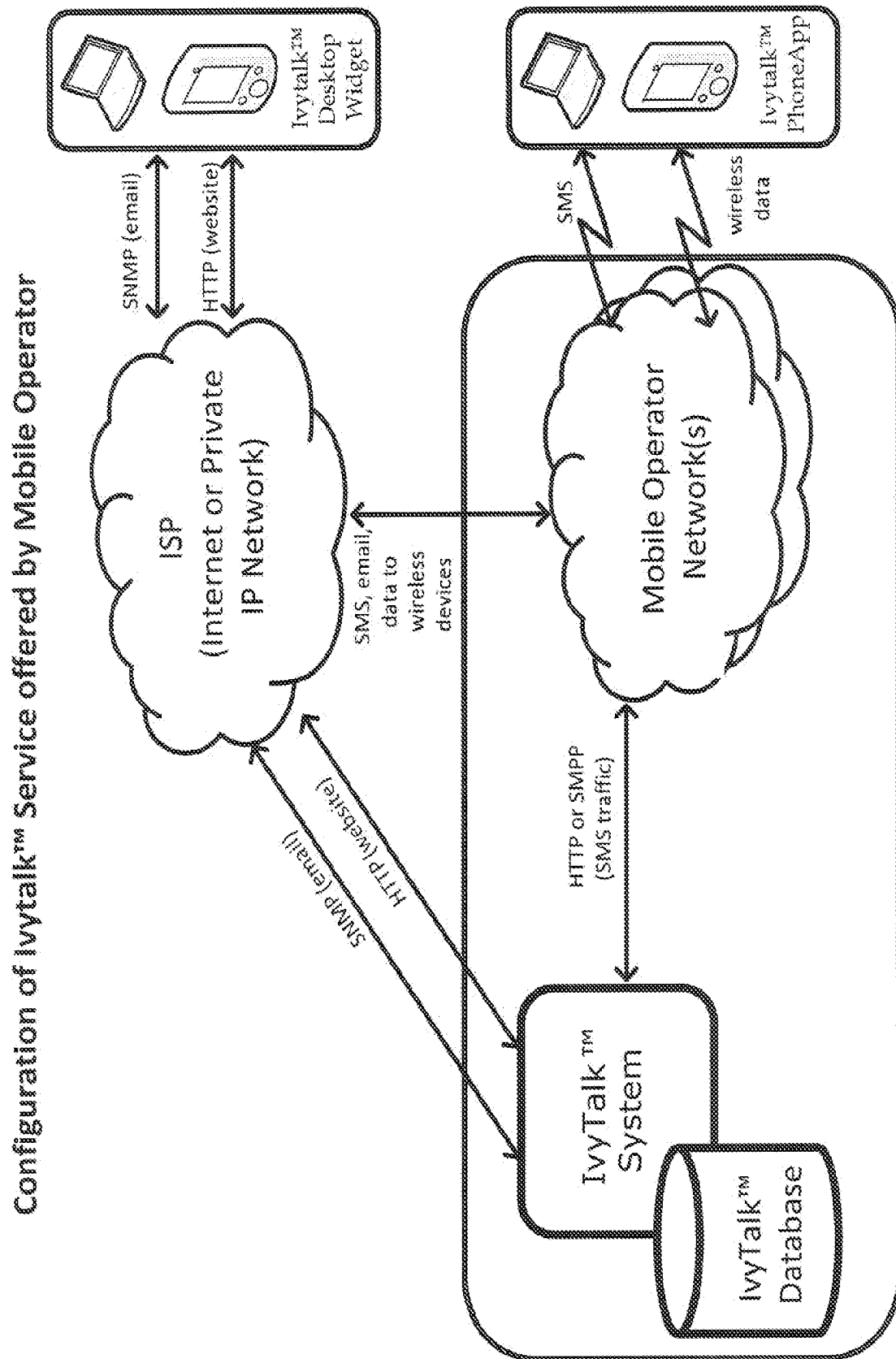


FIG. 14

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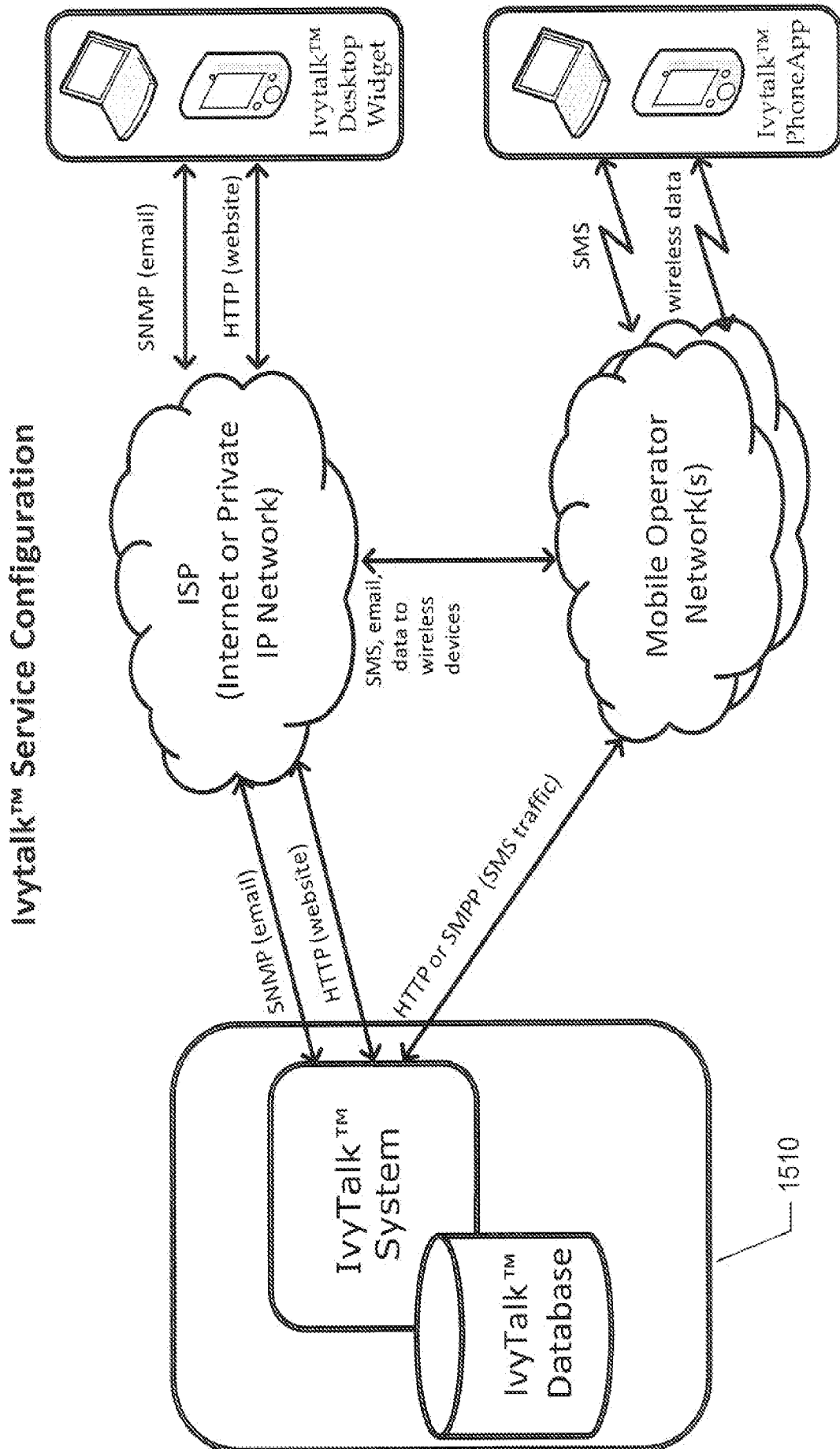
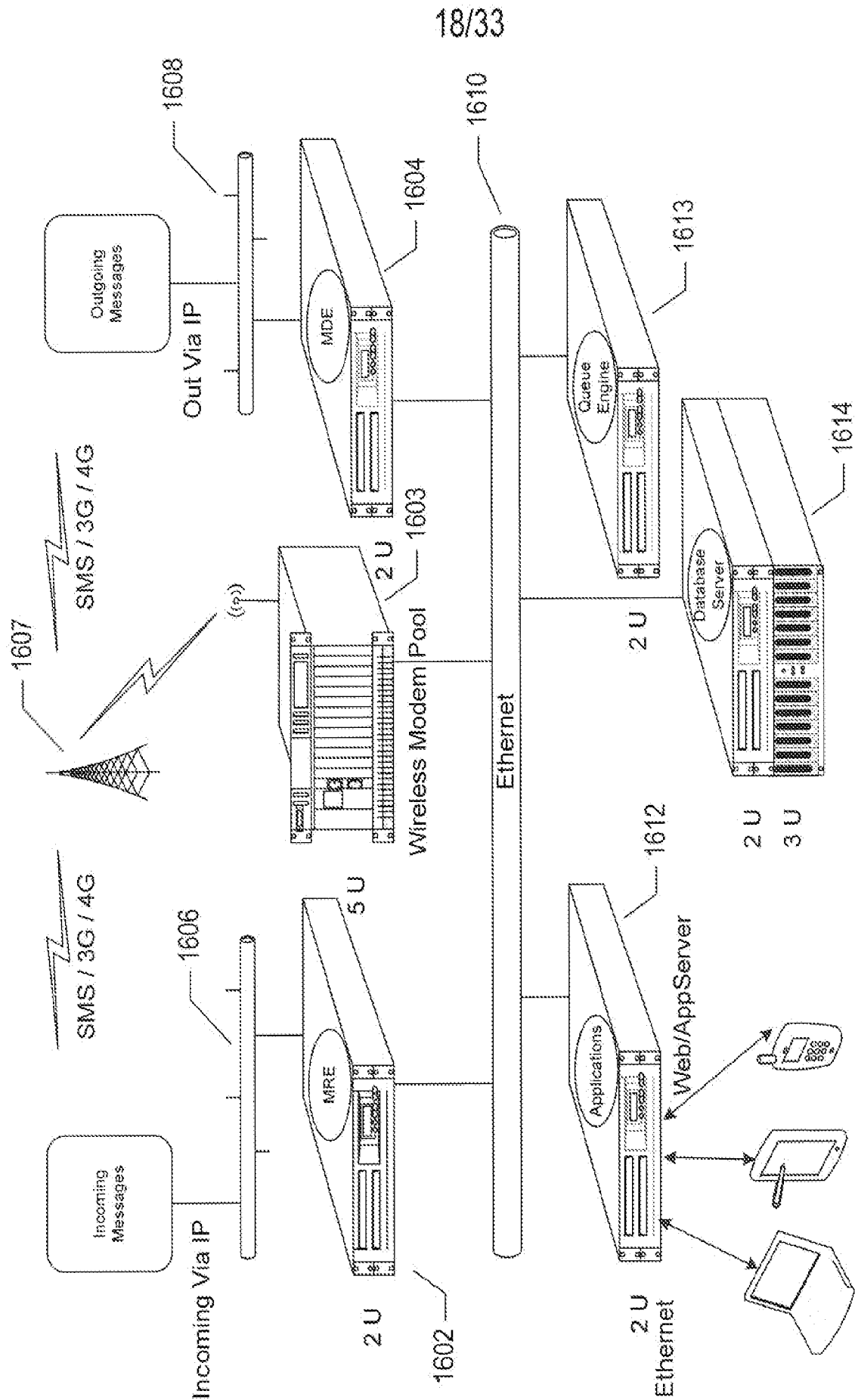


