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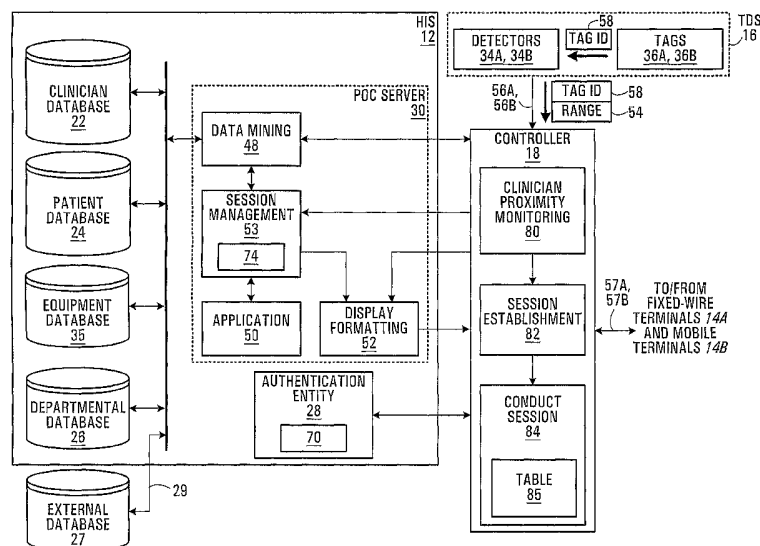
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(54) Title: USE OF LOCATION AWARENESS TO CONTROL RADIO FREQUENCY INTERFERENCE IN A HEALTHCARE ENVIRONMENT



(57) Abstract: A method of controlling RF Interference in a healthcare establishment. The method comprises receiving data regarding a wirelessly detectable tag associated to a first piece of equipment within the healthcare establishment; determining whether the first piece of equipment is positioned relative to a second piece of equipment within the healthcare establishment such that an RF interference constraint is violated, based at least in part on the data regarding the wirelessly detectable tag; and responsive to the RF interference constraint being violated, causing a variation in RF power transmitted by at least one of the first piece of equipment and the second piece of equipment. In this way, wireless communication equipment can be used in the healthcare establishment without deleterious effects on sensitive medical equipment.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

USE OF LOCATION AWARENESS TO CONTROL RADIO FREQUENCY INTERFERENCE IN A HEALTHCARE ENVIRONMENT

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit under 35 U.S.C. 119(e) of a U.S. Provisional Patent Application to Graves et al. entitled "USE OF LOCATION AWARENESS TO ENHANCE COMMUNICATIONS FUNCTIONS IN A HEALTHCARE ENVIRONMENT", Serial No. unknown, filed on February 11, 2005, hereby incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to communications systems and methods having application to a healthcare environment, and benefiting from enhanced functionality and safety due to the availability of location awareness.

BACKGROUND

In recent years, use of electronic methods to store patient records has become more commonplace, both due to ad-hoc actions by physicians and as an industry response to government pressures. To fully exploit the resultant electronic health records (EHR), physicians and other clinicians need to be given access to both read and write these records. However, patient data is of a confidential nature, thus creating the problem of having to balance the need for privacy against the desire to simplify existing access and authentication protocols and procedures, which are often cumbersome.

In addition, a wide range of communications typically take place in a healthcare environment and are characterized by various degrees of criticality

1 from the perspective of both patients and clinicians. The efficiency with which
2 communications occur in a healthcare environment often directly affects the
3 quality of the healthcare services provided to patients and, in some cases,
4 has a critical impact on the condition of patients. For instance, in some
5 situations where a few minutes can represent the difference between life and
6 death for a patient, the efficiency of communications may be a determining
7 factor in saving the patient's life.

8
9 Moreover, while wireless technology has the potential to provide the desired
10 improvement in communications efficiency (such as improved clinician-
11 clinician voice contact and delivery of medical information from databases to
12 the clinician at the point-of-care), the electromagnetic radiating nature of this
13 technology has led to concern over interference with sensitive medical
14 equipment.

15
16 There is thus a need in the industry for improvements in communications
17 systems and methods having application in healthcare environments.

18 19 20 **SUMMARY OF THE INVENTION**

21
22 In accordance with a first broad aspect, the present invention seeks to
23 provide a method of controlling RF interference in a healthcare establishment.

24 The method comprises receiving data regarding a wirelessly detectable tag
25 associated to a first piece of equipment within the healthcare establishment;
26 determining whether the first piece of equipment is positioned relative to a
27 second piece of equipment within the healthcare establishment such that an
28 RF interference constraint is violated, based at least in part on the data
29 regarding the wirelessly detectable tag; and responsive to the RF interference
30 constraint being violated, causing a variation in RF power transmitted by at
31 least one of the first piece of equipment and the second piece of equipment.

32
33 In accordance with a second broad aspect, the present invention seeks to
34 provide a system for controlling RF interference in a healthcare

1 establishment. The system comprises a first functional entity adapted to
2 receive location data regarding a medical device and location data regarding
3 a mobile communication device that transmits RF power at a certain level, the
4 location data regarding the mobile communication device being determined
5 on a basis of signals received from a wirelessly detectable tag associated with
6 the mobile communication device; a second functional entity adapted to
7 determine, at least partly based on the location data regarding the mobile
8 communication device and the location data regarding the medical device,
9 whether the mobile communication device and the medical device are
10 positioned relative to one another such that a RF interference condition is
11 met; and a third functional entity adapted to cause the mobile communication
12 device to reduce the level at which it transmits RF power in response to the
13 RF interference condition being met.

14

15 In accordance with a third broad aspect, the present invention seeks to
16 provide a computer-readable storage medium comprising a program element
17 for execution by a computing device to control RF interference in a healthcare
18 establishment. The program element includes computer-readable program
19 code for receiving location data regarding a medical device and location data
20 regarding a mobile communication device that transmits RF power at a
21 certain level, the location data regarding the mobile communication device
22 being determined on a basis of signals received from a wirelessly detectable
23 tag associated with the mobile communication device; computer-readable
24 program code for determining, at least partly based on the location data
25 regarding the mobile communication device and the location data regarding
26 the medical device, whether the mobile communication device and the
27 medical device are positioned relative to one another such that a RF
28 interference condition is met; and computer-readable program code for
29 causing the mobile communication device to reduce the level at which it
30 transmits RF power in response to the RF interference condition being met.

31

32 These and other aspects and features of the present invention will now
33 become apparent to those of ordinary skill in the art upon review of the
34 following description of specific embodiments of the invention in conjunction

1 with the accompanying drawings.

2

3

4 **BRIEF DESCRIPTION OF THE DRAWINGS**

5

6 In the accompanying drawings:

7

8 Figs. 1A and 1B are conceptual block diagrammatic views of a
9 communications network in a hospital, including a plurality of terminals, a
10 hospital information system (HIS) and a controller;

11

12 Fig. 1C is a detailed block diagrammatic view of the controller, in accordance
13 with an embodiment of the present invention;

14

15 Fig. 1D shows an example structure of an equipment database, a clinician
16 database and an electronic health record;

17

18 Fig. 2A is a flowchart showing steps in an authentication process performed
19 by an authentication entity in the HIS, in accordance with an embodiment of
20 the present invention;

21

22 Fig. 2B shows interaction among various elements of the communications
23 network as a result of performing the authentication process, in accordance
24 with an embodiment of the present invention;

25

26 Fig. 3A illustrates two instances of a scenario where a clinician is located in
27 proximity to a terminal of the hospital communications network;

28

29 Fig. 3B is a flowchart showing steps in a session establishment process
30 performed by the controller, in accordance with an embodiment of the
31 present invention;

32

33 Fig. 3C depicts a path of an established session through elements of the
34 communications network, in accordance with an embodiment of the present

1 invention;

2

3 Fig. 4 is a flowchart showing steps in a session resumption process performed
4 by the controller, in accordance with an embodiment of the present invention;

5

6 Fig. 5A illustrates a scenario in which a clinician who has an established
7 session with one terminal of the communications network is located in
8 proximity to a second terminal of the communications network;

9

10 Fig. 5B is a flowchart showing steps in a session transfer process performed
11 by the controller, in accordance with an embodiment of the present invention;

12

13 Fig. 5C illustrates the scenario of Fig. 5A upon transfer of at least part of the
14 session to the second terminal, in accordance with one path in the flowchart
15 of Fig. 5B;

16

17 Figs. 5D through 5G illustrate the scenario of Fig. 5C after a re-transfer of
18 part of the session back to the first terminal, in accordance with various
19 embodiments of the present invention;

20

21 Figs. 6A and 6B are conceptual block diagram views of a communications
22 network, including a plurality of terminals, a hospital information system
23 (HIS) and a controller;

24

25 Fig. 7 depicts detection of a burst of radio frequency emitted by a tag in order
26 to determine the location of the tag, in accordance with an embodiment of
27 the present invention;

28

29 Fig. 8 is a detailed block diagrammatic view of the controller of Figs. 6A and
30 6B, in accordance with an embodiment of the present invention;

31

32 Figs. 9A to 9C combine to create a flowchart showing steps in a process used
33 to establish communications with a target clinician in the hospital, in
34 accordance with an embodiment of the present invention;

1

2 Fig. 10 is a flowchart showing steps in a process used to establish
3 communications with a team of clinicians required to respond to a medical
4 event in the hospital, in accordance with an embodiment of the present
5 invention;

6

7 Fig. 11 shows an example structure of the equipment database that is
8 enhanced for the purposes of enabling a function that tracks equipment, in
9 accordance with an embodiment of the present invention;

10

11 Fig. 12 shows an example structure of the equipment database that is
12 enhanced for the purposes of enabling a function that monitors RF
13 interference, in accordance with an embodiment of the present invention;

14

15 Fig. 13 is a flowchart showing steps in a process used to monitor and control
16 RF interference, in accordance with an embodiment of the present invention;

17

18 Figs. 14 and 15 are flowcharts showing steps in two alternative versions of a
19 process used to describe control of, and interaction with, a charger of mobile
20 terminals, in accordance with an embodiment of the present invention.

21

22

23 **DETAILED DESCRIPTION OF EMBODIMENTS**

24

25

26 **1. FIRST SYSTEM ARCHITECTURE**

27

28 Figs. 1A and 1B show a conceptual view of a communications network 10 of
29 a healthcare establishment, in accordance with a first example of
30 implementation of the present invention. For ease of reading, the healthcare
31 establishment will hereinafter be referred to as a hospital, but it should be
32 understood that the healthcare establishment may be of any size and may
33 consist of a single building or a campus including one or more buildings or
34 pavilions and possibly one or more adjacent areas such as roads and parking

1 lots.

2

3 A plurality of fixed terminals 14A and a plurality of mobile terminals 14B
4 serve as entry points to the communications network 10. The terminals 14A,
5 14B are accessed by a plurality of "clinicians" 20 who are mobile within the
6 hospital. The term "clinician" is used to denote the broad category of
7 individuals who may require access to the communications network 10 in the
8 execution of their duties pertaining to diagnosis and/or treatment of one or
9 more patient. While not intended to be an exhaustive list, typically clinicians
10 20 can include physicians, radiologists, pharmacists, interns, nurses,
11 laboratory technicians and orderlies, who are all involved in patient diagnosis
12 and/or treatment. In contrast, hospital administrative management, building
13 facilities staff and janitorial staff are not considered to be "clinicians" under
14 this interpretation.

15

16 The communications network 10 also includes a tag / detector subsystem
17 (TDS) 16 connected to a controller 18, which is connected to a healthcare
18 information system (HIS) 12. In the non-limiting example of implementation
19 shown in greater detail in Fig. 1C, the HIS 12 includes a clinician database 22,
20 a patient database 24, a departmental database 26 and an equipment
21 database 35, as well as an authentication entity 28 and a point-of-care (POC)
22 server 30. In addition, the HIS 12 may permit access to a trusted external
23 database 27, for instance a national electronic health record (EHR) database,
24 via a secure link 29.

25

26 The aforementioned components of the communications network 10 will now
27 be described in greater detail.

28

29 Terminals 14A, 14B

30

31 The terminals 14A, 14B allow communication between the clinicians 20 and
32 the HIS 12 via the controller 18. Terminals 14A are fixed-wire terminals,
33 such as stationary terminals or workstations, connected to the controller 18
34 via communication links 57A. Terminals 14B are mobile terminals, such as

1 handheld units (e.g., personal digital assistant (PDA)) or laptop computers,
2 which communicate with the controller 18 via communication links 57B that
3 include wireless portions. The wireless portions of the communication links
4 57B are secure links that may be encapsulated within the communications
5 network 10, as would be the case for a wireless local area network (WLAN)
6 using WLAN access points 60. In another embodiment, the wireless portions
7 of the communication links 57B may involve an external network connection,
8 as would be the case when the mobile terminals 14B are cellular phones or
9 cellular data devices.

10
11 Each of the terminals 14A, 14B has a display capability, which may be
12 different for different types of terminals. For example, mobile terminals 14B
13 may have display capabilities limited by the necessity of being portable and
14 hence of small size. On the other hand, certain ones of the fixed-wire
15 terminals 14A may have superior display capabilities, not being faced with the
16 same constraints as mobile terminals. For example, some fixed-wire
17 terminals 14A may be uniquely qualified for displaying full diagnostic quality
18 radiology images.

19
20 Equipment database 35

21
22 With reference to Fig. 1D, the equipment database 35 stores information on
23 the hospital's equipment such as terminals and medical devices. For
24 example, the equipment database 35 comprises a plurality of fields for each
25 piece of equipment, including a unique equipment identifier 103 (e.g., a serial
26 number) and, in the case of equipment having a "tag" (further information
27 regarding tags is provided herein below), an equipment-specific tag ID 105
28 associated with a tag that is expected to be associated with that piece of
29 equipment. Still other information regarding the specific piece of equipment
30 may include, *inter alia*, an equipment type 107 (such as "terminal", "fixed
31 terminal", "mobile terminal", "PDA", "fetal heart monitor", etc.) and a display
32 capability 109 (as described in the preceding paragraph). Still other
33 information may be stored in the equipment database 35, such as a
34 predetermined location of a static piece of equipment, if known.

1

2 Clinician Database 22

3

4 The clinician database 22 stores information regarding the clinicians 20. In
5 one embodiment, with reference to Fig. 1D, the information regarding a
6 specific clinician 20 includes a unique clinician identifier 38 (e.g., an employee
7 number) for the specific clinician 20, as well as "authentication information"
8 40 for the specific clinician 20. The authentication information 40 can be, for
9 instance, a password and/or data indicative of a biometric characteristic such
10 as a fingerprint or retina scan of the specific clinician 20. Other information
11 regarding the specific clinician 20 may include a clinician-specific tag ID 42
12 associated with a tag that is expected to be worn by the specific clinician 20.
13 (Further information regarding tags is provided herein below.) Still other
14 information regarding the specific clinician 20 may include, *inter alia*, a profile
15 44 of the specific clinician 20, which defines certain qualifications of the
16 specific clinician 20, as well as access privileges 46 defining types of
17 information of the HIS 12 that the specific clinician 20 is allowed to access.
18 For example, if the specific clinician 20 is a physician, still further other
19 information regarding the physician can include a list of patients under the
20 responsibility of the physician and/or a list of facilities commonly used by the
21 physician.

22

23 Patient Database 24

24

25 The patient database 24 stores information on the hospital's patients. In one
26 embodiment, with reference to Fig. 1D, the patient database 24 is configured
27 as a database of electronic health records, whereby the information on each
28 patient is stored as an electronic health record (EHR) 47 of the patient. For
29 example, the EHR 47 of a given patient can include information regarding:
30 the long-term and short-term health history of the patient; the treatment
31 and/or surgical history of the patient; one or more diagnostics on the
32 condition of the patient; ongoing and/or planned treatments or surgery for
33 the patient; results of one of more tests performed on the patient (e.g., blood
34 test results, images from medical imaging techniques (e.g. x-rays, MRI

1 images, etc.), or results from any other conceivable test performed on the
2 patient); as well as other information specific to the patient such as
3 admissions records. Due to the sensitive and confidential nature of this
4 information, access to the information contained in the patient database 24
5 is subject to various authentication and access privilege verifications, as
6 described in further detail below.

7 8 Departmental Database 26

9
10 The departmental database 26 (there may be more than one) stores
11 information related to a respective department of the hospital. For instance,
12 the radiology department of the hospital may have its own database storing
13 x-ray images and/or images from other modalities generated as a result of
14 tests performed on patients of the hospital. Similarly, other departments of
15 the hospital, such as the cardiology, chemotherapy, physiotherapy,
16 pharmacy, emergency room, admissions, billing, maintenance, supplies,
17 administration, kitchen, cafeteria, and any other conceivable department of
18 the hospital, may have their own databases storing information pertaining to
19 their respective nature and activities. Again, it should be understood that Fig.
20 1C depicts only one of many possible architectures for the HIS 12 and that
21 various other architectures are possible without leaving the scope of the
22 present invention. For example, in a possible architecture, the HIS 12
23 includes multiple departmental databases 26, or includes no departmental
24 database, with all of the information related to the departments of the
25 hospital being stored in a global database (not shown) of the HIS 12.