FIG. 15B



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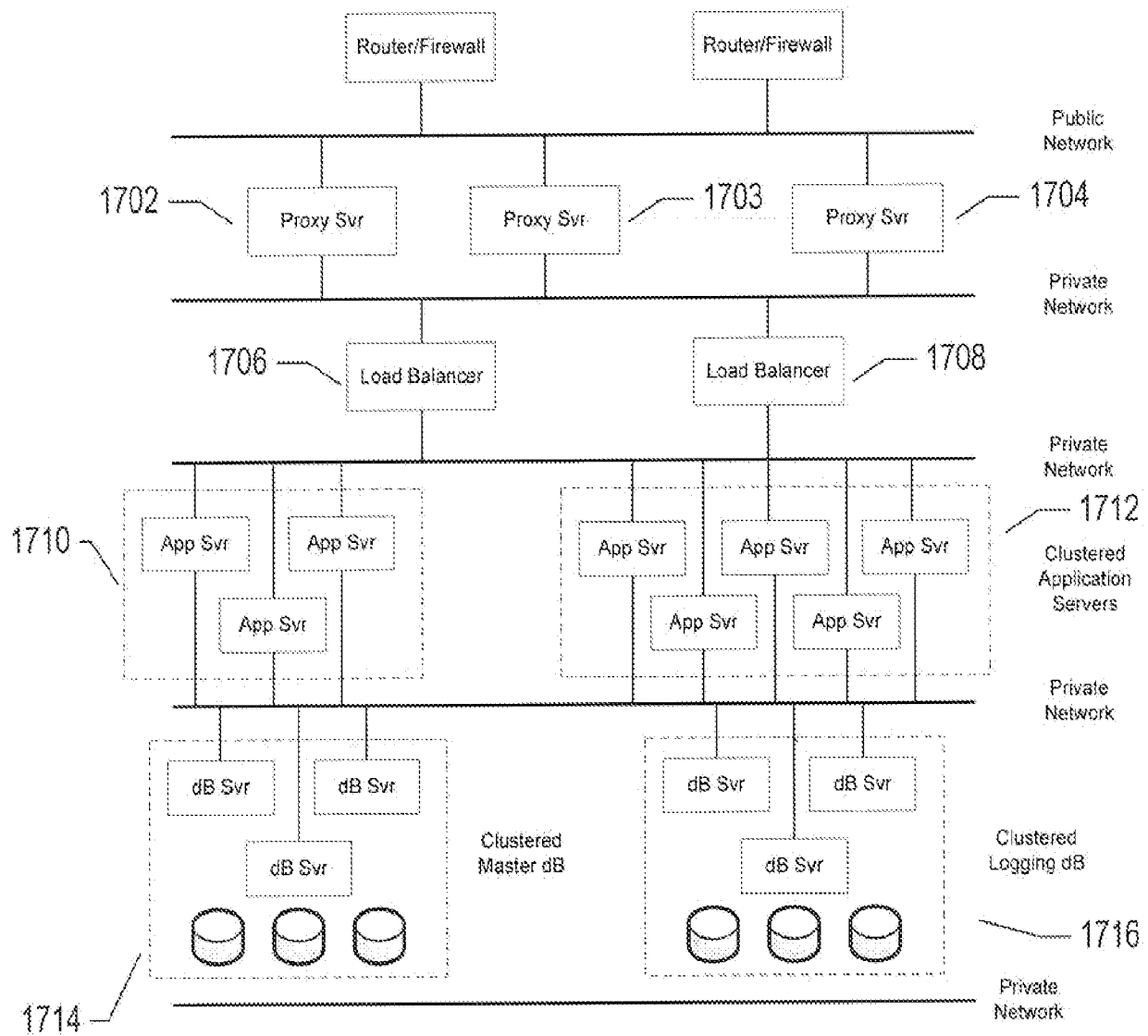


FIG. 17

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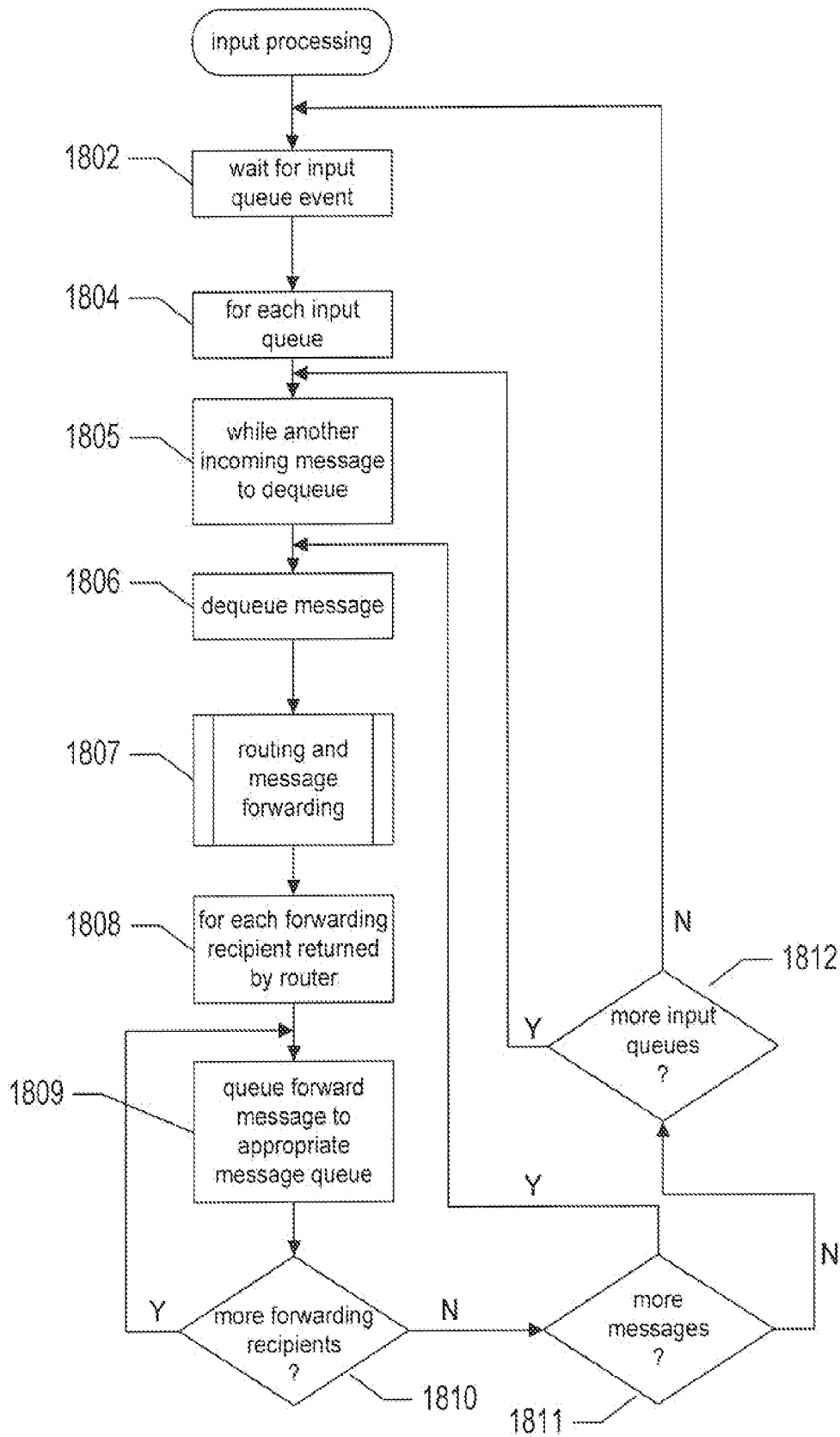


FIG. 18

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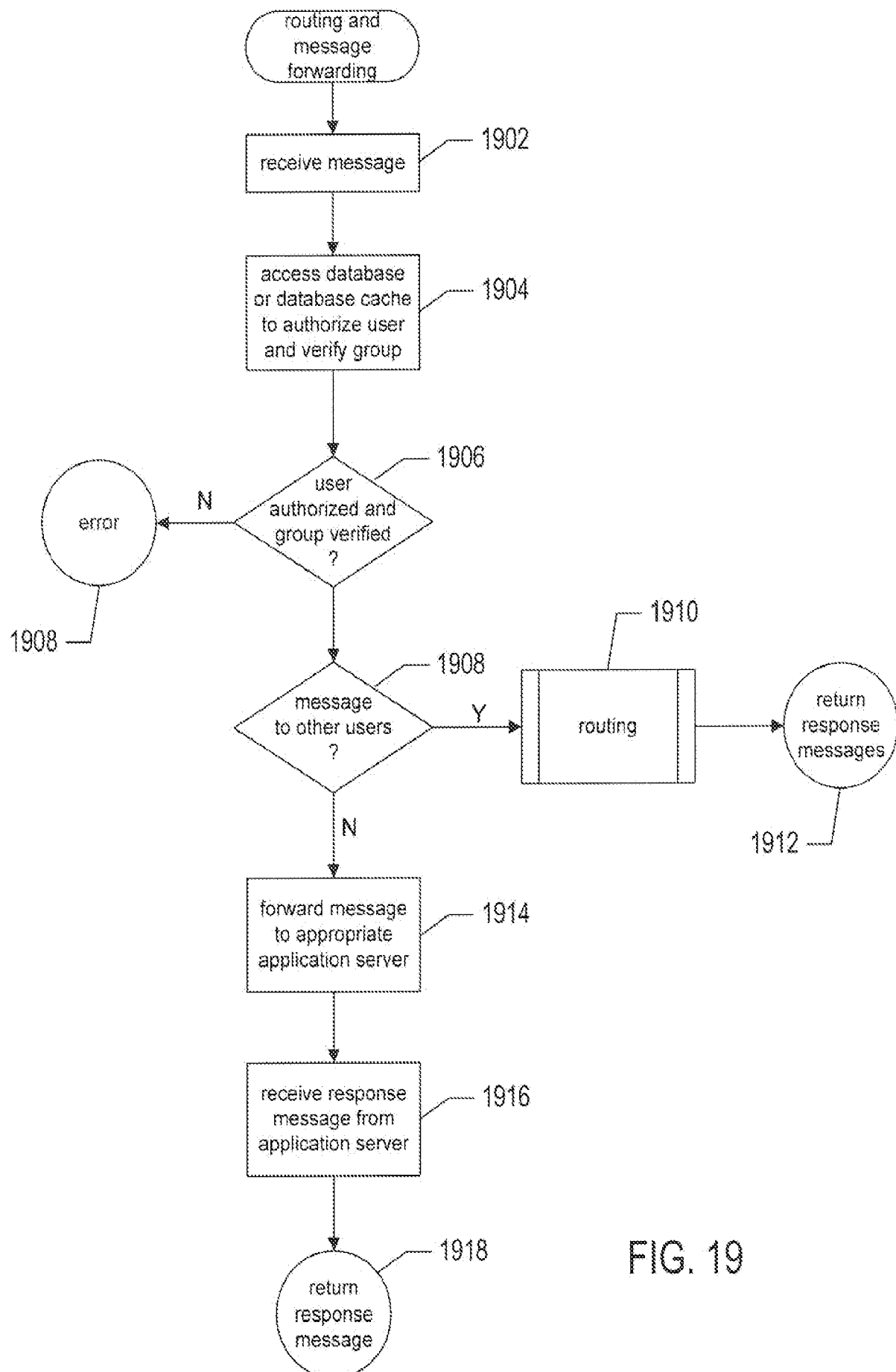