26 27 POC server 30

28
29 The POC server 30 comprises suitable software, hardware and/or control logic
30 for implementing a variety of functions, including a data mining function 48,
31 one or more application functions 50, a display formatting function 52 and a
32 session management function 53.

33
34 The purpose of the session management function 53 is to administrate

1 "sessions" for authenticated clinicians interacting with the HIS 12 via the
2 various terminals 14A, 14B in the communications network 10. As will be
3 seen later on, a session established for a given clinician is basically a
4 connection between a given terminal and the HIS 12, allowing the given
5 clinician to run clinical applications at the given terminal or within the HIS 12
6 and to exchange information with the HIS 12 via the given terminal. The
7 given terminal is said to "support" the session for the given clinician.
8 Administrating a session involves any one or more of establishing, canceling,
9 suspending, resuming and/or changing the data rate, accessible applications
10 and/or accessible information of the session, as a function of various factors
11 such as authentication and authorization levels.

12

13 During the course of a session for an authenticated clinician, the clinician may
14 input certain queries, commands or responses, which are processed by the
15 session management function 53, resulting in an action such as: a request for
16 data to be read from or written to the HIS 12 (via the data mining function
17 48), activation of a clinical application (via the application functions 50),
18 termination or suspension of the session, etc. Data destined for the
19 authenticated clinician during a session is sent via the display formatting
20 function 52. Further detail regarding the manner in which sessions are
21 established between the HIS 12 and the terminals 14A, 14B will be provided
22 herein below.

23

24 The purpose of the data mining function 48 is to retrieve from the clinician
25 database 22, the patient database 24, the departmental database 26, the
26 equipment database 35 and the external database 27, information to be
27 made available at the terminals 14A, 14B for sessions established between
28 the HIS 12 and the terminals 14A, 14B. Similarly, the data mining function
29 48 is also operative to modify information contained in the above-mentioned
30 databases or add new information to these databases as a result of sessions
31 established between the HIS 12 and the terminals 14A, 14B. In this way, the
32 data mining function 48 acts as a conduit between the databases 22, 24, 26,
33 35, 27 and the clinicians 20.

34

1 The purpose of the one or more application functions 50 is to run various
2 applications that may be required to process information exchanged in the
3 course of sessions established between the HIS 12 and the terminals 14A,
4 14B. Examples of such applications are computerized physician order entry
5 (CPOE) applications, decision information support tools (DIST), and any other
6 conceivable applications that may be required based on the nature of the
7 various sessions that can be established between the HIS 12 and the
8 terminals 14A, 14B.

9

10 The purpose of the display formatting function 52 is to format the information
11 to be displayed on the display of a specific one of the terminals 14A, 14B in
12 accordance with the display capability of that display. For instance, the
13 display formatting function 52 may cause an x-ray image to be displayed in
14 its entirety and with high-resolution at one of the fixed terminals 14A having
15 a display of relatively large size and high resolution, yet may cause the same
16 x-ray image to be displayed only in part and/or with low-resolution at one of
17 the mobile terminals 14B (e.g., a PDA) having a display of relatively small
18 size and low resolution. Knowledge of the display capability of each of the
19 terminals 14A, 14B may be stored in the display formatting function 52 or
20 may be obtained from the terminals themselves during sessions between the
21 terminals 14A, 14B and the HIS 12.

22

23 The above-mentioned functions of the POC server 30 implement a so-called
24 "thin client" or "semi-thin client" architecture, whereby the bulk of the
25 processing, such as retrieval, modification, addition, and formatting of
26 information as well as running of applications involved in sessions established
27 between the terminals 14A, 14B and the HIS 12, is mainly handled by the
28 POC server 30. In such an architecture, the terminals 14A, 14B basically act
29 as dependent terminals, primarily providing display and input functions.
30 Advantageously, in such an architecture, sensitive information such as
31 information regarding the hospital's patients does not need to be stored in
32 non-volatile form at the terminals 14A, 14B during established sessions,
33 thereby inhibiting access to such sensitive information via a given one of the
34 terminals, should such be stolen or otherwise compromised. However, it is

1 to be understood that, in other examples of implementation, part or all of the
2 processing involved in sessions established between the terminals 14A, 14B
3 and the HIS 12 may be handled by the terminals 14A, 14B.

4
5 Tag / Detector Subsystem (TDS) 16
6

7 The TDS 16 basically includes a system of tags and tag detectors, with the
8 tags being attached to people (e.g., clinicians) or equipment (e.g., terminals,
9 medical devices) that are to be tracked (e.g., because they are mobile), and
10 the detectors being attached to the entry points into the communications
11 network 10. The tags are referred to as being "wirelessly detectable", in the
12 sense that their presence can be detected by a detector without requiring that
13 a fixed-wire connection be established between the tags and the detector.

14
15 As best seen in Fig. 1B, the tags include a first plurality of tags 36A
16 respectively associated with the clinicians 20 and a second plurality of tags
17 36B respectively associated with the mobile terminals 14B. By way of specific
18 non-limiting example, the tags 36A attached to the clinicians 20 may be in
19 the form of badges clipped to, or sewn into, the clothing of the clinicians 20.

20 As for the tags 36B attached to the mobile terminals 14B, these may take
21 the form of embedded or adhesively mounted devices. Of course, other ways
22 of associating tags 36A to clinicians 20, and associating tags 36B to mobile
23 terminals 14B, will be known to those of ordinary skill in the art and are
24 within the scope of the present invention.

25
26 A given tag 36A, 36B operates in such a way as to allow its location and
27 identity to be detected by a compatible detector. For instance, it may employ
28 a brief radio frequency signal that encodes an identifier of the given tag 36A,
29 36B, hereinafter referred to as a "tag ID" 58. Without being interpreted as
30 a limitation of the present invention, the tags 36A, 36B can be active (i.e. the
31 tag frequently or periodically emits a signal), semi-active (i.e. the tag emits
32 a signal only in response to receiving another signal), or passive (i.e. the tag
33 only reflects a received signal). The decision to use active, semi-active or
34 passive tags depends on various factors such as the required range,

1 precision, and power consumption / battery lifetime / weight considerations.
2 Also, other technologies may be used without departing from the scope of
3 the present invention, such as acoustical, ultrasonic, optical, infrared, etc. As
4 a non-limiting example example, one may use the UWB precision location
5 receivers and tags from Multispectral Solutions, Inc. of Germantown,
6 Maryland, USA.

7
8 The detectors include a first plurality of detectors 34A respectively associated
9 with the fixed-wire terminals 14A and a second plurality of detectors 34B
10 respectively associated with the mobile terminals 14B. The detectors 34A,
11 34B detects aspects of the location of the tags 36A, 36B as well as the tag ID
12 58. For instance, with detectors and tags utilizing RF transmission
13 technologies, and depending on the type of tag used, each of the detectors
14 34A, 34B may include either a receiver for receiving radio frequency signals
15 emitted by active tags, or both a transmitter for emitting radio frequency
16 pulses and a receiver for receiving radio frequency signals emitted (or
17 reflected) by semi-active (or passive) tags in response to the emitted radio
18 frequency pulses.

19
20 As shown in Fig. 1B (which can be viewed as an overlay onto Fig. 1A),
21 detectors 34A are connected to the controller 18 via communication links
22 56A. Since detectors 34A are associated with the fixed terminals 14A, it may
23 prove economical or efficient to use the same physical medium for
24 communication links 57A and 56A. Similarly, detectors 34B are connected to
25 the controller 18 via communication links 56B that may include wireless
26 portions. Since detectors 34B are associated with the mobile terminals 14B,
27 it may prove economical or efficient to use the same physical medium for
28 communication links 57B and 56B. However, this is not a requirement of the
29 present invention.

30
31 Moreover, it is noted that in the case of detectors 34B, the associated mobile
32 terminals 14B are also associated with the tags 36B as indicated above.
33 Hence, in some embodiments, it may prove economical or efficient to equip
34 each mobile terminal 14B with a single radio-frequency device that

1 incorporates an individual detector 34B as well as the associated tag 36B.
2 However, this is not a requirement of the present invention.

3
4 In view of the above, it will be apparent that the detectors 34A, 34B receive
5 signals from one or more nearby tags 36A, 36B, detect the tag IDs 58 in the
6 received signals and communicate the tag IDs 58 to the controller 18 along
7 a set of communication links 56. The information contained in the tag ID 58
8 is unique for the various tags 36A, 36B. Assuming that there is a one-to-one
9 physical association between the clinicians 20 and the tags 36A, then the tag
10 ID 58 for the tag 36A attached to a given clinician 20 can contain the clinician
11 identifier 38 of the given clinician 20. (Alternatively, if the clinician identifier
12 38 needs to be kept confidential, then the tag ID 58 can contain the clinician
13 -specific tag ID 42 for the given clinician 20.) Similarly, if there is a one-to-
14 one physical association between the mobile terminals 14B and the tags 36B,
15 then the tag ID 58 for the tag 36B attached to a given mobile terminal 14B
16 can contain a serial number or MAC address of the given mobile terminal 14B.

17
18 In addition to detecting the tag IDs 58 in the signals received from the tags
19 36A, 36B and forwarding the tag IDs 58 to the controller 18, the detectors
20 34A, 34B generate range messages 54 indicative of the distance between the
21 tags 36A, 36B and the detectors 34A, 34B. The generation of the range
22 messages 54 can be based on the intensity of the received signals, or on the
23 round-trip travel time of individual tag IDs. The range messages 54 may
24 contain information permitting the determination of range (distance) between
25 a given detector and a given tag, or they may reflect the result of signal
26 processing at the given detector by virtue of which it was concluded that the
27 given tag is "in proximity" to the given detector. Those skilled in the art will
28 appreciate that still other parameters or characteristics of a signal received
29 at a particular detector may serve as the basis to generate the range
30 messages 54 for a particular tag ID 58 relative to a particular detector 34A,
31 34B.

32
33 It should also be understood that in cases where clinicians 20 are assumed
34 at all times to be using specifically assigned mobile terminals 14B, the need

1 for separate tags 36A, 36B attached to both the clinicians 20 and the mobile
2 terminals 14B may be obviated, as long as the single tag contains the ability
3 to convey authentication data from the clinician, as may be required in order
4 to satisfy security constraints. Rather, a single set of tags (either 36A or
5 36B) would suffice to enable the various functions described herein.

6
7 It will thus be appreciated from the foregoing, as well as from portions of the
8 description to follow, that detection by a particular detector of the tag ID 58
9 corresponding to a particular tag may lead to a conclusion that a clinician 20
10 or mobile terminal 14B is somewhere in the vicinity of the particular detector.

11 In the case of a suspected nearby clinician 20, this implied knowledge should
12 be confirmed by way of an authentication process, which will be described in
13 further detail in the next section.

14 15 Authentication Entity 28

16
17 The authentication entity 28 comprises suitable software, hardware and/or
18 control logic for implementing an authentication process 70, which positively
19 confirms the clinician's identity and which manages access of the clinicians 20
20 to the HIS 12 via the terminals 14A, 14B. It should be understood that the
21 authentication entity 28 may be a separate entity or it may be integrated to
22 the controller 18 or to the POC server 30, for example.

23
24 The authentication process 70 is now described in greater detail with
25 additional reference to Figs. 2A and 2B. More particularly, at step 202, the
26 authentication entity 28 receives from the controller 18 the clinician identifier
27 of a candidate clinician 20 who needs to be authenticated. This may be
28 triggered under various conditions described later on in greater detail. Let
29 the clinician identifier of the candidate clinician 20 be denoted 38* and let the
30 authentication information for the candidate clinician 20 be denoted 40*.

31
32 The authentication process 70 then proceeds to step 204, where
33 authentication data is requested from the candidate clinician 20. One
34 example of authentication data is a password; another example of

1 authentication data is biometric information. To this end, the badges worn
2 by clinicians 20 may optionally be enhanced with a fingerprint reader
3 operative to generate data indicative of a fingerprint of anyone (including of
4 course the clinician himself/herself) touching the fingerprint reader. A non-
5 limiting example of a fingerprint reader that is adequately dimensioned to be
6 incorporated into a badge in the manner contemplated herein is the
7 FingerLoc® AF-S2 fingerprint sensor manufactured by AuthenTec, Inc.
8 Melbourne, Florida, USA, (see also www.authentec.com). The fingerprint of
9 the candidate clinician 20 would be scanned by the sensor and the results of
10 the scan transmitted to the authentication entity 28. The results of the scan
11 may be in the form of a digitized image of the fingerprint or other metrics
12 derived from local processing of the image.

13

14 Responsive to receipt of the authentication data, the authentication process
15 70 proceeds to step 206, where the authentication entity 28 communicates
16 with the clinician database 22 (via the data mining function 48) to obtain, for
17 comparison purposes, the stored authentication information 40* for the
18 candidate clinician 20. This can be done by supplying to the clinician
19 database 22 the clinician identifier 38* of the candidate clinician 20, which
20 was supplied by the controller 18 at step 202.

21

22 The authentication process 70 then proceeds to step 208, where an
23 authentication result is generated. Specifically, the received authentication
24 data is compared to the stored authentication information 40* for the
25 candidate clinician 20 as obtained from the clinician database 22 at step 206.

26 The authentication result will be a success when there is a match and a
27 failure otherwise. At step 210, the authentication result is returned to the
28 controller 18, where consequential actions are taken in a manner that will be
29 described in greater detail herein below.

30

31 It should be understood that steps 206 and 208 of the authentication process
32 70 may be replaced by a single step whereby the authentication entity 28
33 sends the received authentication data to the clinician database 22,
34 prompting the latter to effect the comparison with the stored authentication

1 information 40* for the candidate clinician 20 and to return the authentication
2 result to the authentication entity 28. This alternative approach may be
3 advantageous from the point of view of data security, since the stored
4 authentication information 40* for the candidate clinician 20 need not exit the
5 clinician database 22.

6
7 It should also be understood that other layers of security and authentication
8 may be provided without departing from the scope of the present invention.

9 For example, the tag IDs 58 may be encrypted to prevent spoofing of the
10 authentication information by a non-valid tag. In addition, or alternatively,
11 the tags 36A can contain memory and processing to associate a clinician's
12 biometric data (such as a fingerprint) to that tag so that authentication is
13 performed locally at the tag either in addition to, or instead of, at the
14 authentication entity 28.

15 16 Controller 18

17
18 As previously mentioned, the controller 18 is connected to the TDS 16 by the
19 communication links 56A, 56B, to the terminals 14A, 14B by the
20 communication links 57A, 57B, as well as to the authentication entity 28 and
21 to the POC server 30. In this first system architecture, the controller 18
22 comprises suitable software, hardware and/or control logic for implementing
23 a clinician proximity monitoring process 80 that operates in the background
24 until it detects that a certain condition is satisfied, whereupon further
25 processing operations are performed. The detailed operation of the controller
26 18 is now described, beginning with the clinician proximity monitoring process
27 80.

28 29 Clinician Proximity Monitoring Process 80

30
31 The clinician proximity monitoring process 80 monitors the output of the TDS
32 16 to decide when individual clinicians 20, for whom sessions have not been
33 established, are considered "in proximity" to individual ones of the terminals
34 14A, 14B. As will be described later on, being deemed "in proximity" has

1 attributes of distance (usually less than a pre-set threshold value) and may
2 also have attributes of time/duration, since a person transiting past a location
3 has a different intent than someone remaining within a certain distance of a
4 location for a certain duration. In one embodiment, the clinician proximity
5 monitoring process 80 operates in the background until it detects that a
6 trigger condition is satisfied, whereupon further processing operations are
7 performed

8
9 With reference to Fig. 3A, it is recalled that in this first system architecture,
10 clinicians 20 are associated with tags 36A, and detectors 34A, 34B are
11 terminal-specific. In other words, a given clinician of interest (denoted 20*)
12 being "in proximity" to a given terminal of interest (denoted 14*) amounts
13 to the tag 36A associated with clinician 20* being "in proximity" to the
14 detector 34A, 34B associated with terminal 14*. The ability of the clinician
15 proximity monitoring process 80 to make decisions regarding individual
16 clinicians 20 (including clinician 20*) being in proximity to terminal 14* stems
17 from the processing of tag IDs 58 and range messages 54 received from the
18 TDS 16.