FIG. 19

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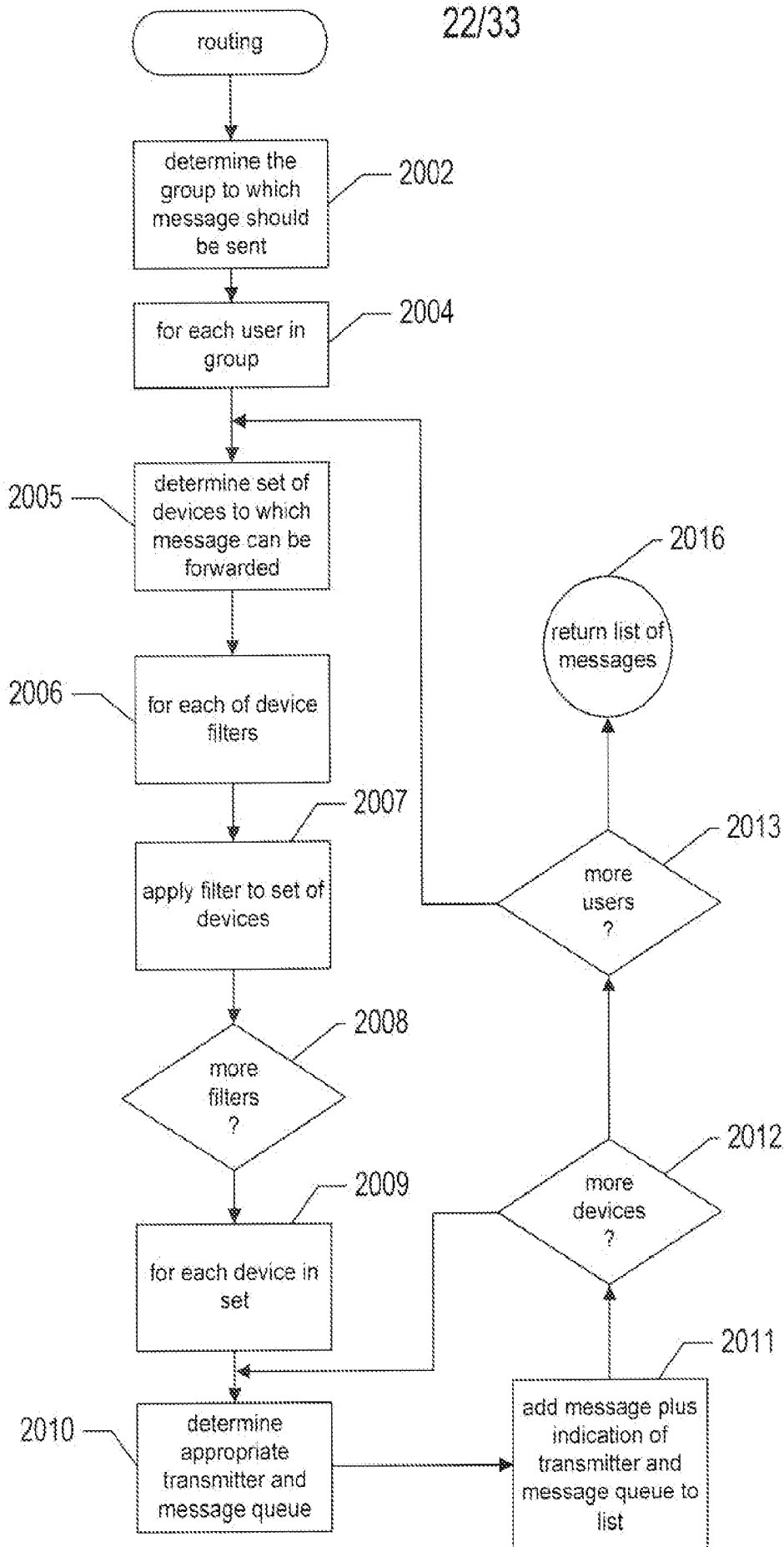
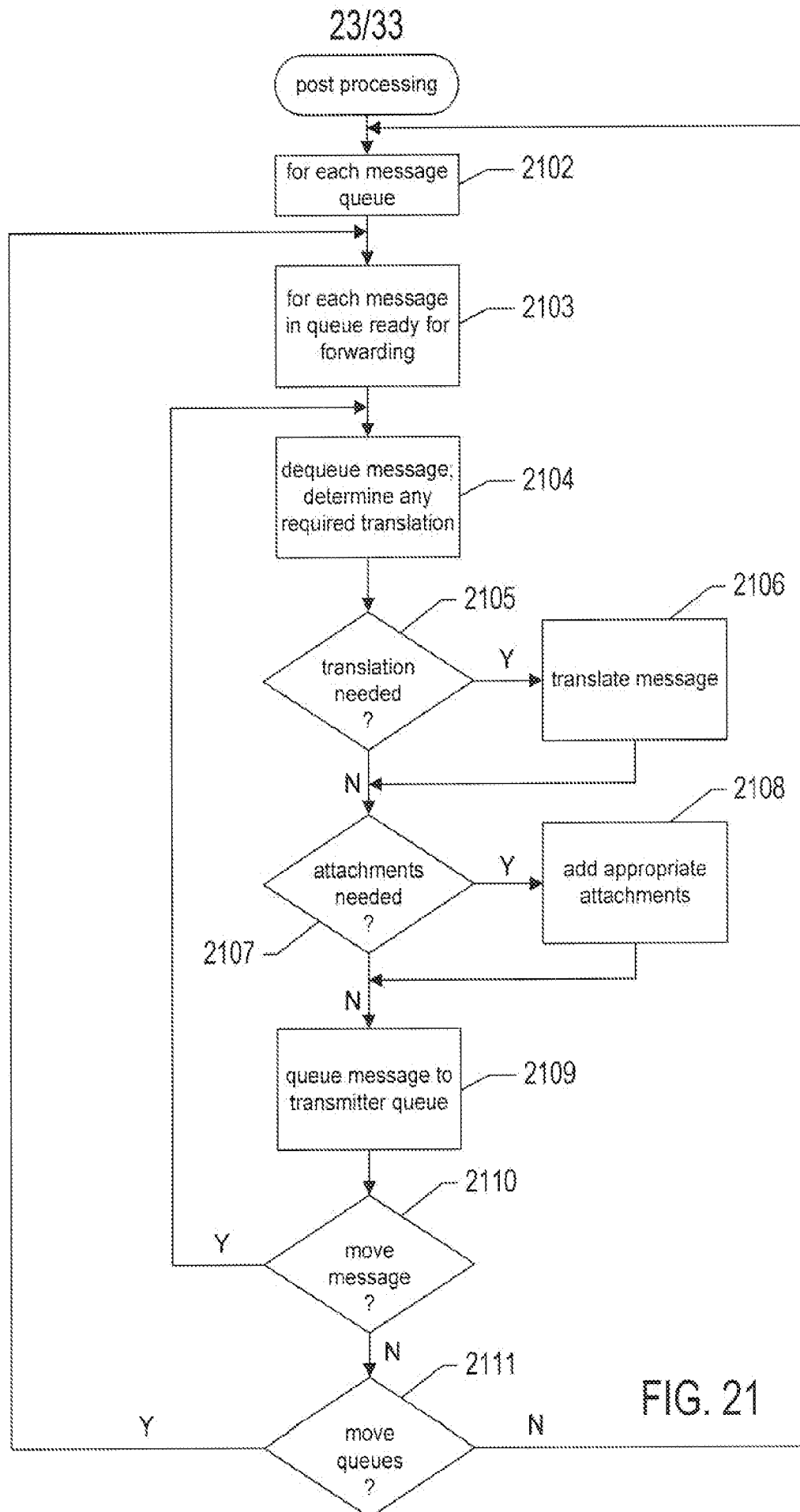
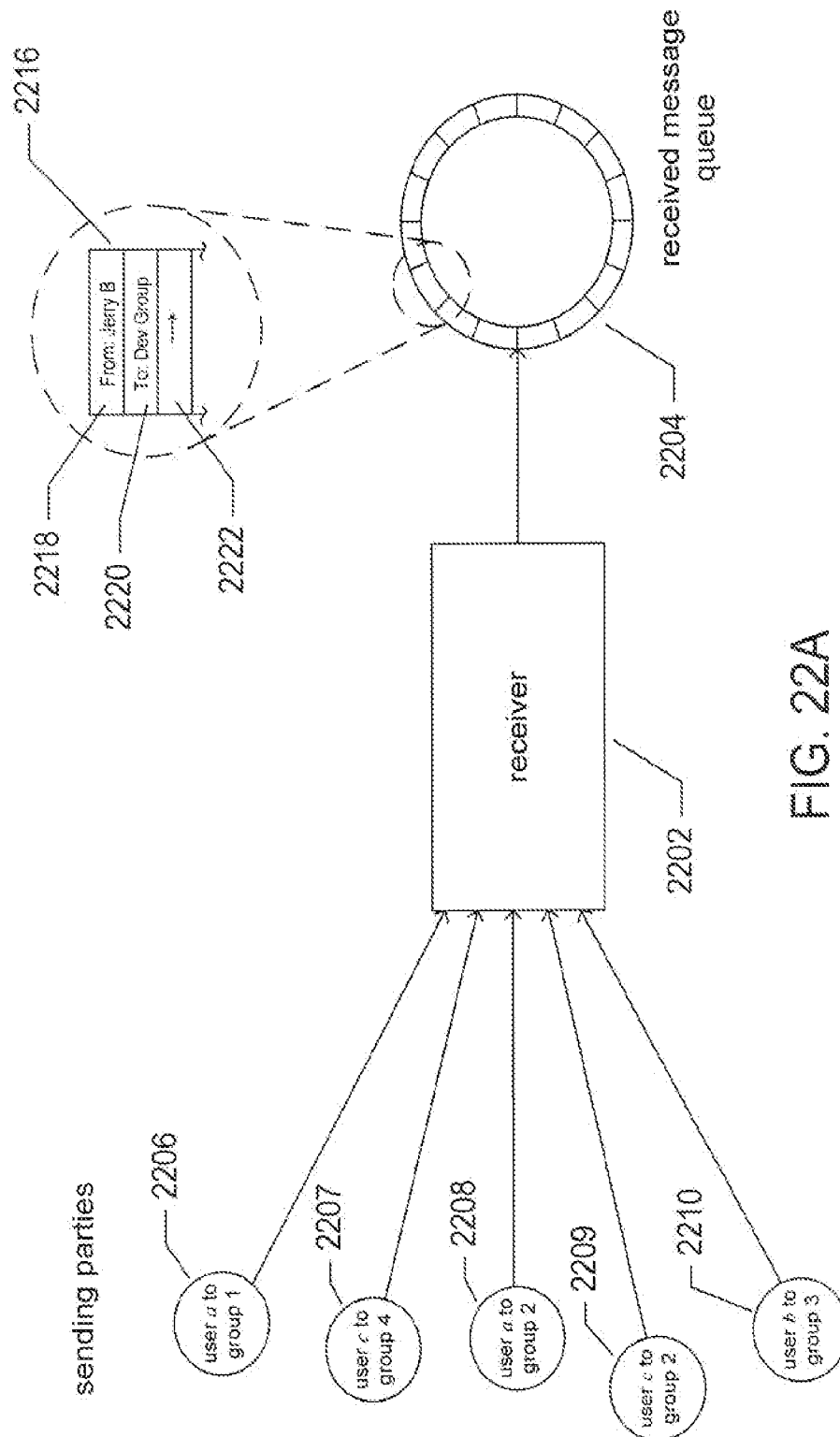