19
20 The definition of "in proximity" may vary in accordance with operational
21 requirements. In one embodiment, clinician 20* being "in proximity" to
22 terminal 14* may be defined as satisfaction of a computed "proximity
23 condition", which occurs when the estimated distance between clinician 20*
24 and terminal 14* is below a threshold distance, continuously, for at least the
25 duration of a time window. Generally speaking, a judicious choice of distance
26 and/or the distance-time relationship ensures smooth, easy attachment and
27 authentication for clinicians desirous of such events while not triggering "false
28 starts" due to transient clinician traffic passing nearby terminal 14*. Too
29 "close" a distance threshold leads to trouble triggering a greeting
30 message/opportunity to authenticate, while too "far" a distance threshold
31 leads to triggering numerous unnecessary greeting messages, which may
32 ultimately affect existing sessions and/or core system load. Moreover, too
33 brief a "time window" results in increased likelihood of false "in proximity"
34 detections, while too lengthy a "time window" (say more than 1-2 seconds)

1 will make the system seem sluggish and unresponsive. Additionally, the
2 proximity condition may be variable in terms of both distance and duration
3 – for instance a closer distance requiring a shorter time window. Of course,
4 it is within the scope of the present invention to further refine the definition
5 of the proximity condition using additional factors. For instance, such
6 additional factors may include the identity or professional role of clinician 20*,
7 the physical location of static equipment in the hospital and/or the hospital
8 department in which terminal 14* is located.

9
10 Once the clinician proximity monitoring process 80 has determined that the
11 proximity condition has been satisfied for clinician 20* with respect to
12 terminal 14*, the controller 18 executes a session establishment process 82,
13 shown in Fig. 1C and now described with additional reference to Figs. 3B and
14 3C.

15 16 Session Establishment Process 82

17
18 Although the clinician proximity monitoring process 80 has deemed clinician
19 20* to be in proximity to terminal 14*, his or her intent to use terminal 14*
20 has not yet been established. Accordingly, at step 302 of the session
21 establishment process 82, the controller 18 sends a command to the display
22 formatting function 52, causing the latter to display a greeting message on
23 the display of terminal 14* for clinician 20*. For instance, assuming that
24 clinician 20* is a certain Dr. Jones, the greeting message displayed on the
25 display of terminal 14* may be *"Welcome Dr. Jones. Please confirm your*
26 *identity if you wish to use this terminal."*, or any conceivable variant thereof.

27 It is noted that since the identity of terminal 14* is considered to be known
28 by the display formatting function 52, its display capabilities will also be
29 known *a priori*.

30
31 Meanwhile, or following execution of step 302, the controller 18 proceeds to
32 step 304, which causes execution of a preliminary processing operation in
33 anticipation of potential establishment of a session for clinician 20* between
34 the HIS 12 and terminal 14*. In a non-limiting example of a preliminary

1 processing operation, the controller 18 sends a command to the data mining
2 function 48 in the POC server 30, causing the latter to pre-fetch information
3 from the clinician database 22, the patient database 24, the departmental
4 database 26, the equipment database 35 and/or the external database 27 in
5 anticipation of potential establishment of a session for clinician 20*.

6

7 In the specific non-limiting case where clinician 20* is a physician, the pre-
8 fetched information may include one or more of the profile of the physician;
9 the access privileges of the physician; a list of patients under the
10 responsibility of the physician; information (e.g., an electronic health record
11 47, or a portion thereof) related to one or more patients in the list of patients
12 under the responsibility of the physician; and information related to one or
13 more patients in proximity to terminal 14*.

14

15 It should be appreciated that the identity of patients in proximity to terminal
16 14* can be obtained in various ways. In one embodiment, terminal 14* is
17 one of the fixed-wire terminals 14A, and the knowledge of nearby patients is
18 obtained on the basis of information stored in the patient database 24, the
19 departmental database 26, the equipment database 35 and/or the external
20 database 27, such as the location of terminal 14* within the hospital and the
21 location of each patient's bed within the hospital. In another embodiment,
22 each patient is provided with a tag such as a tag in the form of a bracelet
23 worn by the patient. In such an embodiment, the tag of a patient interacts
24 with the detector 34A of terminal 14* in the aforementioned manner, allowing
25 the controller 18 to learn of the relative proximity of each patient to terminal
26 14*. Alternatively, a standard RF-ID tag could be used, although in such an
27 embodiment, there may be limitations in terms of range that need to be
28 taken into consideration.

29

30 In addition, the information that is pre-fetched may also be organized or
31 filtered by using the clinician's location and identity. For example, the list of
32 patients for a particular physician may be sorted by those whose assigned
33 beds are nearest the particular physician.

34

1 The information that is pre-fetched by the data mining function 48 is kept in
2 a holding location 74 that is accessible to the session management function
3 53 but as yet inaccessible to clinician 20* deemed to be in proximity to
4 terminal 14*. More specifically, the pre-fetched information will become
5 available to clinician 20* once a session is established for clinician 20*, but
6 such a session has not yet been established because (1) the intent of clinician
7 20* to use terminal 14* is still not known; and (2) clinician 20* has not been
8 authenticated (for example, it has not yet been confirmed that the individual
9 who is presumed to be Dr. Jones by virtue of information received from the
10 TDS 16 really is Dr. Jones).

11

12 At step 306, the controller 18 continues to attempt to establish the intent of
13 clinician 20* to use terminal 14* by waiting for input from clinician 20* in
14 response to the greeting message. At this point, two basic outcomes are
15 possible. In the first outcome, clinician 20* ignores the greeting message.
16 Accordingly, the controller 18 will detect an absence of a response for a
17 predetermined amount of time and will conclude that there is no intent by
18 clinician 20* to use terminal 14*. This leads to execution of step 308,
19 whereby a command is sent to the display formatting function 52, causing the
20 greeting message to disappear from the display of terminal 14*. In addition,
21 the controller 18 performs step 310, which is optional, whereby a command
22 is sent to the session management function 53 to delete the pre-fetched
23 information in the holding location 74 in order to avoid potential security leaks
24 due to hacking. In an alternative embodiment, step 310 is replaced by a
25 different series of steps, whereby the pre-fetched data may be held in the
26 holding location 74 until clinician 20* leaves the vicinity of terminal 14*, so
27 that the pre-fetched data can be delivered quickly, should clinician 20* later
28 decide, during his/her patient encounter, to initiate a session. Thus, even
29 though a session is not established for clinician 20*, it can be said that the
30 pre-fetched data is held in trust for clinician 20*.

31

32 However, in the alternate outcome of step 306, clinician 20* does indeed
33 respond to the greeting message in a timely manner, e.g., by pressing a key
34 or touching the screen. This is interpreted by the controller 18 as an intent

1 to use terminal 14*, and leads to step 312. Specifically, the controller 18
2 sends a message to the authentication entity comprising the clinician
3 identifier of clinician 20*, denoted 38*. Receipt of clinician identifier 38* by
4 the authentication entity 28 triggers the authentication process 70 previously
5 described with reference to Figs. 2A and 2B, which typically involves the
6 submission of authentication data 40* by clinician 20* (e.g., via a fingerprint
7 reader).

8

9 In an alternative embodiment, steps 302 and/or 312 may be omitted. For
10 example, without having executed step 302, the controller 18 proceeds to
11 step 304, which causes execution of a preliminary processing operation in
12 anticipation of potential establishment of a session for clinician 20* between
13 the HIS 12 and terminal 14*. At this point, without having displayed a
14 greeting message, the controller 18 is attentive to clinician 20* requesting a
15 session by touching a fingerprint reader on clinician 20*'s badge. This will be
16 interpreted by the controller 18 as an intent to use terminal 14* as well as a
17 submission of authentication data 40* by clinician 20*. In other words, steps
18 302 and 312 can be omitted if the mere fact that authentication data is
19 submitted by clinician 20* serves to confirm the intent of clinician 20* to use
20 terminal 14*. Hence, the use of greetings is not required. Of course,
21 whether or not a greeting message is used is a design consideration, and both
22 approaches are to be considered as being within the scope of the present
23 invention.

24

25 In either case, at step 314, the controller 18 receives an authentication result
26 from the authentication entity 28. If the authentication result is a failure,
27 then clinician 20* may be allowed to make one or more additional attempts
28 to authenticate himself or herself in accordance with security policies in effect.
29 However, if authentication fails each time, then clinician 20* is denied access
30 to the information contained in the HIS 12, i.e. no session is established for
31 clinician 20*. Specifically, at step 316, the controller 18 sends a command
32 to the display formatting function 52, causing a change in the display of
33 terminal 14* (e.g., blank screen). In addition, the controller 18 performs
34 step 318, whereby a command is sent to the session management function

1 53 to delete the pre-fetched information in the holding location 74 in order
2 to avoid potential security leaks due to hacking.

3

4 On the other hand, the authentication result may be a success, in which case
5 the controller 18 proceeds to step 320, where additional processing is
6 performed in order to effect establishment of a session for clinician 20*.
7 Specifically, the controller 18 sends a message to the session management
8 function 53 in the POC server 30, which indicates to the session management
9 function 53 that the clinician who is deemed to be at terminal 14* is
10 permitted to access the pre-fetched information in the holding location 74 as
11 well as possibly other information in the HIS 12. With specific reference to
12 Fig. 3C, the session management function 53 establishes a connection 350
13 between the HIS 12 and terminal 14*, allowing clinician 20* to exchange
14 information with the HIS 12 via terminal 14*. The connection 350 is
15 hereinafter referred to as a "session", while terminal 14* is said to "support"
16 the session 350 for clinician 20*.

17

18 It will thus be appreciated that establishment of the session 350 for clinician
19 20* at terminal 14* has been facilitated by (1) preparing information in
20 anticipation of the intent of clinician 20* to use terminal 14*, thereby
21 reducing the real-time computational load of the POC server 30 and other
22 elements of the HIS 12; and (2) simplifying the log-in procedure for clinician
23 20* to a "confirmation of identity" procedure, whereby clinician 20* is simply
24 required to provide data for his or her authentication; this can
25 advantageously be done by clinician 20* touching a fingerprint reader on his
26 or her badge.

27

28 It should also be understood that, in some situations, two or more clinicians
29 20 may be in proximity to terminal 14* at a given instant. In those
30 situations, the controller 18 may then cause the POC server 30 to pre-fetch
31 information related to each one of the nearby clinicians 20 in anticipation of
32 potential establishment of a session for one or more of these individuals at
33 terminal 14*. In cases where more than one of the nearby clinicians 20
34 simultaneously wish to use terminal 14*, the controller 18 may effect

1 establishment and management of a session for a given one of those
2 individuals based on a "first to authenticate" basis or based on an access
3 priority for each one of those individuals (e.g. the access privileges of the
4 nearby clinicians 20 may specify that one, e.g., a doctor, has access priority
5 over the other, e.g., a nurse, etc.).

6 7 Conduct Session Process 84

8
9 Once the session 350 is established, the controller 18 enters a "conduct
10 session" process 84 for the session 350, which is transparent to most of the
11 goings on between clinician 20* and the session management function 53.

12 For example, the conduct session process 84 transparently allows the session
13 management function 53 to implement a graphical user interface (GUI) that
14 presents information and applications available for use by clinician 20* during
15 the session 350. Of course, the actual display of information on terminal 14*
16 will continually be formatted by the display formatting function 52 in
17 accordance with the display capabilities of terminal 14*.

18
19 During the session 350, clinician 20* may perform a variety of activities
20 leading to any one of the following non-limiting example scenarios **A-** through
21 **D-**.

22 23 **A- PROVIDE TRADITIONAL POINT-OF-CARE SERVICES**

24
25 Consider the case where clinician 20* is a physician and terminal 14* is a
26 fixed-wire terminal near the bed of a particular patient. In this scenario, the
27 physician accesses one of the application functions 50, which allows the
28 physician to retrieve information from, or add observations and diagnostic
29 information to, the electronic health record 47 of the patient, order a certain
30 treatment or test to be given to the patient, use various application functions
31 50 such as decision information support tools (DIST), etc.

32 33 **B- PERFORM LOCATION-BASED POINT-OF-CARE FUNCTIONS**

1 Consider the case where terminal 14* is a mobile terminal, such as a PDA,
2 which has inferior display capabilities to those required for a particular
3 function (e.g., viewing X-ray images). In this scenario, clinician 20* accesses
4 a location-based POC function (e.g., one of the application functions 50 in the
5 POC server 30, or a separate function in the controller 18) which informs
6 clinician 20* of the nearest available terminal having the required display
7 capabilities.

8
9 Specifically, the indication provided by location-based POC function can be
10 based on knowledge of the particular communications link 57B and WLAN
11 access point 60 that the PDA (i.e., terminal 14*) is using to communicate
12 with the POC server 30, thereby allowing a list of terminals in the "coverage
13 zone" of the WLAN access point 60 (or of a plurality of WLAN access points)
14 to be identified. Combined with knowledge at the POC server 30 of which of
15 the terminals in the list are available for use, the capabilities of these
16 terminals and the display quality required by the image to be viewed, this
17 allows identification of the nearest available terminal having the required
18 display capability. Let this nearest available terminal be denoted 14+. As a
19 possible option, the location-based POC function may allow clinician 20* to
20 "reserve" terminal 14+ for a short period of time, say 2 minutes (to cover the
21 estimated walking time of clinician 20* to reach terminal 14+).

22 23 **C- EXPLICITLY TERMINATE THE SESSION**

24
25 Consider the case where clinician 20* wishes to terminate the session 350.
26 In this scenario, clinician 20* interacts with the session management
27 function 53 to perform a log-off procedure to terminate the session 350. For
28 example, this can be effected by entering a log-off command at terminal 14*,
29 e.g., by clicking on a log-out icon on the display of terminal 14*. This
30 command is detected by the session management function 53 which, in
31 response, sends a command to the display formatting function 52, causing
32 a change in the display of terminal 14* (e.g., blank screen). In addition, the
33 session management function 53 deletes session-related information it may
34 have stored (such as pre-fetched information in the holding location 74).

1

2 **D- EXPLICITLY SUSPEND THE SESSION**

3

4 Consider the case where clinician 20* wishes to suspend the session 350 for
5 various reasons (e.g., snack break, migration to another terminal, etc.). In
6 this scenario, clinician 20* interacts with the session management function
7 53 to trigger a session suspend process to suspend the session 350. For
8 example, this can be effected by entering a suspend command at terminal
9 14*, e.g., by clicking on a suspend icon on the display of terminal 14*. This
10 command is detected by the session management function 53 which, in
11 response, sends a command to the display formatting function 52, causing
12 a change in the display of terminal 14* (e.g., blank screen). However, the
13 session management function 53 does not delete session-related information,
14 since the session may be resumed by clinician 20* at a later time in a variety
15 of ways.

16

17 If the session 350 remains suspended for a considerable length of time (e.g.,
18 beyond a certain threshold such as 10 minutes) without having been resumed
19 in one of the variety of ways alluded to above, then the session suspend
20 process in the session management function 53 may autonomously terminate
21 the session 350, which will result in deletion of session-related data such as
22 the pre-fetched data in the holding location 74.

23

24 Although it is transparent for most of the activities conducted during the
25 session 350, the conduct session process 84 nevertheless continues to
26 monitor the information from the TDS 16 in order to detect certain conditions
27 of clinician-terminal proximity and terminal-terminal proximity. Specifically,
28 during the session 350, clinician 20* may perform a variety of activities in
29 addition to the above, which may lead to one of the following non-limiting
30 example scenarios **E-** through **G-**.

31

32 **E- MOVE AWAY FROM TERMINAL 14***

33

34 Consider the case where clinician 20* leaves the vicinity of terminal 14*

1 without having terminated or suspended the session 350. One situation in
2 which this may occur is when clinician 20* has identified (or has been
3 directed to) a nearby terminal with superior display capabilities (see **B-**
4 above) and heads towards that terminal. Another situation in which this may
5 occur is when clinician 20* simply forgets to terminate or suspend the session
6 350.

7
8 In each of these and myriad other example scenarios, the conduct session
9 process 84 will detect, using the data available from the TDS 16, that clinician
10 20* is no longer within a certain distance of terminal 14*. More generally,
11 clinician 20* can be said to satisfy a computed "remoteness condition".
12 However, it is not yet clear whether clinician 20* did or did not intend to
13 terminate the session. Thus, instead of terminating the session immediately,
14 the conduct session process 84 causes the session to be suspended by
15 causing the session management function 53 to autonomously execute the
16 session suspension process (see **D-** above).

17
18 Clearly, the autonomous suspension of the session 350 based on deeming
19 clinician 20* to have left the vicinity of terminal 14* reduces the potential of
20 confidential information being viewed at terminal 14* by a patient, passerby
21 or unauthorized clinician, as well as reduces the possibility of undesired
22 access to the HIS 12 via terminal 14* without having clinician 20* nearby.
23 The overall effect is an increase in the security of the HIS 12 and the
24 information contained therein.

25

26 **F- APPEAR IN PROXIMITY TO A TERMINAL (WITH PREVIOUSLY**
27 **SUSPENDED SESSION)**

28

29 Consider the case where the session 350 has been suspended as described
30 herein above (e.g., either by explicit action on the part of clinician 20* or
31 autonomously as a result of clinician 20* having left the vicinity of terminal
32 14*). In addition, clinician 20* approaches a terminal, denoted 14+, which
33 may or may not be the same terminal 14* as the one previously used by
34 clinician 20* at the time the session 350 was suspended. The conduct

1 session process 84 will detect, using the data available from the TDS 16, that
2 clinician 20* is in proximity to terminal 14+. This triggers a session
3 resumption process, now described with reference to Fig. 4.

4

5 At this stage, it is not yet known whether clinician 20* intends to use terminal
6 14+. Thus, the conduct session process 84 begins by establishing the intent
7 of clinician 20* to access the HIS 12 at terminal 14+. Specifically, at step
8 402, the conduct session process 84 sends a command to the display
9 formatting function 52, causing the latter to display a greeting message on
10 the display of terminal 14+. Since the session 350 is in a suspended state,
11 the greeting message may be adapted to reflect this fact. For instance,
12 assuming that clinician 20* is still presumed to be Dr. Jones, the greeting
13 message displayed on the display of terminal 14+ may be *"Welcome Dr.*
14 *Jones. Please confirm your identity if you wish to resume your session at this*
15 *terminal."*, or any conceivable variant thereof. It is noted that since the
16 identity of terminal 14+ is considered to be known *a priori* by the display
17 formatting function 52, its display capabilities will also be known. Of course,
18 if terminal 14+ is different from terminal 14*, its display capabilities may be
19 different as well. This leads to the advantageous situation where the
20 information displayed to clinician 20* is tailored to the terminal in use.

21

22 Meanwhile, or following execution of step 402, the controller proceeds to step
23 404, where a preliminary processing operation is caused to take place. In a
24 non-limiting example of a preliminary processing operation, the conduct
25 session process 84 causes a command to be sent to the data mining function
26 48 in the POC server 30, causing the latter to pre-fetch information from the
27 clinician database 22, the patient database 24, the departmental database
28 26, the equipment database 35 and/or the external database 27. Now, it is
29 recalled that the session 350 for clinician 20* has been suspended. Hence,
30 portions of the preliminary processing operation that would otherwise be
31 required are not needed.

32

33 Specifically, in the case where clinician 20* is a physician, the pre-fetched
34 information which is already in the holding location 74 due to the session 350

1 having been previously established may include one or more of the profile of
2 the physician; access privileges of the physician; a list of patients under the
3 responsibility of the physician; and information (e.g., an electronic health
4 record 47, or a portion thereof) related to one or more patients in the list of
5 patients under the responsibility of the physician. Thus, the preliminary
6 processing operation performed at step 404 can be limited to other
7 information specifically related to terminal 14+. For example, this
8 information may relate to one or more patients in proximity to terminal 14+.
9 (If terminal 14+ is the same as terminal 14*, then even this last piece of
10 information does not need to be pre-fetched during execution of step 404.)

11

12 The information that is pre-fetched by the data mining function 48 during
13 step 404 is added to the other information in the holding location 74 that is
14 accessible to the session management function 53 but as yet inaccessible to
15 clinician 20*. More specifically, the pre-fetched information will become
16 available to clinician 20* once the session 350 is resumed, but it is not yet
17 appropriate to resume the session 350 because (1) the intent of clinician 20*
18 to use terminal 14+ is not known; and (2) clinician 20* has not been
19 authenticated (in this example, it has not yet been confirmed that the
20 individual who is presumed to be Dr. Jones by virtue of information received
21 from the TDS 16 really is Dr. Jones).

22

23 From this point on, the remainder of the steps performed by the conduct
24 session process 84 are similar, although sometimes not identical, to steps
25 306-320 described previously with reference to Fig. 3A. At step 406, the
26 conduct session process 84 continues to attempt to establish the intent of
27 clinician 20* to use terminal 14+ by waiting for input from clinician 20* in
28 response to the greeting message. At this point, two basic outcomes are
29 possible. In the first outcome, clinician 20* ignores the greeting message.
30 Accordingly, the conduct session process 84 will detect an absence of a
31 response for a predetermined amount of time and will conclude that there is
32 no intent by clinician 20* to use terminal 14+. This leads to execution of step
33 408, whereby a command is sent to the display formatting function 52,
34 causing the greeting message disappear from the display of terminal 14+.

1 However, no command is issued to cause deletion of the pre-fetched
2 information in the holding location 74, since there is an underlying
3 assumption that clinician 20* will eventually wish to resume the session 350,
4 although perhaps not at terminal 14+. Rather, deletion of pre-fetched
5 information related to the suspended session 350 may occur for other
6 reasons, such as the amount of time during which the session 350 has been
7 suspended (see **D-** above).

8

9 When clinician 20* does indeed respond to the greeting message in a timely
10 manner, e.g., by pressing a key or touching the screen, this is interpreted by
11 the conduct session process 84 as an intent to use terminal 14+, and leads
12 to step 412. Specifically, the conduct session process 84 causes a message
13 to be sent the authentication entity 28, comprising the clinician identifier 38*
14 of clinician 20*. Receipt of the clinician identifier 38* by the authentication
15 entity 28 triggers the authentication process 70 previously described with
16 reference to Figs. 2A and 2B, which typically involves the submission of
17 authentication data by clinician 20* (e.g., via a fingerprint reader). It should
18 be understood that step 412 can be omitted if the submission of
19 authentication data (e.g., touching the fingerprint reader) is itself used to
20 confirm one's intent to use terminal 14+.

21

22 In either case, at step 414, the conduct session process 84 receives an
23 authentication result from the authentication entity 28. If the authentication
24 result is a failure, then clinician 20* may be allowed to make one or more
25 additional attempts to authenticate himself or herself in accordance with
26 security policies in effect. However, if the authentication result is a failure
27 each time, then clinician 20* is denied access to the information contained in
28 the HIS 12, i.e. the session 350 is not resumed. In fact, the conduct session
29 process 84 may go so far as to cause termination of the suspended session
30 350 by issuing a command at step 416. This command is detected by the
31 session management function 53 which, as previously described (see **C-**
32 above), sends a command to the display formatting function 52, causing a
33 change in the display of terminal 14* (e.g., blank screen) and deletes
34 session-related information it may have stored (such as pre-fetched

1 information in the holding location 74).

2

3 On the other hand, the authentication result may be a success, which leads
4 to resumption of the session 350 for clinician 20*. Specifically, at step 420,
5 the conduct session process 84 causes a message to be sent to the session
6 management function 53 in the POC server 30, which indicates to the session
7 management function 53 that the clinician deemed to be at terminal 14+
8 should be permitted to regain access to the pre-fetched information in the
9 holding location 74 as well as other information in the HIS 12. The session
10 management function 53 then establishes a new connection, this time
11 between the HIS 12 and terminal 14+, allowing clinician 20* to exchange
12 information with the HIS 12 and perform the various other functions referred
13 to above. The new connection represents a resumed version of the once
14 suspended session 350, and is now supported by terminal 14+.

15

16 It will thus be appreciated that resumption of a session for clinician 20* at
17 terminal 14+ has been facilitated by (1) relying on pre-fetched information
18 in anticipation of the clinician's intent to use terminal 14+, thereby reducing
19 the real-time computational load of the POC server 30 and other elements of
20 the HIS 12; and (2) simplifying the re-log-in procedure for clinician 20* to a
21 "confirmation of identity" procedure, whereby clinician 20* is simply required
22 to provide data for his or her authentication; this can advantageously be done
23 by touching a fingerprint reader on his or her badge.

24

25 **G- APPEAR IN PROXIMITY TO A NEW TERMINAL 14+, ACCOMPANIED**
26 **BY TERMINAL 14* (WHICH CONTINUES TO SUPPORT AN ONGOING**
27 **SESSION)**

28

29 With reference to Fig. 5A, consider the case where clinician 20* approaches
30 a new terminal, denoted 14+, while a session 550 is ongoing between the HIS
31 12 and terminal 14*. One situation in which this may occur is when clinician
32 20* is a physician communicating with the HIS 12 through the physician's
33 PDA (in this case terminal 14* which supports the session 550) and the
34 physician wishes to view certain information on a fixed terminal with

1 advanced display capabilities (in this case terminal 14+ which is being
2 approached). Of course, it should be understood that the following
3 description also applies to the case where the terminal being approached
4 (i.e., terminal 14+) is a mobile terminal.

5

6 Based on data available from the TDS 16, the conduct session process 84
7 detects that terminal 14* is in proximity to terminal 14+. This causes the
8 conduct session process 84 to trigger a live session transfer process, now
9 described with reference to the flowchart in Fig. 5B. Specifically, at step 502,
10 the conduct session process 84 causes a command to be sent to the display
11 formatting function 52, which causing the latter to display a greeting message
12 on the display of terminal 14+ for clinician 20*. For instance, assuming that
13 clinician 20* is Dr. Jones, the greeting message displayed on the display of
14 terminal 14+ may be *"Welcome Dr. Jones. Please confirm your desire to
15 transfer your session to this terminal."*, or any conceivable variant thereof.

16 It is noted that since the identity of terminal 14+ is known to the display
17 formatting function 52, its display capabilities will also be known.

18

19 Meanwhile or following execution of step 502, the conduct session process 84
20 executes step 504, whereby a preliminary processing operation is performed.

21 In a non-limiting example of a preliminary processing operation, the conduct
22 session process 84 causes a command to be sent to the data mining function
23 48 in the POC server 30, causing the latter to pre-fetch information from the
24 clinician database 22, the patient database 24, the departmental database
25 26, the equipment database 35 and/or the external database 27. However,
26 it is recalled that the session 550 for Dr. Jones is ongoing between the HIS
27 12 and terminal 14*. Therefore, certain elements of the preliminary
28 processing operation that would otherwise be required are not needed.

29

30 For example, where clinician 20* is a physician, the information which is
31 already in the holding location 74 by virtue of prior establishment of the
32 session 550 includes one or more of: the profile of the physician, access
33 privileges of the physician, a list of patients under the responsibility of the
34 physician, and information (e.g., an electronic health record 47, or a portion

1 thereof) related to one or more patients in the list of patients under the
 2 responsibility of the physician. Thus, the preliminary processing operation
 3 performed at step 504 can be limited to pre-fetching additional information
 4 specifically related to terminal 14+, such as information relating to the
 5 patients that may find themselves near terminal 14+.

6
 7 Generally speaking, at this stage, the information in the holding location 74
 8 pertains to two terminals that are related to one another by a common
 9 clinician 20* and a common session 550. One of these terminals is the one
 10 with which clinician 20* had an ongoing session before approaching the other.

11 Thus, one of these terminals can have the status of a "session transferor"
 12 and the other can have the status of a "session transferee". In this example,
 13 terminal 14* is the session transferor and terminal 14+ is the session
 14 transferee. Moreover, each of the terminals is associated with a session page
 15 delivery indicator that indicates which "pages" of the session 550 are
 16 currently being supported by that terminal. At this stage in the live session
 17 transfer process, the session transferor supports the entirety of the session
 18 550 and the session transferee does not yet support any of the session 550.

19
 20 In order to help keep track of which terminal is the session transferor and
 21 which terminal is the session transferee for a variety of sessions, the
 22 controller 18 may store a table 85 that is accessible to the conduct session
 23 process 84. The table 85, which can be stored in the controller 18 or
 24 elsewhere, may resemble the following (for the as yet untransferred session
 25 550). Note that terminal 14+ does not yet have the knowledge that it is
 26 about to have certain pages of the session 550 transferred to it:

27

Terminal	Session	Status	Pages
14*	550	Transferor	All
14+	N/A	N/A	None

28

29 Next, the conduct session process 84 proceeds to establish the intent of
 30 clinician 20* to transfer at least a portion (e.g., certain pages) of the session
 31 550 from terminal 14* (the session transferor) to terminal 14+ (the session

1 transferee). Thus, at step 506, the conduct session process 84 waits for input
2 from clinician 20* in response to the greeting message. At this point, two
3 basic outcomes are possible. In the first outcome, clinician 20* ignores the
4 greeting message. Accordingly, the conduct session process 84 will detect an
5 absence of a response for a predetermined amount of time and will conclude
6 that there is no intent by clinician 20* to transfer any pages of the session
7 550 to terminal 14+. This leads to execution of step 508, whereby a
8 command is sent to the display formatting function 52, causing the greeting
9 message disappear from terminal 14+. However, no command is issued to
10 cause deletion of the pre-fetched information in the holding location 74, since
11 the session 550 is still ongoing between clinician 20* and terminal 14*. Thus,
12 operation of terminal 14* (the session transferor) remains unaffected.

13

14 In the other possible outcome, clinician 20* responds to the greeting
15 message in a timely manner to signal an intent to transfer at least a portion
16 (e.g., some pages) of the session 550 to terminal 14+ or to resume a given
17 session at a given point or page. This can occur in the various ways
18 previously described, such as a pressing a key or touching the screen of
19 terminal 14+.

20

21 In addition, the response provided by clinician 20* may indicate the pages of
22 the session 550 that are to be transferred (e.g., the entire session, only
23 visualization of images, etc.) to the session transferee. Alternatively, the
24 portion of the session 350 to be transferred to terminal 14+ may be
25 established by the application context. For example, if clinician 20* has
26 requested an X-ray image on his/her PDA (terminal 14*) and the application
27 has noted the unsuitability of the PDA display and has directed clinician 20*
28 to a terminal that does have a suitable display, then the application can
29 remain in control of displaying the X-ray image on the high quality terminal
30 (terminal 14+), once clinician 20* is authenticated as being at that terminal.

31

32 Another way in which clinician 20* can signal an intent to transfer at least a
33 portion of the session 550 to terminal 14+ is by bringing terminal 14* closer
34 to terminal 14+ than what initially caused the conduct session process 84 to

1 deem that terminal 14* was "in proximity" to terminal 14+. Generally, this
2 can be referred to causing terminal 14* to satisfy a computed "terminal
3 proximity condition" with respect to terminal 14+. The terminal proximity
4 condition may be defined by a different distance-time relationship than the
5 "proximity condition" defined earlier. Of course, it is within the scope of the
6 present invention to further refine the definition of the terminal proximity
7 condition using additional factors. For instance, such additional factors may
8 include the type of terminal 14* and the type of terminal 14+.

9

10 The conduct session process 84 therefore monitors the data available from
11 the TDS 16 to detect whether terminal 14* has indeed satisfied the terminal
12 proximity condition relative to terminal 14+. If this is the case, then the
13 conduct session process 84 concludes that clinician 20* intends to transfer at
14 least a portion of the session 550 to terminal 14+. Whether the session is
15 fully or partly transferred is a design consideration, and may further be made
16 selectable (e.g., by requiring user input via a keyboard or by requiring that
17 terminal 14* be moved so as to satisfy a computed "terminal remoteness
18 condition" and then moved again to satisfy the terminal proximity condition
19 within a predetermined amount of time, such as 5 seconds, etc.).

20

21 Yet another way in which clinician 20* can signal an intent to transfer at least
22 a portion of the session 550 to terminal 14+ is by submitting biometric data
23 (e.g., the transmittal of which is triggered by touching a fingerprint reader on
24 a badge) in the absence of a request for authentication.

25

26 Whether the session 550 is fully or partly transferred is a design
27 consideration, and may further be made selectable (e.g., by requiring user
28 input via a keyboard or by requiring that biometric data be resubmitted
29 several times in a given sequence). Alternatively, the pages to be transferred
30 may be established by the session application function 50. In either case, the
31 conduct session process 84 learns of a desired portion of the session 550 to
32 be transferred from the session transferor to the session transferee.

33

34 Once the intent of clinician 20* to transfer certain desired pages the session

1 from terminal 14* to terminal 14+ has been confirmed, the conduct session
 2 process 84 proceeds transfer the desired portion of the session 550 for
 3 clinician 20* from terminal 14* to terminal 14+. Specifically, the conduct
 4 session process 84 causes a message to be sent to the session management
 5 function 53 in the POC server 30, thereby indicating to the session
 6 management function 53 which portion of the session 550 is now to be
 7 conducted with terminal 14+ and which portion is no longer to be conducted
 8 by terminal 14+.

9

10 Meanwhile, terminal 14* of course remains the "session transferor" and
 11 terminal 14+ remains the "session transferee". However, the session page
 12 delivery indicator for these two terminals will change under the control of the
 13 session management function 53. This change is reflected in the table 85
 14 stored in the controller 18, which may now resemble the following:

15

Terminal	Session	Status	Pages
14*	550	Transferor	All except pages A..N
14+	550	Transferee	A..N

16

17 Thus, with reference to Fig. 5C, the session 550, which previously existed
 18 only between the HIS 12 and terminal 14*, now exists either between the
 19 HIS 12 and terminal 14+ alone, or has a first portion that exists between the
 20 HIS 12 and terminal 14+ in addition to a remaining portion that exists
 21 between the HIS 12 and terminal 14*.