FIG. 20



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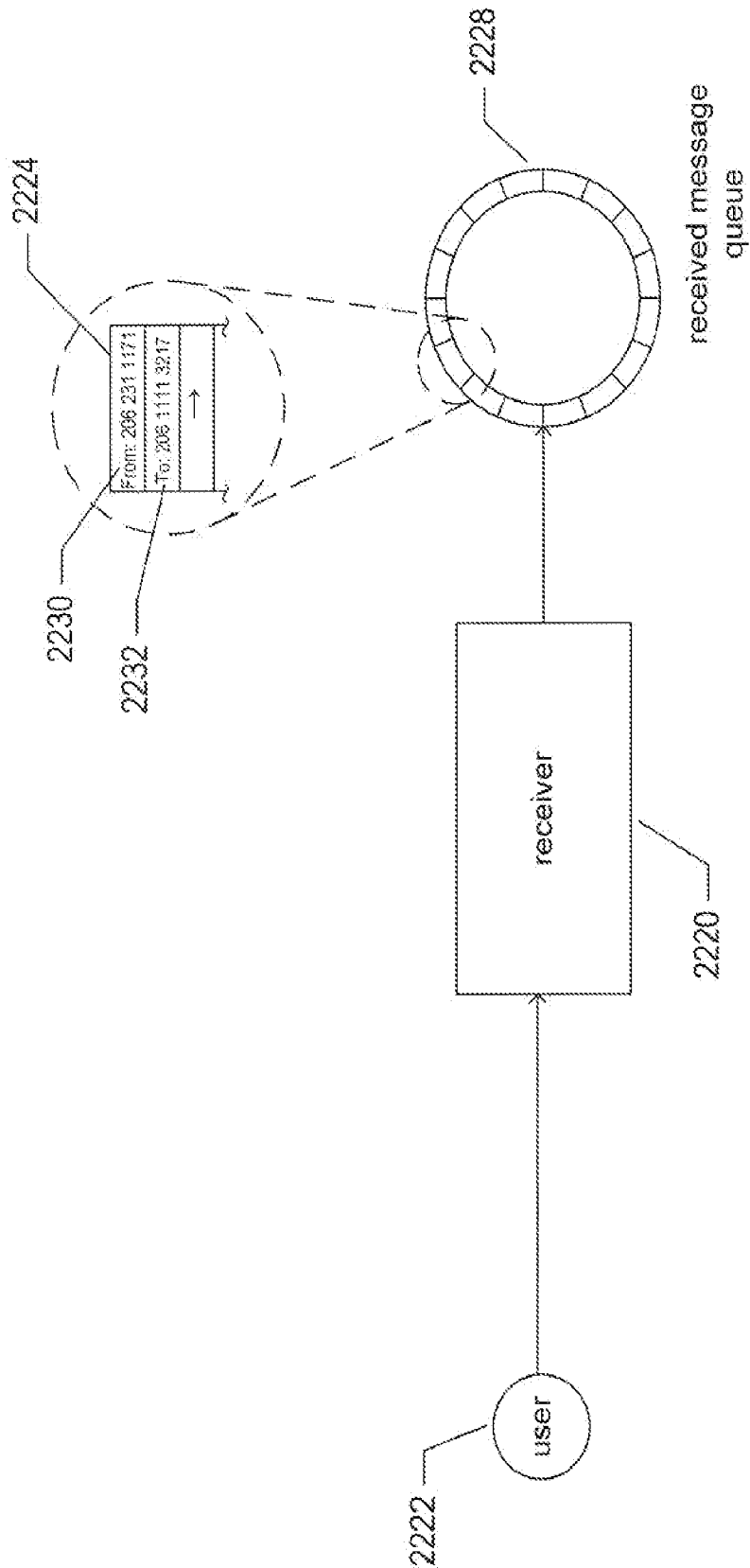