22

23 Clinician 20* can then perform a number of tasks during the session 550
 24 while using terminal 14+ (and possibly also terminal 14*). Moreover,
 25 clinician 20* may continue conducting the session 550 with terminal 14+ as
 26 long as necessary, after which point there are a number of possibilities, each
 27 of which is now discussed.

28

29 First Possibility (Explicit Transfer Of Session)

30

Under a first possibility, with reference to Fig. 5D, clinician 20* explicitly signals an intent to transfer the session 550 back to terminal 14*. For example, clinician 20* may click on an appropriate "transfer back" icon on the display of terminal 14+ (or terminal 14*). Alternatively, clinician 20* will cause terminal 14* to re-satisfy the "terminal proximity condition" (with respect to terminal 14+). In either case, an intent to transfer the session 550 back to the session transferor, i.e., terminal 14*, has been signaled by clinician 20*.

Clinician 20*'s intent to transfer the session 550 is detected by the conduct session process 84, which causes a message to be sent to the session management function 53 in the POC server 30, indicating to the session management function 53 that the session 550 is no longer to be conducted with terminal 14+. In response, the session management function 53 sends a command to the display formatting function 52, causing a change in the display of terminal 14+ (e.g., blank screen). However, the session management function 53 does not delete session-related information, since the session 550 continues to be conducted with terminal 14*.

In addition, the session page delivery indicator for terminal 14* and terminal 14+ will change under the control of the session management function 53. This change is reflected in the table 85 stored in the controller 18, which may now resemble the following:

Terminal	Session	Status	Pages
14*	550	Transferor	All
14+	550	Transferee	None

As long as clinician 20* and terminal 14* remain in proximity to terminal 14+, the session 550 can continue to be transferred back and forth between the two terminals as described above. If the session 550 is explicitly transferred back to terminal 14*, and clinician 20* then moves away from terminal 14+, this is detected by the conduct session process 84. The conduct session process 84 then informs the session management function

53, which modifies the above to indicate that terminal 14+ has lost its status as "session transferee" for the session 550. At this point, terminal 14+ will be treated like any other terminal in the communications network 10.

Second Possibility (Mobility Scenario I)

Under a second possibility, with reference to Fig. 5E, clinician 20* takes terminal 14* and moves away from terminal 14+ without having explicitly transferred the session 550 back to terminal 14* before his or her departure from terminal 14+. In other words, clinician 20* remains in proximity to terminal 14* but not in proximity to terminal 14+. This is detected by the conduct session process 84 as satisfaction of a computed "terminal remoteness condition". The conduct session process 84 then takes the necessary actions to autonomously effect a transfer the session 550 back to terminal 14*. This can be referred to, from the session 550's point of view, as "snapping back" to the session transferor (i.e., terminal 14*).

Specifically, the conduct session process 84 causes a message to be sent to the session management function 53 in the POC server 30, indicating to the session management function 53 that the session 550 is no longer to be conducted with terminal 14+. In response, the session management function 53 sends a command to the display formatting function 52, causing a change in the display of terminal 14+ (e.g., blank screen). This eliminates the risk of displaying sensitive data on the display of terminal 14+. However, the session management function 53 does not delete session-related information from the holding location 74, since the session 550 continues to be conducted with terminal 14*.

In addition, the session management function 53 modifies the aforementioned table 85 to indicate that terminal 14+ has lost its status as "session transferee" for the session 550, and also modifies the table 85 to indicate that the full session is supported by terminal 14*. From this point, terminal 14+ is treated like any other terminal in the communications network 10.

1

2 Third Possibility (Mobility Scenario II)

3

4 The third possibility is similar to the second possibility, in that clinician 20*
5 moves away from terminal 14+ without having explicitly transferred the
6 session 550 back to terminal 14* before his or her departure from terminal
7 14+. However, in this case and with reference to Fig. 5F, clinician 20* is
8 unaccompanied by terminal 14*. In other words, clinician 20* remains is no
9 longer in proximity to either terminal 14* or terminal 14+. This is detected
10 by the conduct session process 84, which then takes the necessary actions
11 to transfer the session 550 back to the session transferor, but to immediately
12 follow by suspending the session 550.

13

14 Specifically, the conduct session process 84 causes a message to be sent to
15 the session management function 53 in the POC server 30, indicating to the
16 session management function 53 that the session 550 is no longer to be
17 conducted with terminal 14+. In response, the session management function
18 53 sends a command to the display formatting function 52, causing a change
19 in the display of terminal 14+ (e.g., blank screen). This eliminates the risk
20 of displaying sensitive data on the display of terminal 14+. Accordingly, the
21 session management function 53 modifies the aforementioned table 85 to
22 indicate that terminal 14+ has lost its status as "session transferee" for the
23 session 550, and also modifies the table 85 to indicate that the full session is
24 supported by terminal 14*. From this point, terminal 14+ is treated like any
25 other terminal in the communications network 10.

26

27 In addition, the conduct session process 84 suspends the session 550 by
28 autonomously executing the session suspend process for terminal 14* (see
29 E- above), since clinician 20* is deemed to have moved away from terminal
30 14*.

31

32 Fourth Possibility (Mobility Scenario III)

33

34 Under a second possibility, with reference to Fig. 5G, terminal 14* (which is

1 the session transferor for the session 550) leaves the vicinity of both clinician
2 20* and terminal 14+. Such a scenario may arise if clinician 20*'s PDA is lent
3 to a co-worker or is carried away while clinician 20* is viewing a large-screen
4 display on terminal 14+ (the session transferee).

5
6 It is noted that this scenario actually amounts to the equivalent of clinician
7 20* moving away from terminal 14* and satisfying a remoteness condition,
8 which is covered by **E-** above. Specifically, in accordance with **E-** above, the
9 conduct session process 84 would send a message to the session
10 management function 53, causing the latter to execute the session suspend
11 process for terminal 14*. Additionally, in view of **F-** above, because clinician
12 20* is still in proximity to terminal 14+, clinician 20* would then immediately
13 be asked if he or she wishes to resume the now suspended session at
14 terminal 14+ (see **F-** above).

15
16 Now, although the above actions have the desirable effect of preventing a
17 security breach from arising, there may be a disruption to the activities taking
18 place at terminal 14+. To avoid such a disruption, an additional layer of
19 complexity may be added to **E-** and **F-** above. Specifically, instead of
20 suspending the session 550 and then asking clinician 20* if he or she wishes
21 to resume the session 550, the session 550 can simply be transferred to
22 terminal 14+, provided that terminal 14+ is the session transferee for the
23 session 550 (which, in this case, it is).

26 **2. SECOND SYSTEM ARCHITECTURE**

27
28 In the first system architecture, advantageous use was made of the
29 knowledge that individual clinicians and mobile terminals were in proximity
30 to individual fixed-wire of mobile terminals. This enabled various functions
31 related to establishment and management of sessions with the HIS 12. The
32 second system architecture enables these same functions, in addition to a
33 variety of other functions that make advantageous use of the position (or
34 location) of individually "tagged" clinicians and equipment (e.g., terminals or

1 medical devices) within an overall "location-awareness area" in the hospital.

2 These include:

3

4 - communication with clinicians based depending on their deemed
5 availability;

6 - assembling a team of clinicians in response to a medical emergency
7 occurring at a given location in the hospital;

8 - tracking of equipment associated with individual clinicians to detect
9 suspicious movement of such equipment;

10 - preventative control of communications devices when found to be in
11 proximity of sensitive medical devices.

12

13 The second system architecture differs from the first one in that:

14 - an array of detectors is established across the entire location-awareness
15 area, which may be the overall campus or a significant portion thereof;
16 and

17 - the absolute location of tagged clinicians and equipment (e.g., terminals
18 and medical devices) is detected, calculated and tracked.

19

20 From the location and tracking of absolute coordinates of tags, relative to the
21 building spatial grid, the distance between two tag-bearing people or pieces
22 of equipment can be calculated and from a history of these distance
23 calculations, it can be determined whether a given proximity or remoteness
24 constraint is satisfied.

25

26 Accordingly, Figs. 6A and 6B (which should be considered overlaid onto one
27 another) show a conceptual view of a communications network 610 of a
28 healthcare establishment, in accordance with a second example of
29 implementation of the present invention. Again, for ease of reading, the
30 healthcare establishment will hereinafter be referred to as a hospital, but it
31 should be understood that the healthcare establishment may be of any size
32 and may generally consist of a single building or a campus including one or
33 more buildings or pavilions and possibly one or more adjacent areas such as
34 roads and parking lots.

1
2 A plurality of fixed terminals 14A and a plurality of mobile terminals 14B
3 serve as entry points to the communications network 610. The terminals
4 14A, 14B are accessed by a plurality of clinicians 20 who are mobile within
5 the hospital. The term "clinician" is used to denote any individual who may
6 require access to the communications network 10 in the execution of their
7 duties pertaining to diagnosis and/or treatment of one or more patient. While
8 not intended to be an exhaustive list, typically clinicians 20 can include
9 physicians, radiologists, pharmacists, interns, nurses, laboratory technicians
10 and orderlies. In either case, when interpreting the present invention, the
11 word "clinician" should not be construed as limiting the invention to
12 applicability in an environment where individuals are required to have specific
13 medical qualifications.

14
15 The communications network 610 also includes a tag / detector subsystem
16 (TDS) 616 connected to a controller 618, which is connected to a healthcare
17 information system (HIS) 12 and a communications system head end 650.
18 In a non-limiting example of implementation, shown in and previously
19 described with reference to Fig. 1C, the HIS 12 includes a clinician database
20 22, a patient database 24, a departmental database 26, an equipment
21 database 35, as well as an authentication entity 28 and a point-of-care (POC)
22 server 30. In addition, the HIS 12 may permit access to a trusted external
23 database 27, for instance a national electronic health record (EHR) database,
24 via a secure link 29.

25
26 Some of the aforementioned components of the communications network 10
27 will now be described in greater detail. However, a description of the clinician
28 database 22, the patient database 24, the departmental database 26, the
29 equipment database 35, the authentication entity 28 and the point-of-care
30 (POC) server 30 is omitted, since these components have already been
31 described with reference to Fig. 1C, and any variations or modifications
32 required to support the second system architecture will be readily understood
33 and easily implemented by a person of ordinary skill in the art.

34

1 Terminals 14A, 14B

2

3 The terminals 14A, 14B allow communication between the clinicians 20 and
4 the HIS 12 via the controller 618. Terminals 14A are fixed-wire terminals,
5 such as stationary terminals or workstations, connected to the controller 618
6 via communication links 57A. Terminals 14B are mobile terminals, such as
7 handheld units (e.g., personal digital assistant (PDA)) or laptop computers,
8 which communicate with the controller 18 via communication links 57B that
9 include wireless portions. The wireless portions of the communication links
10 57B are secure links that may be encapsulated within the communications
11 network 610, as would be the case for a wireless local area network (WLAN)
12 using WLAN access points 60. In another embodiment, the wireless portions
13 of the communication links 57B may involve an external network connection,
14 as would be the case when the mobile terminals 14B are cellular phones or
15 cellular data devices.

16

17 Each of the terminals 14A, 14B has a display capability, which may be
18 different for different types of terminals. For example, mobile terminals 14B
19 may have inferior display capabilities, while certain ones of the fixed-wire
20 terminals 14A may have superior display capabilities.

21

22 Medical devices 602

23

24 A plurality of medical devices 602 is also collectively shown in Figs. 6A and
25 6B. A medical device refers to a piece of healthcare equipment used for a
26 particular purpose in the hospital. Examples of medical devices 602 include
27 but are not limited to surgical instruments, wheelchairs, emergency
28 resuscitation carts (colloquially referred to as "crash carts"), life-support
29 units, computerized axial tomography (CAT) or magnetic resonance imaging
30 (MRI) scanners, and any other conceivable piece of equipment, either mobile
31 or stationary, normally found in a healthcare environment.

32

33 It will be noted that a first subset of the medical devices 602 is connected to
34 the communications network 610, and these are shown in Fig. 6A. Non-

1 limiting examples of medical devices that may be members of the first subset
2 include devices that are used to input data into the HIS 12 or extract data
3 from the HIS 12, for example CAT scanners and MRI scanners. Stationary
4 medical devices in the first subset may be connected to the communications
5 network 610 via the communication links 57A, while mobile medical devices
6 in the first subset may be connected to the communications network 610 by
7 communication links 57B.

8

9 Aspects of operation of the medical devices 602 in the first subset (i.e.,
10 connected to the communications network 610) can be controlled by the
11 controller 618. One example of operation that can be controlled would be
12 authorization/authentication to use a particular medical device, this being
13 limited to only those operatives trained in so-doing. This would be achieved
14 by only allowing the medical device to be functional while a qualified,
15 authorized, authenticated operator is found to be in its vicinity. Another
16 example of an aspect of operation is an on/off state of the medical device
17 602.

18

19 A second subset of the medical devices 602 is not connected to the
20 communications network 610 because there is no need to exchange data
21 between these devices and the HIS 12. Such medical devices may be
22 referred to as "passive" from the communications standpoint and, although
23 not illustrated in Fig. 6A, they are represented in Fig. 6B. By way of non-
24 limiting example, wheelchairs and stretchers may be members of the second
25 subset of the medical devices 602. However, it is envisaged that certain
26 other conventionally "passive" devices may be equipped with communication
27 functionality and therefore whether a particular medical device belongs to the
28 first subset or the second subset might depend on factors other than simply
29 the nature of particular medical device.

30

31 Communications System Head End 650

32

33 Although clinicians 20 may communicate with one another using mobile
34 terminals 14B, the communications network 610 may further provide the

1 ability to use a more conventional communications system. To this end, the
2 communications system head end 650 enables telephony-style or other
3 communication between individuals in the hospital or external to the hospital,
4 including the clinicians 20. In one embodiment, the communication system
5 head end 650 may comprise a switch and processing equipment, and may be
6 connected to an intercom system and speakers distributed throughout the
7 hospital for communicating with individuals or group of individuals in the
8 hospital. Optionally, the communication system head end 650 may be
9 connected to a plurality of communication devices 614 via a plurality of paths
10 57C (fixed or partly wireless). Non-limiting examples of the communication
11 devices 614 include pagers and WLAN phones. The communication devices
12 614 are typically carried by the clinicians 20, allowing telephony-style
13 communications to be established with specific individuals in the hospital.
14 The communications system head end 650 could also comprise a PBX
15 connected to fixed and wireless telephones, with the location of the fixed
16 telephones being known *a priori*.

17

18 Tag / Detector Subsystem (TDS) 616

19

20 With specific reference now to Fig. 6B, the TDS 616 includes a plurality of
21 tags 36A, 36B, 36C, 36D, a plurality of contact-less tag detectors 654 and a
22 location calculation engine (LCE) 658, which may be integrated with the
23 controller 618 or separate therefrom. The tags 36A, 36B, 36C and 36D are
24 associated with the various people and equipment whose location needs to be
25 ascertained. In this case, as before, tags 36A are respectively associated
26 with the clinicians 20 and tags 36B are respectively associated with the
27 mobile terminals 14B. In addition, tags 36C are respectively associated with
28 the medical devices 602 in both the first and second subsets, while tags 36D
29 are respectively associated with the fixed-wire terminals 14A.

30

31 Similarly to what was described with reference to the first system
32 architecture, a given tag 36A, 36B, 36C, 36D operates in such a way as to
33 provide a brief radio frequency signal that encodes an identifier of the given
34 tag 36A, 36B, 36C, 36D, hereinafter referred to as a "tag ID" 58. Without

1 being interpreted as a limitation of the present invention, the tags 36A, 36B,
2 36C, 36D can be active (i.e. the tag frequently or periodically emits a signal),
3 semi-active (i.e. the tag emits a signal only in response to receiving another
4 signal), or passive (i.e. the tag only reflects a received signal). The decision
5 to select active, semi-active or passive tags depends on various factors such
6 as the required range, precision, and power consumption / battery lifetime /
7 weight considerations.

8
9 In the selection of a suitable tag technology, care should also be taken to
10 ensure that the tags, which are themselves transmitters of RF energy, do not
11 interfere with sensitive medical equipment, e.g., certain ones of the medical
12 devices 602. In a non-limiting example, the use of a low-power multi-GHz
13 center-frequency Ultra Wideband (UWB) solution, which operates with RF
14 bursts of 1 nanosecond duration at a peak power of 15-30 mW (giving an
15 average power of nanowatts or picowatts), meets this requirement.

16
17 It is noted that the information contained in the tag IDs 58 is unique for the
18 various tags 36A, 36B, 36C, 36D. Assuming that there is a one-to-one
19 physical association between the clinicians 20 and the tags 36A, then the tag
20 ID 58 for the tag 36A attached to a given clinician 20 can contain the clinician
21 identifier 38 of the given clinician 20. (Alternatively, if the clinician identifier
22 38 needs to be kept confidential, then the tag ID 58 can contain the clinician
23 -specific tag ID 42 for the given clinician 20.) Similarly, if there is a one-to-
24 one physical association between the mobile terminals 14B, medical devices
25 602 and fixed-wire terminals 14A on the one hand, and the tags 36B, 36C
26 and 36D on the other, then the tag ID 58 for the tag attached to a given one
27 of these pieces of equipment can contain a serial number or MAC address of
28 the given piece of equipment.

29
30 The detectors 654 are distributed throughout the hospital rather than being
31 collocated with the fixed-wire terminals 14A. The detectors 654 are
32 positioned at known locations and may take the form of a grid or an array.
33 Specifically, the locations of the detectors 654 may be kept in a database
34 662 in the location calculation engine (LCE) 658. In addition, the detectors

1 654 may span multiple floors of a common building, thus effectively being
2 distributed in three dimensions. Also, the detectors 654 may be vertically
3 separated on a given floor, thereby giving an improved capability for z-axis
4 spatial resolution within that floor.

5

6 Depending on the type of tag used, each of the detectors 654 may include
7 either a receiver for receiving radio frequency signals emitted by active tags,
8 or both a transmitter for emitting radio frequency pulses and a receiver for
9 receiving radio frequency signals emitted (or reflected) by semi-active (or
10 passive) tags in response to the emitted radio frequency pulses.

11

12 Each of the detectors 654 detects tags in a surrounding three-dimensional
13 volume which is a "coverage zone" for that detector 654. The union of the
14 coverage zones for all of the detectors 654 defines a location-awareness area
15 of the hospital. If a given tag is located within the location-awareness area
16 of the hospital, then the tag ID 58 that the given tag emits (or reflects) will
17 be detectable by at least one of the detectors 654. The fact that the location
18 of the detectors 654 is known is sufficient to give an approximate idea as to
19 where a detected tag is located within the location-awareness area of the
20 hospital; however, it is insufficient to provide a precise estimate of the
21 location of that tag. Thus, the second system architecture utilizes the LCE
22 658 to provide the precision required in estimating the location of individual
23 tags in the location-awareness area of the hospital.

24

25 For example, assume that the desired precision in the relative location
26 between a clinician 20 and a piece of equipment (e.g., terminal 14A, terminal
27 14B, medical device 602), or between two pieces of equipment, is on of the
28 order of ± 10 -25 cm. Thus, approximately twice this precision (i.e., ± 5 -12.5
29 cm) on the absolute measurements is required, assuming that errors occur
30 randomly. The required precision can be achieved by use of high resolution
31 ultra-wideband radio-frequency transmitting tags, which emit sub-
32 nanosecond bursts of radio frequency. Alternatively, the required precision
33 can be achieved by use of ultrasonic acoustic tags which emit sub-millisecond
34 bursts of acoustic energy, since the propagation length of both a 1 ns

1 electromagnetic burst and a 1 millisecond acoustic burst is of the order of 1
2 foot, limiting the spatial resolution to around this level, depending upon
3 exactly how the signal is received and measured.

4

5 One possible way to achieve adequate spatial resolution on the basis of time
6 measurements is now described. Specifically, the LCE 658 maintains an
7 absolute system time reference, which it distributes to the detectors 654.
8 With reference to Fig. 7, when a burst 702 corresponding to a particular tag
9 (denoted 36*) having a particular tag ID (denoted 58*) is received at a
10 particular detector (denoted 654₁), the particular detector 654₁ measures the
11 absolute system time T_1 at which the burst 702 was received. In addition,
12 other detectors (in this case three detectors denoted 654₂, 654₃, 654₄) also
13 receive the same burst 702, possibly at different times. Upon receipt of the
14 burst 702, each of the detectors 654₁, 654₂, 654₃, 654₄ sends to the LCE 658
15 the detected tag ID 58* and the absolute system time T_1 , T_2 , T_3 , T_4 at which
16 the burst 702 was received.

17

18 At the LCE 658, the received times T_1 , T_2 , T_3 , T_4 can be compared to calculate
19 the differences in time of flight to each of at least 3 of the detectors 654₁,
20 654₂, 654₃, 654₄. These differences can then be used to estimate the
21 position of the tag 36* in two- or three-dimensional space, since the
22 detectors' locations are known *a priori* from the installation grid and are
23 available by consulting the database 662 in the LCE 658.

24

25 In an alternative embodiment, rather than use an absolute system time
26 reference, one can measure received signal direction from multiple detectors.
27 To render such an embodiment capable of achieving the required precision,
28 one should consider enhancements such as the use of a large array of large
29 antennas, a very high (~30-40 GHz) radio frequency combined with smaller
30 directional antennas, a directional and/or time difference-measuring optical
31 pulse, or other technologies, such as acoustic, infrared, ultrasonic, etc.

32

33 Of course, the greater the number of detectors used, the greater the number
34 of detectors that will receive a given burst 702 and thus, the more accurate

1 the position estimate will be. For example, while a two-dimensional position
2 estimate of the particular tag 36* requires a minimum of three detectors to
3 detect the tag ID 58*, it may be desirable to use the data from four detectors
4 that receive the tag ID 58*. This will allow for "occlusion" of one detector;
5 alternatively, it allows the use of four sets of three measurements to produce
6 four position estimates, each of which will contain errors. The overall error
7 can be reduced by combining these in various ways including "least squares
8 fit" as well as other methods. In this context, "occlusion" means that no
9 useful signal reaches the detector, and exemplifies an environment where
10 ultra-wideband (UWB) solutions are significantly more robust than optical or
11 acoustic ones.

12
13 In addition, a position estimate can be obtained by integrating the results
14 from multiple bursts. This will lead to an increased location precision for
15 static and slow-moving tag-bearing people or pieces of equipment, but a
16 velocity-related lag in computing the location of fast-moving tag bearers. The
17 effects are dependent upon the pulse repetition rate, the number of pulses
18 over which location data is integrated, the velocity of the tag bearer and the
19 required precision in the location measurement.

20
21 Similarly, to achieve a three-dimensional position estimate, one theoretically
22 requires only four measurements, but such a measurement is rendered
23 difficult and error-prone due to a small vertical baseline (Z-axis) allowed by
24 floor-ceiling distance triangulation in the vertical axis. Thus, it may be
25 preferable to use multiple measurements and reduce error through processing
26 operations. For example, it may be advantageous to collect the data from six
27 (6) detectors, allowing 30 sets of position estimates to be made without
28 receiver occlusion, or 5 sets of position estimates to be made with one
29 receiver being occluded.

30
31 To summarize the above, the detectors 654₁, 654₂, 654₃, 654₄ receive the
32 burst 702 from the nearby tag 36*, detect the tag ID 58* in the received
33 burst 702 and communicate the tag ID 58* to the LCE 658 along a set of
34 communication links 656. Along with the tag ID 58*, the detectors 654

1 provide the absolute system time T_1 , T_2 , T_3 , T_4 at which the burst 702 was
2 received (or, on the other hand, the direction from which the individual tag
3 ID 58* is detected). Based on this information and on knowledge of the
4 positions of the detectors 654₁, 654₂, 654₃, 654₄ within the location-
5 awareness area of the hospital, the LCE 658 then determines the estimated
6 position of the tag 36* within the hospital. The tag ID 58* and the estimated
7 position of the corresponding tag 36* (generally: tags 36A, 36B, 36C, 36D)
8 are provided to the controller 618, which will now be described in greater
9 detail.

11 Controller 618

13 The controller 618 comprises suitable software, hardware and/or control logic
14 for implementing a variety of "monitoring processes" that operate in the
15 background until they detect that a certain trigger condition is satisfied,
16 whereupon further processing operations are performed. As shown in Fig. 8,
17 these include a clinician proximity monitoring process 810, a tagged
18 equipment monitoring process 820, a communications monitoring process
19 830, a medical event monitoring process 840 and an RF interference
20 monitoring process 850. The monitoring processes 810-850 may all run in
21 parallel to one another. Each of the aforementioned monitoring processes
22 is now described in greater detail.

24 I- Clinician Proximity Monitoring Process 810

26 Similar to the clinician proximity monitoring process 80 described earlier, the
27 clinician proximity monitoring process 810 monitors the output of the TDS
28 616 to decide when clinicians 20 who do not have sessions are found to be
29 in proximity to individual ones of the terminals 14A, 14B. The definition of "in
30 proximity" may vary in accordance with operational requirements. In one
31 embodiment, a given clinician of interest (denoted 20*) is deemed to be "in
32 proximity" to a given terminal of interest (denoted 14*) when a computed
33 "proximity condition" is satisfied, e.g., when the relative distance between the
34 estimated position of the tag 36A associated with clinician 20* and the

1 estimated position of the detector 34A, 34B associated with terminal 14*
2 remains less than a certain threshold distance, continuously, for at least the
3 duration of a time window.
4

5 Of course, it is within the scope of the present invention to further refine the
6 definition of the proximity condition using additional factors. For instance,
7 such additional factors may include the identity or professional role of clinician
8 20*. Another example of such an additional factor includes an indication of
9 whether terminal 14* is in clinician 20*'s "field of view". In one embodiment,
10 determining whether terminal 14* is within clinician 20*'s field of view may
11 involve processing the intensity of the signal received from the tag associated
12 with clinician 20*. Based upon the estimated position of clinician 20*,
13 relative to the nearby detectors 654 and hence the known free space path
14 length from clinician 20* to those detectors, the expected received powers at
15 the various detectors 654 can be computed. Any differences from those
16 powers, such as a significant power level drop in one or two detectors, can be
17 attributed to absorption of the signal by the body of clinician 20*, which
18 allows the direction in which clinician 20* is facing to be inferred.
19

20 In other words, a lower-intensity signal may indicate that clinician 20*'s body
21 is in the way and hence it is possible to infer in which direction clinician 20*
22 is facing and determine whether terminal 14* is in clinician 20*'s field of view.

23 In another embodiment, the controller 618 computes a velocity vector of
24 clinician 20* by tracking the location of clinician 20* over time. By taking
25 into account a certain angle on both sides of the velocity vector, and
26 assuming that clinician 20* is moving in the direction that he or she faces,
27 the controller 618 can obtain a field of view of clinician 20* and determine
28 whether terminal 14* is in that field of view. Furthermore, the computed
29 velocity of clinician 20* may allow for a determination of intent, in that if
30 clinician 20* who intends to use terminal 14* will approach it and slow down
31 (and eventually stop), whereas clinician 20* who does not intend to use
32 terminal 14* will likely remain at a high walking speed.
33

34 Thus, it will be appreciated that consideration of clinician 20*'s field of view

1 may be advantageous in order to take into account situations wherein
2 clinician 20*, although "close" to terminal 14*, is oriented in such a way that
3 he or she cannot interact with terminal 14*. (For instance, clinician 20* has
4 his or her back facing terminal 14*.) Thus, the proximity condition may be
5 satisfied not only when clinician 20* is "close" to terminal 14*, but when
6 terminal 14* is within clinician 20*'s "field of view".

7
8 Once the clinician proximity monitoring process 810 has deemed clinician 20*
9 to be in proximity to terminal 14* (i.e., the proximity condition is satisfied),
10 the controller 618 executes a "session establishment" process, which is
11 similar to the session establishment process 82 previously described with
12 reference to Figs. 3B and 3C. This results in the establishment of a session
13 for clinician 20* between terminal 14* and the HIS 12.

14
15 Once the session is established, the controller 618 enters a "conduct session"
16 process for the session, which is similar to the conduct session process 84
17 previously described. During the session, clinician 20* may perform a variety
18 of activities leading to any one of the previously described non-limiting
19 example scenarios **A-** through **D-**. In addition, although it is transparent for
20 most of the activities conducted during the session, the conduct session
21 process nevertheless continues to monitor the information from the TDS 616
22 in order to detect certain conditions of clinician-terminal proximity and
23 terminal-terminal proximity. Specifically, during the session, clinician 20*
24 may perform a variety of activities in addition to the above, which may lead
25 to one of the previously described non-limiting example scenarios **E-** through
26 **G-**.

27
28 In the specific case of scenario G- and mobility scenario III related thereto,
29 it is recalled that this scenario covered the case where clinician 20* had
30 approached a new terminal, denoted 14+, while a session was ongoing
31 between the HIS 12 and terminal 14*. This was followed by terminal 14*
32 leaving the vicinity of both clinician 20* and terminal 14+. It is recalled that
33 such a scenario may arise if clinician 20*'s PDA is lent to a co-worker or is
34 carried away while clinician 20* is viewing a large-screen display on terminal

1 14+ (the session transferee). If the PDA is being lent to colleague, then
2 there may not be cause for concern. However, if the PDA has been stolen,
3 then it may be desirable to detect this action so that the appropriate
4 measures can be taken. Specifically, potentially suspicious motion of tagged
5 equipment in this and other scenarios is handled by the tagged equipment
6 monitoring process, as now described.

7 8 II- Tagged Equipment Monitoring Process 820

9
10 In order to support the tagged equipment monitoring process 820, the
11 equipment database 35 is expanded so as to include additional fields for each
12 piece of tagged equipment (e.g., terminal or medical device), including but
13 not limited to valuable mobile equipment, such as PDAs and tablet PCs.
14 Specifically, with reference to Fig. 11, an enhanced equipment database 1135
15 includes the same fields as the equipment database 35 in Fig. 1D, in addition
16 to an "authorized users" field 1110 and a "physical boundaries" field 1112.

17
18 For a given piece of tagged equipment, the authorized users field 1110
19 provides a list of clinicians who have the authorization to use the given piece
20 of tagged equipment. The clinicians in this list can be identified by their
21 clinician ID 38 or clinician-specific tag ID 42, for example, or by any other
22 conceivable identifier. The list of clinicians who have the authorization to use
23 a given piece of tagged equipment may change over time and may be under
24 the control of hospital administration.

25
26 For a given piece of tagged equipment, the physical boundaries field 1112,
27 which is optional, may indicate specific areas of the hospital where the given
28 piece of tagged equipment is allowed to be present, with everywhere else
29 being considered impermissible. Alternatively, the physical boundaries field
30 1112 may indicate specific areas of the hospital where the given piece of
31 tagged equipment is not allowed to be present, with everywhere else being
32 considered permissible. The chosen significance of the physical boundaries
33 field 1112 may be different for different pieces of tagged equipment, and may
34 depend on the most efficient representation in memory. By way of non-

1 limiting example, it may be the case that a crash cart in a particular Ward
2 should not be removed from there but may be moved around within the
3 ward; hence, the physical boundaries for this particular piece of tagged
4 equipment could be the particular Ward in question.

5
6 Based on the data from the enhanced equipment database 1135 and the data
7 from the TDS 616, the tagged equipment monitoring process 820 determines,
8 for each piece of tagged equipment, the position of the tag associated with
9 the piece of tagged equipment, consults the authorized users field 1110 for
10 the piece of tagged equipment, determines the position of the tags for the
11 clinicians who are authorized to use the piece of tagged equipment, and
12 determines the estimated distance between the tags of the piece of tagged
13 equipment and each of these authorized clinicians. If, for a particular piece
14 of tagged equipment, the estimated distance exceeds a threshold value for
15 all of the authorized clinicians (or is not within the threshold value for at least
16 one of the authorized clinicians), and if the particular piece of tagged
17 equipment is in motion (e.g., based on historical data), the tagged equipment
18 monitoring process 820 will conclude that the particular piece of tagged
19 equipment is being transported by someone or something other than one of
20 the authorized clinicians of the particular piece of tagged equipment. The
21 particular piece of tagged equipment is said to be undergoing suspicious
22 motion, which may be the result of an act of theft. A suitable alarm signal
23 can thus be generated, which may lead to actions such as communicating
24 with building security, activation of cameras, locking of doors, erasure of
25 data, etc.

26
27 In addition, having determined, for each piece of tagged equipment, the
28 position of the tag associated with the piece of tagged equipment, the tagged
29 equipment monitoring process 820 consults the physical boundaries field
30 1112 for the piece of tagged equipment and determines whether the piece of
31 tagged equipment is in an area where it is (or is not) allowed to be,
32 irrespective of whether the piece of tagged equipment is in motion or not. If
33 the piece of tagged equipment in question is in an area where it is not allowed
34 to be (or is outside any and all areas where it is allowed to be) then a suitable

1 alarm signal can be generated as described above.

2

3 III- Communications Monitoring Process 830

4

5 With reference to Figs. 9A, 9B and 9C, at step 902, the controller 618 detects
6 that a "source clinician" desires to reach a "target clinician" in the hospital.

7 This can be achieved by monitoring the communications system head end
8 650, as well as the data exchanged during an ongoing session for the source
9 clinician, to detect a particular clinician identifier, or the address or directory
10 number of the communication device 614 (e.g., pager or WLAN phone) or
11 terminal 14A, 14B being used by a particular clinician. For the purposes of
12 the discussion below, the particular clinician will be referred to as the "target"
13 clinician.