FIG. 22B

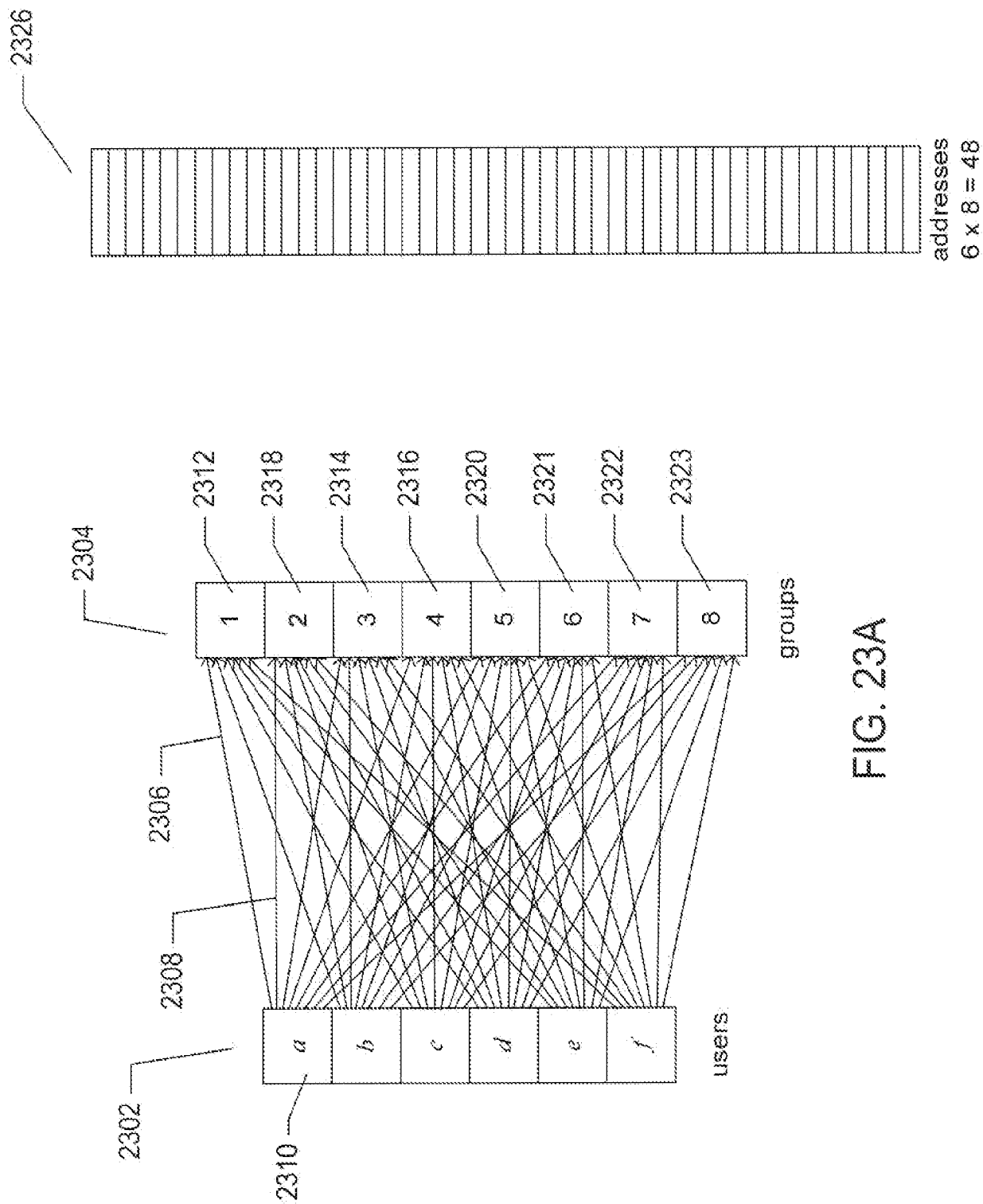


FIG. 23A

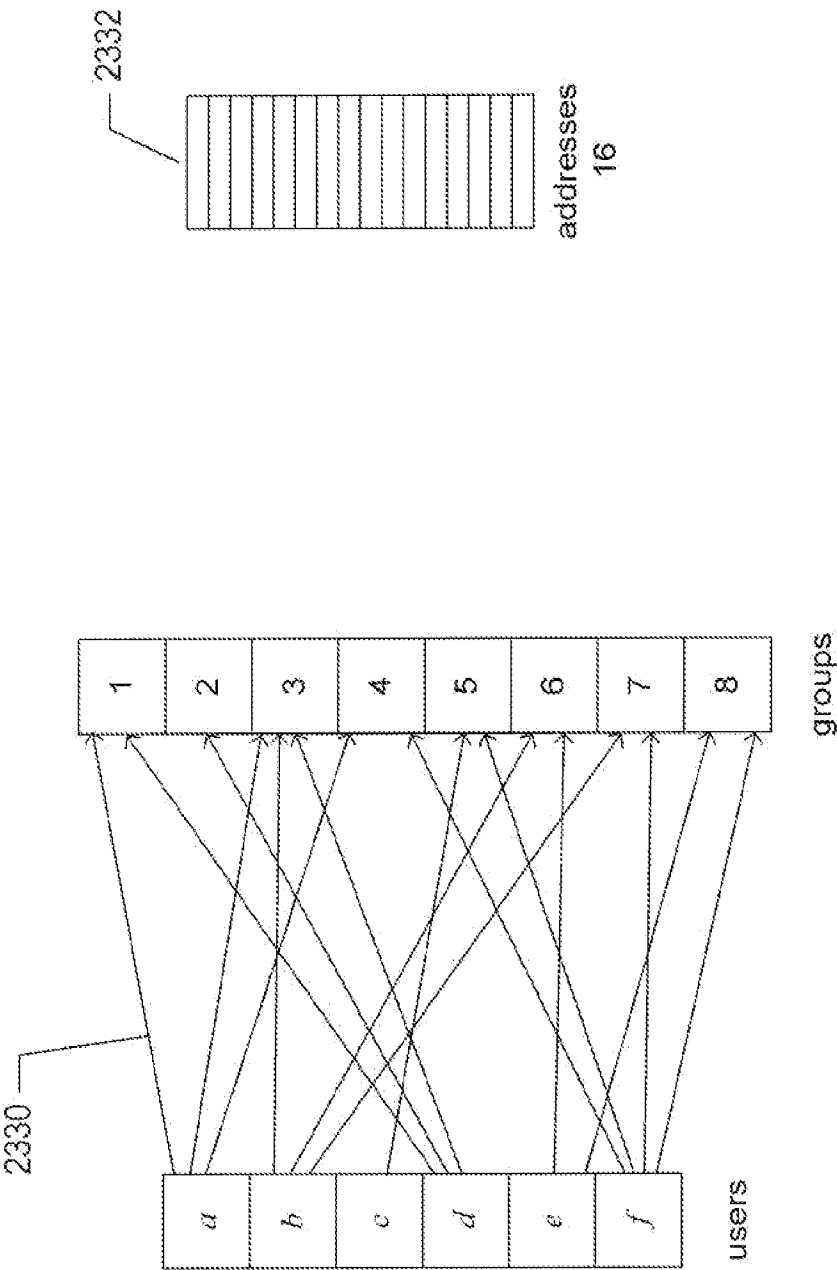


FIG. 23B

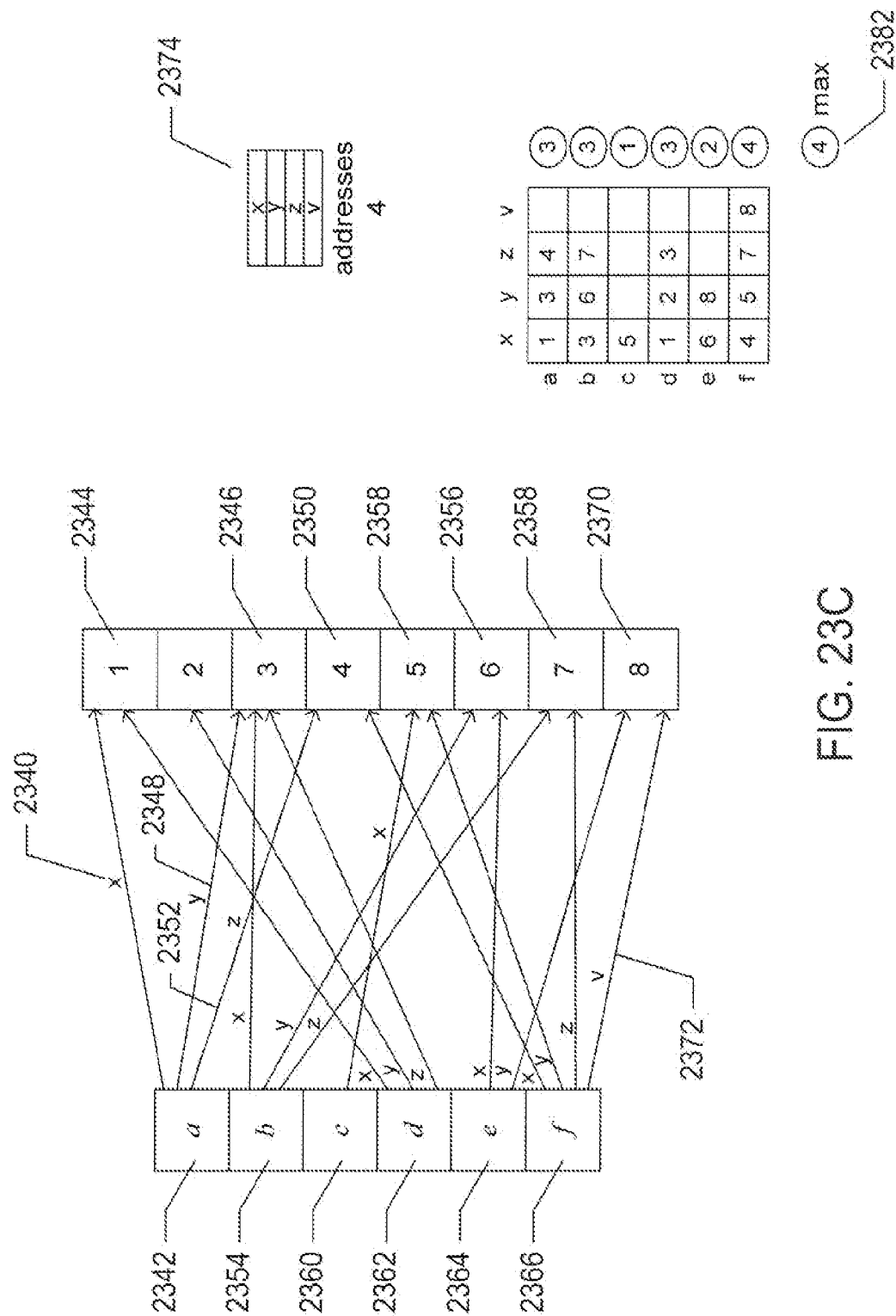
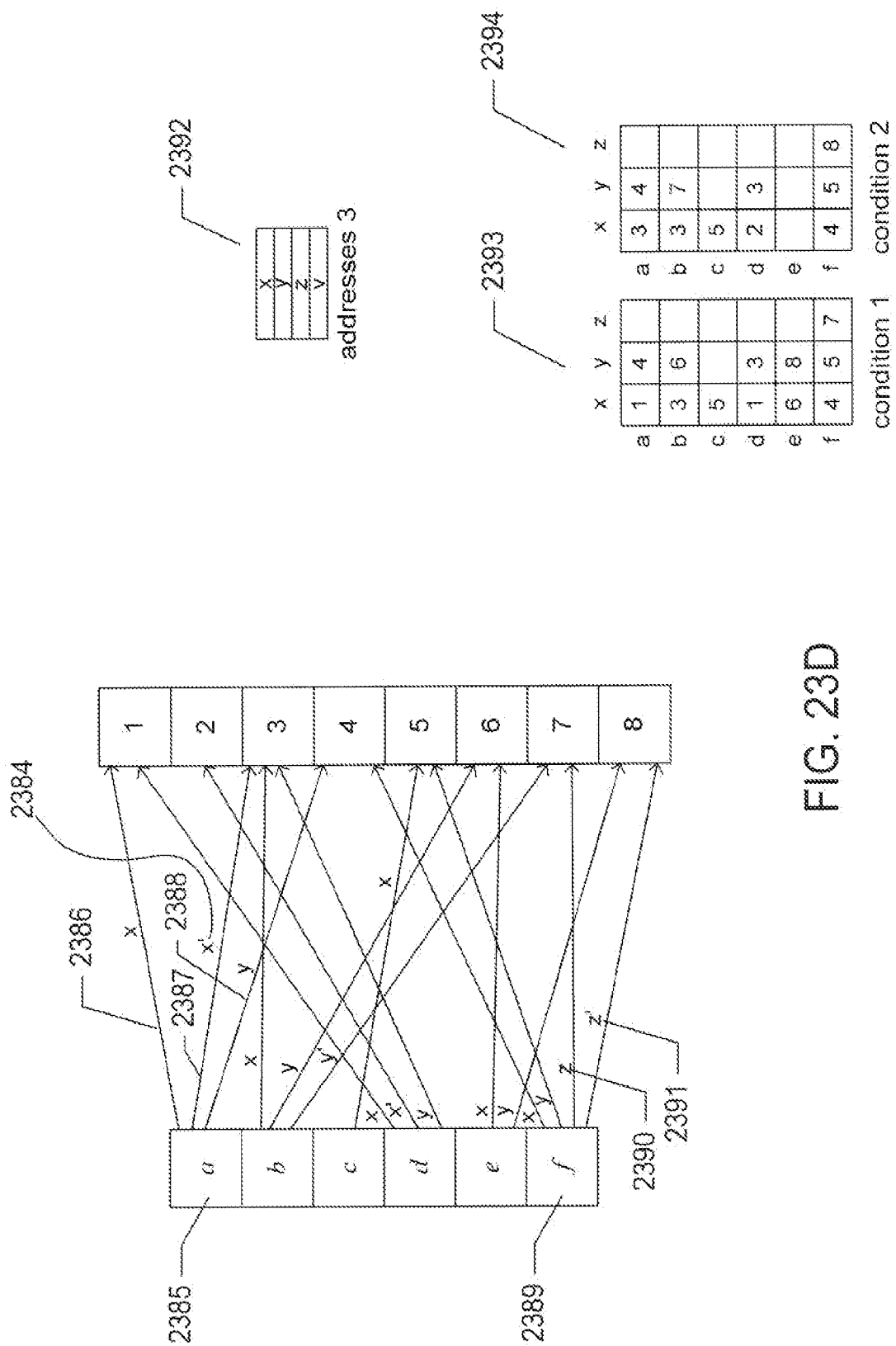