14

15 At step 904, the controller 618 consults the LCE 658 to determine the location
16 of the target clinician identified at step 902. At step 906, the controller 618
17 determines whether the target clinician is available by applying an
18 "unavailability policy" based at least in part of the location of the target
19 clinician determined at step 904. A non-limiting example of an unavailability
20 policy is to deem the target clinician as "unavailable" when located in a subset
21 of the location-awareness area of the hospital, where the subset includes
22 operating rooms and emergency rooms. Conversely, if the target clinician
23 does not fall within this subset of the location-awareness area of the hospital,
24 the target clinician is deemed to be available.

25

26 Generally speaking, the subset of the location-awareness area of the hospital
27 where the target clinician will be deemed unavailable depends on knowledge
28 of the topography of the hospital, i.e., the layout and configuration of the
29 various rooms, floors and areas of the hospital. The topography of the
30 hospital may be stored in the controller 618 or it may be stored in the
31 departmental database 26 and accessed by the controller 618 when needed.

32

33 Of course, the unavailability policy may be more complex than the mere
34 identification of certain fixed areas of the hospital where target clinicians are

1 deemed unavailable. For example, the unavailability policy may be a function
2 of the professional role (e.g., doctor vs. nurse vs. orderly) of the target
3 clinician. In yet another example, the target clinician's schedule may impact
4 the result of applying the unavailability policy. For example, a target clinician
5 located in the scrub room before a planned surgical intervention may be
6 deemed unavailable, but would not be deemed unavailable if present in the
7 scrub room after surgery is complete. Hence, the unavailability policy may
8 include an element of target clinician location history as well as actual
9 location. For instance, for the case of "history = general hospital area" and
10 "current location = scrub room" then the target clinician may be deemed
11 unavailable, whereas for "location history = operating theatre" and "current
12 location = scrub room", then the target clinician may be deemed available.

13
14 Thus, it is apparent that the unavailability policy may range from simple to
15 complex, to the point where it involves the target clinician's professional role,
16 identity, schedule, etc. It should also be appreciated that the controller 18
17 may obtain the information relevant for application of the unavailability policy
18 from the clinician database 22, whereas the overall unavailability policy itself
19 may be stored in memory the controller 18, and changed from time to time
20 by hospital administrative staff.

21
22 If the outcome of step 906 is that the target clinician is deemed available,
23 then with reference to Fig. 9B, the controller 618 proceeds to step 910, where
24 a paging message is sent to the target clinician. In a non-limiting example
25 embodiment, the paging message can be sent via the communication system
26 head end 650 to reach the communication device 614 (e.g., pager or WLAN
27 phone) being used by the target clinician. Alternatively, the paging message
28 can be sent as an electronic message to the fixed-wire or mobile terminal
29 14A, 14B with which the target clinician has an ongoing session with the HIS
30 12. In yet another embodiment, plural uses of a paging message to attempt
31 to reach the target clinician (who, it is recalled, was deemed to be available)
32 can be employed in parallel.

33
34 At step 912, the controller 618 is attentive to receipt of a positive

1 acknowledgement from the target clinician, either by way of a response via
2 the terminal 14A, 14B being used by the target clinician or via the
3 communication system head end 650. If a positive acknowledgement is
4 received within a certain amount of time (e.g., 10 seconds), then no further
5 action needs to be taken, since the target clinician has been reached and has
6 positively acknowledged that he or she is available. The remainder of the
7 communication between the source clinician and the target clinician may
8 occur in a conventional manner.

9
10 However, if the controller 618 does not receive a positive acknowledgement
11 for a certain amount of time (e.g., 10 seconds) or receives a negative
12 acknowledgement, then the controller 618 proceeds to step 914, where it
13 takes a specific action, depending on the circumstances. A simple example
14 of an action is the display of a reply message at a device being used by the
15 source clinician, which states something to the effect that "Dr. Smith cannot
16 be reached" and offers the source clinician a menu of choices. These may
17 include:

- 18
19 1) Attempt to reach a surrogate clinician for Dr. Smith.
20 2) Attempt to reach an alternative clinician for Dr. Smith;
21 3) Leave a message for Dr. Smith.

22
23 In this context, a "surrogate clinician" for Dr. Smith represents a clinician who
24 is located near Dr. Smith, and who can therefore contact Dr. Smith in case
25 of emergency, but who may not have a comparable skill set to that of Dr.
26 Smith. An "alternative clinician" for Dr. Smith represents a clinician who has
27 a skill set comparable to that of Dr. Smith, and who acts as a "backup" for Dr.
28 Smith, but who may not be located as near to Dr. Smith as the surrogate
29 clinician. The identity of a surrogate clinician and an alternative clinician for
30 a given target clinician represent additional data elements that are associated
31 with the target clinician and it is envisaged that they may be stored in the
32 clinician database 22 alongside other data for the target clinician. Moreover,
33 the identity of the surrogate clinician may be updated by a function operating
34 in the controller 18, which relies on the LCE 658 to determine which clinician

1 should be the surrogate clinician for the target clinician. Also, there may be
2 more than one alternative or surrogate clinician for any one target clinician.
3 Furthermore, the location of the alternative clinician and/or the skill set of
4 the surrogate clinician may be displayed for the source clinician to consider
5 before selecting one of the options 1), 2) and 3) above.

6
7 If the source clinician selects option 1) above, then the controller 618
8 proceeds to step 916, where an attempt to reach the surrogate clinician is
9 made, e.g., by sending a paging message to the surrogate clinician. In a
10 non-limiting example embodiment, the paging message can be sent via the
11 communication system head end 650 to reach the communication device 614
12 (e.g., pager or WLAN phone) being used by the surrogate clinician.
13 Alternatively, the paging message can be sent as an electronic message to
14 the fixed-wire or mobile terminal 14A, 14B with which the surrogate clinician
15 has an ongoing session with the HIS 12. In yet another embodiment, plural
16 uses of a paging message to attempt to reach the surrogate clinician (who
17 may or may not be available) can be employed in parallel.

18
19 The paging message destined for the surrogate clinician may further contain
20 the message to be passed by the surrogate clinician to the target clinician.
21 Assuming again that the target clinician is Dr. Smith, the paging message
22 sent to the surrogate clinician could be "Kindly find out from Dr. Smith
23 whether he checked on Mrs. Jones this morning.", which exemplifies a simple
24 message asking the surrogate clinician to elicit a simple response from the
25 target clinician, and which cannot be answered until the target clinician is
26 reached.

27
28 In the event that option 1) does not end in a satisfactory way (e.g., the
29 surrogate clinician does not positively acknowledge the paging message),
30 then the controller 618 causes the above options to be re-presented to the
31 source clinician.

32
33 If the source clinician selects option 2) above, e.g., after execution of step
34 914 or after execution of step 916, the controller 618 proceeds to step 920,

1 where an attempt to reach the alternative clinician is made, e.g., by sending
2 a paging message to the alternative clinician. In a non-limiting example
3 embodiment, the paging message can be sent via the communication system
4 head end 650 to reach the communication device 614 (e.g., pager or WLAN
5 phone) being used by the alternative clinician. Alternatively, the paging
6 message can be sent as an electronic message to the fixed-wire or mobile
7 terminal 14A, 14B with which the alternative clinician has an ongoing session
8 with the HIS 12. In yet another embodiment, plural uses of a paging
9 message to attempt to reach the alternative clinician (who may or may not
10 be available) can be employed in parallel.

11
12 In the event that this option does not end in a satisfactory way (e.g., the
13 alternative clinician does not positively acknowledge the paging message),
14 then the controller 618 causes the above options to be re-presented to the
15 source clinician.

16
17 If the source clinician selects option 3) above, e.g., after execution of step
18 914 or after execution of step 916 or after execution of step 920, then the
19 source clinician is prompted to leave a message for the target clinician. The
20 message is then delivered to, and accessed by, the target clinician in a
21 conventional manner.

22
23 It is noted that the selection of option 1), 2) or 3) can be automatic based on
24 source clinician preferences, or manual, based on the judgment of the source
25 clinician. For example, the source clinician may consider that it is preferable
26 to contact a surrogate clinician with a slightly inferior or superior skill set than
27 to contact an alternative clinician who may be further from the target
28 clinician. In other circumstances, the source clinician may decide just the
29 opposite, when a very specific skill set is required.

30
31 Returning now to step 906, if the outcome of this step was that the target
32 clinician is deemed unavailable, then with reference now to Fig. 9C, the
33 controller 618 proceeds to step 924, where a reply message is sent to the
34 source clinician. Assuming that target clinician is Dr. Smith, and that the

1 location of the target clinician was found to be "Operating Room 22", the
2 reply message may state something to the effect that "Dr. Smith is currently
3 unavailable in Operating Room 22" and offers the source clinician a menu of
4 choices. These include:

5

- 6 4) Attempt to reach an alternative clinician for Dr. Smith;
- 7 5) Leave a message for Dr. Smith;
- 8 6) Wait for Dr. Smith to become available;
- 9 7) Attempt to reach a surrogate clinician for Dr. Smith.

10

11 If the source clinician selects option 4) above, then the controller 618
12 proceeds to step 926, where an attempt to reach the alternative clinician is
13 made, e.g., by sending a paging message to the alternative clinician. In a
14 non-limiting example embodiment, the paging message can be sent via the
15 communication system head end 650 to reach the communication device 614
16 (e.g., pager or WLAN phone) being used by the alternative clinician.
17 Alternatively, the paging message can be sent as an electronic message to
18 the fixed-wire or mobile terminal 14A, 14B with which the alternative clinician
19 has an ongoing session with the HIS 12. In yet another embodiment, plural
20 uses of a paging message to attempt to reach the alternative clinician (who
21 may or may not be available) can be employed in parallel.

22

23 In the event that this option does not end in a satisfactory way (e.g., the
24 alternative clinician does not positively acknowledge the paging message),
25 then the controller 618 causes the above options to be re-presented to the
26 source clinician.

27

28 If the source clinician selects option 5) above, e.g., after execution of step
29 924 or after execution of step 926, then the source clinician is prompted to
30 leave a message for the target clinician. The message is then delivered to,
31 and accessed by, the target clinician in a conventional manner.

32

33 If the source clinician selects option 6) above, e.g., after execution of step
34 924 or after execution of step 926, the controller 618 performs step 928,

1 where communication with the target clinician is delayed until continued
2 application of the unavailability policy reveals that the target clinician has
3 become available. At that point, a paging message is sent as described
4 herein above with reference to step 910 in Fig. 9B and the steps thereafter.

5'

6 If the source clinician selects option 7) above, then the controller 618
7 proceeds to step 930, where an attempt is made to reach the surrogate
8 clinician, e.g., by sending a paging message to the surrogate clinician. In a
9 non-limiting example embodiment, the paging message can be sent via the
10 communication system head end 650 to reach the communication device 614
11 (e.g., pager or WLAN phone) being used by the surrogate clinician.
12 Alternatively, the paging message can be sent as an electronic message to
13 the fixed-wire or mobile terminal 14A, 14B with which the surrogate clinician
14 has an ongoing session with the HIS 12. In yet another embodiment, plural
15 uses of a paging message to attempt to reach the surrogate clinician (who
16 may or may not be available) can be employed in parallel.

17

18 The paging message may further contain the message to be passed to the
19 target clinician. Assuming again that the target clinician is Dr. Smith, the
20 paging message sent to the surrogate clinician could be "Thank you for
21 finding out from Dr. Smith whether he checked on Mrs. Jones this morning.",
22 which exemplifies a simple message having a "Yes/No" response but which
23 cannot be asked of any other clinician than the target clinician.

24

25 In the event that this option does not end in a satisfactory way (e.g., the
26 alternative clinician does not positively acknowledge the paging message),
27 then the controller 618 causes the above options to be re-presented to the
28 source clinician.

29

30 It is noted that the selection of option 4), 5), 6) or 7) can be automatic based
31 on source clinician preferences, or manual, based on the judgment of the
32 source clinician. For instance, option 7) should ideally be used only in cases
33 of extreme urgency, where Dr. Smith's personal input is vital, such as in a
34 matter of life and death. This is reasonable as a last resort since there is a

1 chance that even though Dr. Smith was deemed unavailable at step 908, he
2 or she may still be in a position to reprioritize his or her activities upon
3 evaluating the merits the current situation.

4
5 Thus, it should be appreciated that application of an unavailability policy
6 which is sensitive to a target clinician's whereabouts can save valuable time
7 in a situation where one wishes to reach the target clinician. For example, if
8 the target clinician is deemed unavailable, this will be known to the controller
9 618 and therefore the source clinician will not have to wait in vain for the lack
10 of a response before attempting to contact another clinician. Moreover, the
11 ability to contact a surrogate clinician who is in the vicinity of the target
12 clinician also has advantages.

13 14 IV- Medical Event Monitoring Process 840

15
16 With reference to Fig. 10, at step 1002, the controller 618 detects that an
17 emergency "medical event" has occurred in the hospital, along with its
18 location. The term "medical event" include but is not limited to an internal
19 hospital emergency that afflict a patient admitted to the hospital, such as the
20 occurrence of a heart attack, seizure, etc. However, the term "medical event"
21 should not be construed as applying only to admitted patients, and therefore
22 is meant to include medical emergencies that may afflict a clinician or other
23 worker in the hospital or even a visitor of an admitted patient. In addition,
24 the term "medical event" should also be understood to include an occurrence
25 that is non-medical in nature (such as an electrical shock, hurricane, tornado,
26 flood) but that may require medical assistance.

27
28 For example, "Code Blue" is an expression indicative a medical event where
29 a person is possibly in danger of immediately dying. The procedure is to
30 immediately call for help (dial 911 or press the nearest "code blue button")
31 and begin life-saving techniques if necessary. Code Blue buttons (not shown
32 in the drawings) are typically distributed throughout the hospital at known
33 locations, and in an embodiment of the present invention they may be in
34 communication with the controller 618 via a network and/or possibly the

1 communications system head end 650. The controller 618 therefore has the
2 ability to determine when a particular Code Blue button has been pressed as
3 well as the location of that code blue button, which can be determined from
4 the hospital floor plan. Alternatively, for mobile Code Blue buttons, these can
5 be provided with their own tags (not shown) and the location of a Code Blue
6 button that has been pressed would be determined using the TDS 616.

7
8 Similarly, the controller 618 has the ability to monitor the communications
9 from the various communication devices 614 in order to detect if someone
10 has dialed 911 and the location of the communication device 614 that has
11 dialed 911. In addition, the nature and location of the medical event can be
12 entered by anyone with access to one of the terminals 14A, 14B, which
13 causes the controller 618 to obtain this information regarding the medical
14 event.

15
16 At step 1004, the controller 618 determines a skill set associated with the
17 medical event. For example, a "Code Blue" may require a physician and two
18 nurses. The skill sets associated with various medical events can be encoded
19 in a mapping that is stored in a database (not shown) in the controller 618
20 or in one of the databases 22, 24, 26, 35, 27.

21
22 At step 1006, the controller 618 determines the identity of clinicians whose
23 skills match one or more of the requisite skills sets found at step 1004. For
24 example, by consulting the clinician profiles in the clinician database 22, the
25 controller 618 can determine the identity of the various clinicians who are on
26 duty and who have the requisite skill sets. These clinicians are considered to
27 be "potentially eligible assistance-providing clinicians".

28
29 At step 1008, the eligibility of the potentially eligible assistance-providing
30 clinicians is confirmed, at least in part on the basis of distance from where the
31 medical event is taking place. For example, the controller 618 consults the
32 LCE 658, which maintains location information regarding various clinicians
33 based on detection of the tags worn by those clinicians. On the basis of the
34 location of the medical event and the locations of the potentially eligible

1 assistance-providing clinicians, the controller 618 determines which
2 potentially eligible assistance-providing clinicians are eligible to provide
3 assistance for the medical event. Thus, in one embodiment, eligibility can be
4 a function of proximity to the medical event; in other words, the closer a
5 potentially eligible assistance-providing clinician is to the medical event, the
6 more eligible he or she is deemed to be to provide assistance. However, it
7 should be understood that a more complex, but still location-dependent,
8 policy can be applied, based additionally on schedule, historical data, etc.

9

10 The net result of this approach is that the nearest suitably qualified clinicians
11 (i.e., the eligible assistance-providing clinicians) are summoned, thereby
12 minimizing the time to bring the "code blue" team together.

13

14 At step 1010, the controller 618 requests assistance from the eligible
15 assistance-providing clinicians determined at step 1008. Specifically, this can
16 involve transmission of a message to the eligible assistance-providing
17 clinicians which specifies the nature and location of the medical event, as
18 determined at step 1002. The message destined for a particular eligible
19 assistance-providing clinician can be transmitted to that clinician via a fixed-
20 wire or mobile terminal 14A, 14B being used by the clinician, or through a
21 communication device 614 (e.g., pager or WLAN phone) being used by the
22 clinician, etc. If the eligible assistance-providing clinician is the only one
23 having that skill set within a certain acceptable distance from the medical
24 event, and if that clinician is not reachable for any reason, then a
25 surrogate clinician in the vicinity may be contacted to forward the message.