FIG. 23C



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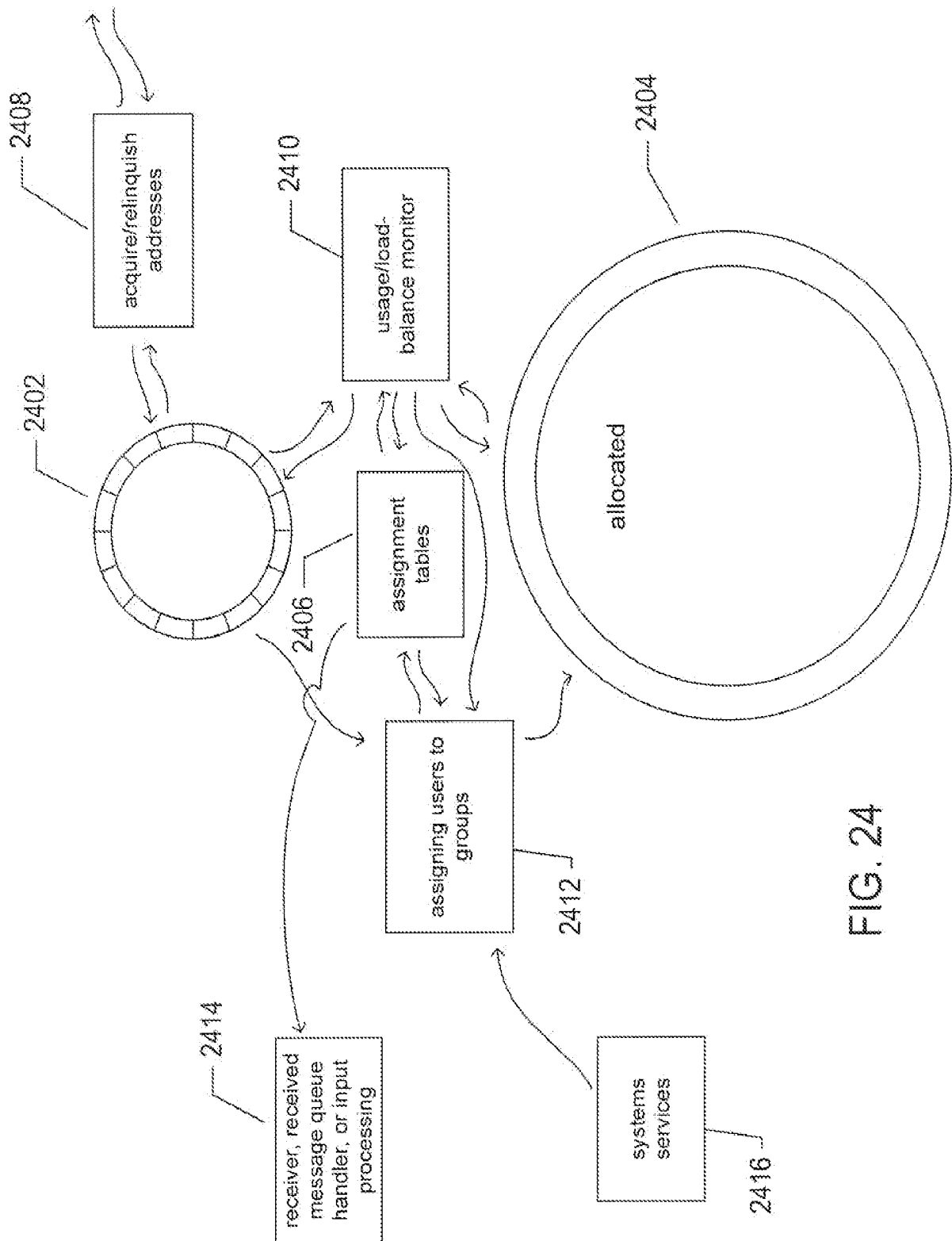


FIG. 24

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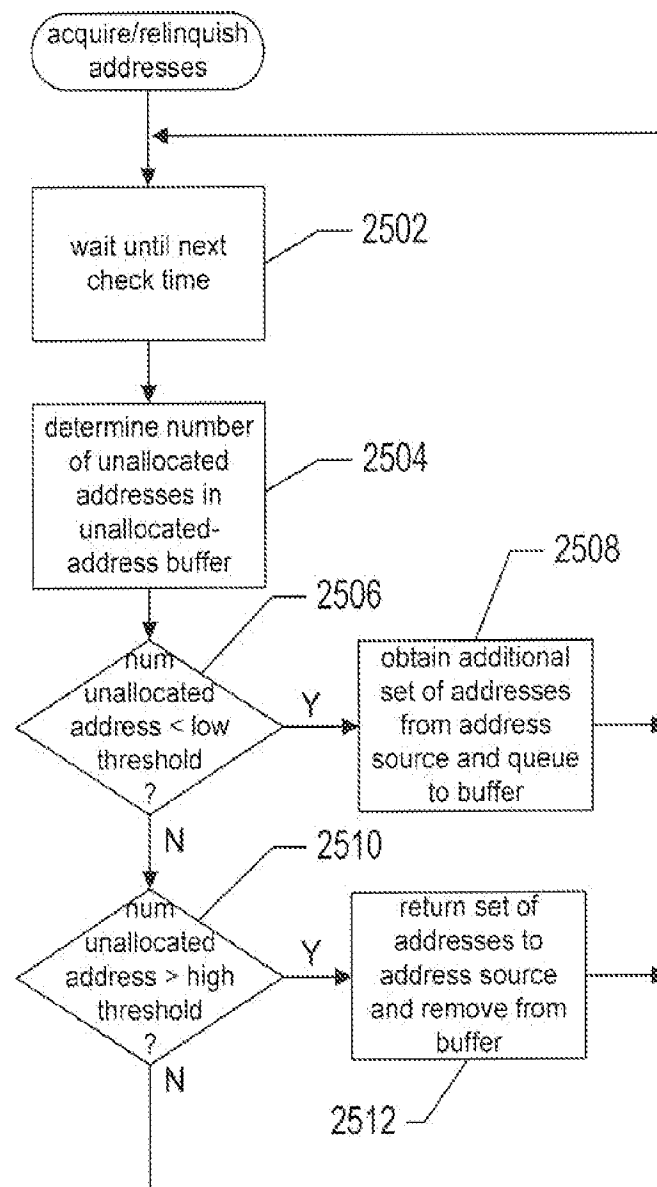


FIG. 25

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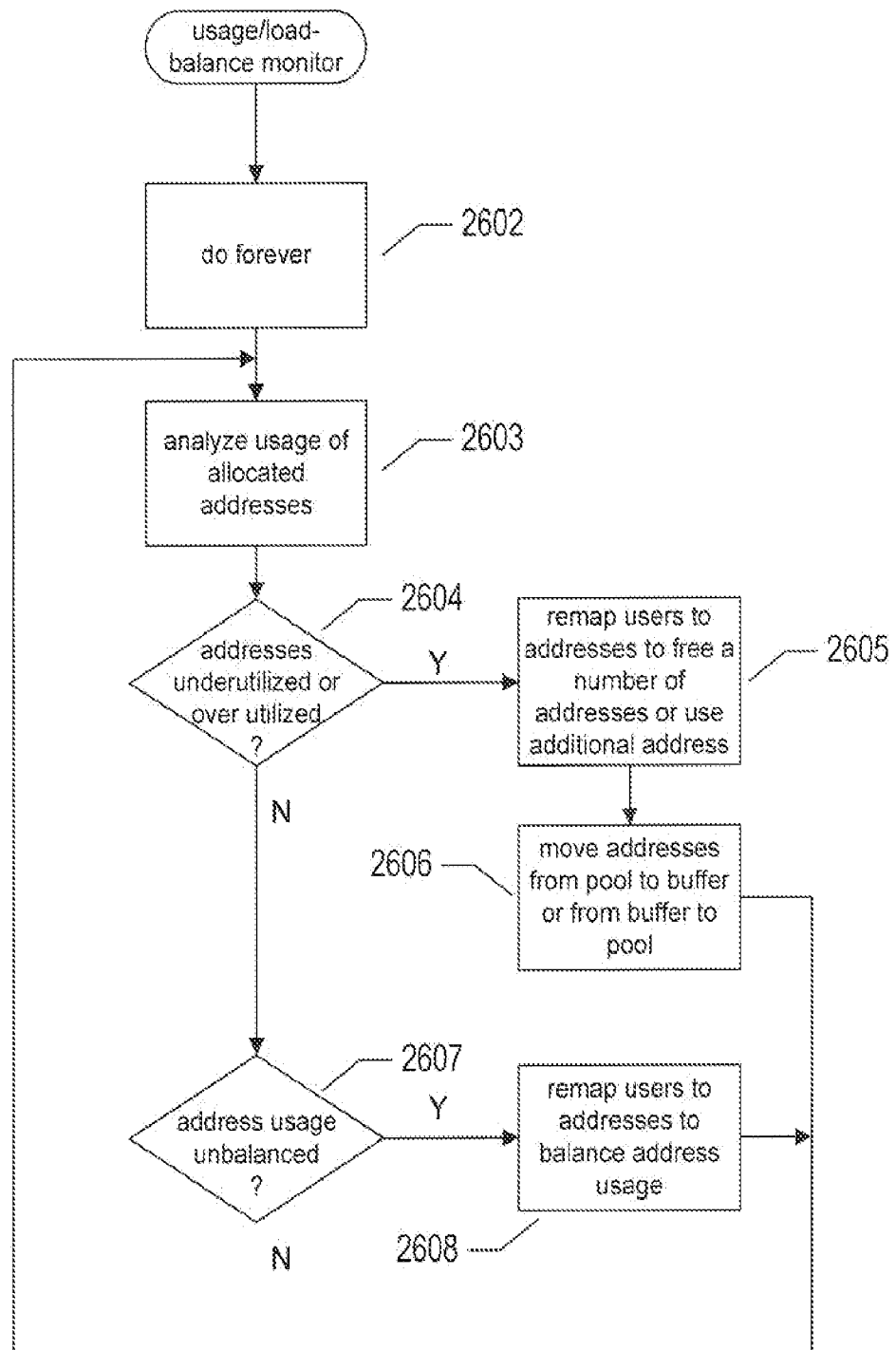


FIG. 26

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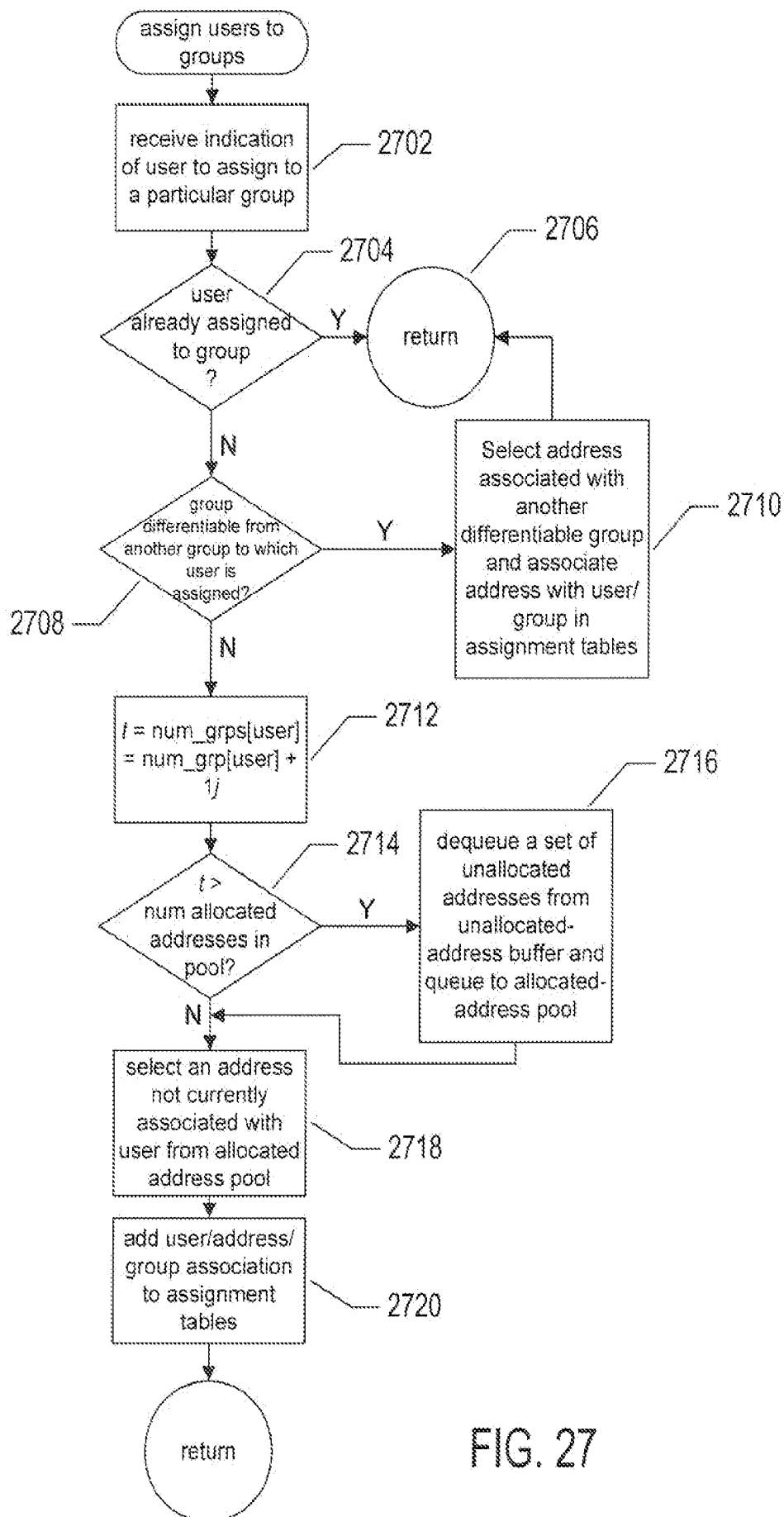


FIG. 27