26

27 In a variant, steps 1006 and 1008 can be reversed. Specifically, the
28 controller 618 may begin by applying a location-dependent policy to all
29 clinicians, regardless of their skill set. For example, the controller 618 may
30 consult the LCE 658 in order to obtain the identity and location of the clinician
31 closest to the medical event. In other cases, the location-dependent policy
32 may be more complex. In any event, the end result is the identification of an
33 "eligible potentially assistance-providing clinician", i.e., a clinician who is
34 located close to the medical event, but whose skill set remains unknown.

1 Accordingly, the controller 618 then consults the clinician database 22 to
2 determine whether the skill set associated with the eligible potentially
3 assistance-providing clinician matches or exceeds one of the skill sets that is
4 required in order to handle the medical event. If so, that particular skill set
5 is considered to have been met and the search for an eligible assistance-
6 providing clinician is over for that particular skill set (although there may be
7 more than one requisite skill set or a need for more than one clinician of the
8 same skill set; in such cases, the process is repeated as many times as
9 needed). If, however, the eligible potentially assistance-providing clinician
10 does not have any of the requisite skill sets, then this clinician is not
11 "assistance-providing" and the search continues for the next closest clinician,
12 et cetera, until an eligible assistance-providing clinician for all requisite skill
13 sets has been identified. Again, operation of the controller 618 expedites
14 formation of a response team to the medical event, by identifying the nearest
15 clinicians of the requisite skill set. In this way, precious seconds or minutes
16 can be saved before the team is assembled.

17

18 V- RF Interference Monitoring Process 850

19

20 In order to support the RF interference monitoring process 850, the
21 equipment database 35 is expanded so as to include additional fields for each
22 piece of tagged equipment (e.g., terminal or medical device), including but
23 not limited to RF-radiating terminals and sensitive medical devices.
24 Specifically, with reference to Fig. 12, an enhanced equipment database 1235
25 includes the same fields as the equipment database 35 in Fig. 1D, in addition
26 to a "maximum transmitted RF power" field 1210 and an "exposed RF field
27 strength limit" field 1220. Of course, an enhanced equipment database could
28 be based on the enhanced equipment database 1135 previously described
29 with reference to the tagged equipment monitoring process 820.

30

31 For a given piece of tagged equipment, the "maximum transmitted RF power"
32 field 1210 indicates the maximum level of RF power that can be generated by
33 the given piece of tagged equipment under its current operating condition.
34 This may be given in units such as milliwatts (mW). For example, a WLAN

1 phone may generate in the range of 50-100 mW of RF power.

2

3 For a given piece of tagged equipment, the "exposed RF field strength limit"
4 field 1220 indicates the immunity of the given piece of tagged equipment,
5 e.g., level of RF interference that the given piece of tagged equipment is
6 designed to withstand. One common way of expressing the exposed RF field
7 strength limit is in terms of a field strength (V/meter) over a given range of
8 frequencies. The immunity may be defined by a standard, a non-limiting
9 example of which is IEC-60601-1-2, 2nd, 2001 edition, incorporated by
10 reference herein. According to this standard, modern medical devices are
11 required to function in a 10V/m radio frequency interfering field (over a wide
12 RF frequency range) if it is life-supporting equipment and 3V/m if it is not life-
13 supporting. In other words, life-supporting equipment manufactured to meet
14 the above standard may malfunction if exposed to RF interference having a
15 level of greater than 10V/m and non-life-supporting equipment manufactured
16 to meet the above standard may malfunction if it is exposed to RF
17 interference having a (somewhat weaker) level of more than 3 V/m.

18

19 Based on the above example data, a WLAN phone operating at around 50-
20 100 mW can come to within about 2 meters of a 3V/m-immune medical
21 device or to within about 0.6-0.7 meters of a 10 V/m-immune medical device
22 without any deleterious effect, but coming any closer both violates IEC-
23 60601-1-2 and puts the performance of the medical device in jeopardy.
24 Those skilled in the art will appreciate that IEC-60601-1-2 defines adequate
25 and ample margins such that, irrespective of propagation conditions, a
26 transmitter that does not approach a medical instrument to closer than the
27 transmit-power-dependent-distance defined in that specification can never
28 cause an RF field in excess of the design limits of a medical instrument at that
29 transmit power.

30

31 Also, it is recalled that the medical devices 602 themselves are equipped with
32 tags, which are transmitting elements in their own right. While this may
33 seem self-defeating at first glance, interference into the medical device 602
34 can be avoided by using ultra-low-power transmission. This is possible

1 because the bandwidth needed to convey a tag identifier at a required
2 periodicity is miniscule, relative to the bandwidth required for communication
3 via a WLAN phone. Specifically, by application of Shannon's limit theory on
4 information channels, the low data rate requirement allows the tags to
5 operate at a significantly lower power level than a WLAN phone.

6
7 For example, the tags may be UWB multi-GHz tags which transmit infrequent
8 (1-10/sec) RF bursts of very short duration (e.g. 1 nanosecond) and with
9 burst peak powers around 15-30 mW such that the integrated RF power over
10 time is extremely low (nanowatts or less), such that it does not interfere with
11 narrowband or even wideband electronics found in a given medical device.

12 On the other hand, the spectral components of multi-GHz CW modulated
13 transmissions from a WLAN phone do interfere if received at a high enough
14 power, since non-linearities in the electronics of the medical device rectify the
15 high-frequency carrier, thereby injecting the resulting demodulated envelope
16 into the rest of the medical device. This may contain signal components
17 within the passband of the medical device, causing the latter to malfunction.

18
19 Since a sensitive medical device may malfunction if strong sources of RF
20 power are brought so close as to overcome the immunity of the medical
21 device in question, it becomes highly advantageous to control the transmitted
22 RF power as a function of distance between the sensitive medical device and
23 the source of RF power. Specifically, as a source of RF power approaches the
24 sensitive medical device (or vice-versa), it is advantageous to reduce the
25 transmitted RF power of the source. Conversely, when there is no longer any
26 sensitive medical device in the vicinity of the emitter, its transmitted RF
27 power can be increased again (e.g., in order to support a higher data rate).

28
29 The aforementioned principle is now described in somewhat greater detail
30 with additional reference to Fig. 13, which is shown as being executed for a
31 particular piece of tagged equipment having a non-zero entry in the exposed
32 RF field strength limit field 1220. This is representative of a sensitive medical
33 device and will hereinafter be referred to as an "interferee". It should be
34 understood that a similar flowchart may be executed in parallel for all other

1 interferees.

2

3 At step 1310, based on the data from the enhanced equipment database
4 1135 and the data from the TDS 616, the RF interference monitoring process
5 850 identifies those pieces of tagged equipment having a non-zero entry in
6 the transmitted RF power field 1210. In other words, the RF interference
7 monitoring process 850 identifies potential sources of RF interference for the
8 interferee, which are hereinafter referred to as "interferors".

9

10 At step 1320, for each given interferor, the RF interference monitoring
11 process 850 determines the position of the tag associated with the given
12 interferor (along with the position of the tag associated with the interferee,
13 although this could possibly be pre-computed or computed on a less frequent
14 basis). At step 1330, the RF interference monitoring process 850 determines
15 the estimated distance between the positions computed at step 1320. At step
16 1340, the RF interference monitoring process 850 computes an estimate of
17 the exposed RF field strength at the interferee by computing a mathematical
18 function of (i) the current transmitted RF power of the given interferor and
19 (ii) the estimated distance between each given interferor and the interferee
20 (found at step 1330).

21

22 In specific non-limiting examples, the mathematical function may be based
23 upon (a) textbook inverse-square-law-based free space propagation
24 properties; (b) a reference model (e.g. AWGN, HiperLAN) that tries to take
25 into account median building properties; and/or (c) mathematical
26 relationships defined in IEC-60601-1-2 or a similar direct EMI standard.
27 Where a reference is in place, such as the IEC-60601-1-2 standard, the
28 transmit-power / interferee-sensitivity / interferor-interferee-distance
29 relationships from the reference can be used to ensure that transmitters do
30 not violate a safe power level according to that reference.

31

32 Generally speaking, the mathematical function may take into consideration
33 various useful, concrete and tangible factors, such as analytical data
34 regarding free space propagation and empirical data regarding propagation

1 in the environment of the hospital in question (or hospitals in general). In
2 addition, the mathematical function may also take into consideration the
3 location coordinates of the tags associated with each given interferor and the
4 interferee with respect to topographical and structural knowledge of the
5 hospital (e.g., floor plan, number and thickness of walls between each given
6 interferor and the interferee, as well as materials used to construct them), in
7 addition to knowledge of whether each given interferor and the interferee are
8 located on the same floor (to account for RF absorption by floors and
9 ceilings). Still other functions that permit the computation of an estimate of
10 the exposed RF field strength at the interferee are within the scope of the
11 present invention.

12

13 At step 1350, the outcome of step 1340, which is an estimate of the exposed
14 RF field strength at the interferee due to each given interferor, is compared
15 to the value in the exposed RF field strength limit field 1220 for the
16 interferee. If the estimate of the exposed RF field strength is greater than
17 the exposed RF field strength limit (or less than but to within a pre-
18 determined delta thereof) for at least one of the given interferors (hereinafter
19 referred to as a "guilty interferor" or "guilty interferors"), then the RF
20 interference monitoring process 850 concludes that the current transmitted
21 RF power level of the guilty interferor(s) is excessive. In general terms, it can
22 be said that an "RF interference constraint" is violated). Thus, in response,
23 the next step is step 1360, where the RF interference monitoring process 850
24 sends a message to the power control entity 630, causing it to send a
25 message to each guilty interferor, ultimately causing the guilty interferors to
26 reduce their transmitted RF power by a certain amount (hereinafter referred
27 to as a step size) or to a specific level.

28

29 The process then returns to step 1310, which eventually leads to a
30 computation of new estimates of the exposed RF field strength at the
31 interferee due to various interferors (including the guilty interferor(s)).
32 Assuming for argument's sake that the guilty interferor(s) and the interferee
33 have not moved relative to one another, the new exposed RF field strength
34 estimates at the interferee due to the guilty interferor(s) will tend to be lower

1 than the previous ones, and if the step size is chosen judiciously, the new
2 estimates of the exposed RF field strength will fall below the value in the
3 exposed RF field strength limit field 1220 for the interferee, hence not
4 requiring a further reduction in the RF power generated by the guilty
5 interferors.

6

7 It is noted that in some cases where the interferor is a mobile terminal, a
8 session may be ongoing between the mobile terminal and the HIS 12 when
9 the above steps take place. By lowering the transmitted RF power of the
10 mobile terminal in accordance with step 1360, the mobile terminal may not
11 be able to maintain the same data rate for the ongoing session, in the
12 direction from the mobile terminal to the HIS 12. In other words, reducing
13 the transmitted RF power may have the consequence of degrading the
14 transmission capability between the mobile terminal and the nearby WLAN
15 access point 60. This can be addressed by reducing the channel throughput
16 and adapting the radio link to the new conditions. Standard techniques may
17 be used for this purposes, such as those described in IEEE standard 802.11.

18

19 Accordingly, before causing the mobile terminal to lower the transmitted
20 power, the RF interference monitoring process 850 may perform an additional
21 step 1355, whereby a command is sent to the session management function
22 53, such command being instrumental in causing the session management
23 function 53 to lower the data rate being used by the mobile terminal to
24 transmit over the communication network 610. This may be achieved by
25 using less dense coding constellations, resulting in lower throughput.

26

27 Returning now to step 1350, if execution of this step revealed that the
28 estimate of the exposed RF field strength at the interferee due to each given
29 interferor is less than the value in the exposed RF field strength limit field
30 1220 for the interferee, then the RF interference monitoring process 850
31 proceeds to step 1380, where it is determined whether those interferors who
32 are not at full power (i.e., transmitting at a level less than the value of the
33 "maximum transmitted RF power" field 1210 for the interferor in question),
34 would hypothetically cause the RF interference constraint to be violated if

1 they were to transmit at the next highest power setting.

2

3 If there is no such hypothetical violation of the RF interference constraint for
4 a particular interferor, the controller 18 / 618 proceeds to step 1390 where
5 it causes the transmitted RF power (and, correspondingly, the data rate) to
6 be increased for the particular interferor. On the other hand, if there would
7 be a hypothetical violation of the RF interference constraint for a particular
8 interferor, there is no change in the transmitted power level for the particular
9 interferor. Similarly, for those interferors already transmitting at full power,
10 there is no change in the transmitted power level.

11

12 Thus, as a given interferor and the interferee get closer to one another, the
13 RF interference monitoring process 850 causes the given interferor to
14 transmit at ever lower RF power levels, and also causes the use of less dense
15 coding constellations. Despite the reduced throughput, a session can be
16 maintained while the interferor in question can be brought much closer to the
17 interferee than would be possible at full power.

18

19 It should also be noted that the reduced throughput for a given interferor is
20 not a disadvantage in most cases, since it affects the relatively low data rate
21 in the direction from the given interferor to the HIS 12. There is typically no
22 need to adjust the transmit power of the WLAN access points 60 (i.e., in the
23 reverse direction), since they are strategically positioned in locations close to
24 the ceiling and may have complex antenna patterns, such that interference
25 with stationary sensitive medical device can be avoided by design. However,
26 should a sensitive medical device be moved around (e.g., during surgery) to
27 approach a WLAN access point 60, it is within the scope of the present
28 invention to apply the principles described above to temporarily reduce the
29 transmit power of the WLAN access point.

30

31 The communications network 10 of the first system architecture and/or the
32 communications network 610 of the second system architecture may also
33 comprise a plurality of chargers disposed at various locations throughout the
34 hospital for the example purpose of replenishing the battery charge in hand-

1 held devices. The chargers are connected to the controller 18 / 618 by a
2 communications link. In an embodiment, the chargers comprise charging
3 stations for receiving mobile terminals (such as PDAs or tablet PCs) and
4 having electrical connections for providing a recharging capability. The
5 mobile terminals in the charger do not support any session for any clinician.

6
7 A certain level of interaction between a given clinician (hereinafter denoted
8 20*) and a given charger occurs where clinician 20* inserts into the charger
9 a mobile terminal that he or she is currently using, for example, when leaving
10 for the day or when the battery is near exhaustion. In this case, clinician 20*
11 approaches the charger, where his or her presence will be detected by a
12 clinician-charger proximity monitoring process executed by the controller 18
13 in the first system architecture and/or the controller 618 in the second
14 system architecture. The controller 18 / 618 may then execute a series of
15 steps, such as (in the case where an ongoing session exists) causing the
16 display of a greeting message such as *"Please insert this mobile terminal into
17 a charging station and consider whether you wish to terminate or suspend
18 your session"*, or any conceivable variant thereof. Before inserting the mobile
19 terminal into the charger, clinician 20* may thus choose to explicitly
20 terminate or suspend an ongoing session (if there is one). Explicit
21 termination or suspension of a session has already been described herein
22 above in the context of scenarios **C-** and **D-**, respectively. It will be recalled
23 that termination leads to ending the session for clinician 20*, whereas
24 suspending the session has the effect of putting the session "on-hold" until
25 clinician 20* authenticates himself/herself when in the vicinity of another
26 terminal.

27
28 Another level of interaction between clinician 20* and the charger may occur
29 where clinician 20* is deemed to not be using a mobile terminal and is also
30 deemed to be "in proximity" to the charger (i.e., has satisfied a proximity
31 condition). For example, this may occur when clinician 20* begins his or her
32 shift, or has just inserted his or her mobile terminal into the charger, possibly
33 following suspension or termination of a session as described in the previous
34 paragraph. The fact that clinician 20* is in proximity to the charger and that

1 clinician 20* is not using a mobile terminal is detected by the aforementioned
2 clinician-charger proximity monitoring process executed by the controller 18
3 in the first system architecture and/or the controller 618 in the second
4 system architecture. In this case, the controller 18 / 618 executes a series
5 of steps, as now described with reference to Fig. 14.

6
7 At step 1410, a signal is provided to clinician 20* to suggest a particular
8 mobile terminal that he or she may use. This may be done by controlling
9 (e.g., by way of colour or by blinking) a light located on the outside of the
10 suggested mobile terminal or causing the display of a personalized greeting
11 message on the suggested mobile terminal. This may also be done by
12 controlling a visual indicator on the charger itself so as to indicate to the
13 clinician 20* the suggested mobile terminal. The suggested mobile terminal
14 may be selected on the basis of charge capacity or other parameter.
15 Optionally, at step 1420, a locking mechanism which is by default engaged
16 for all mobile terminals in the charger would be disengaged for the suggested
17 mobile terminal while remaining engaged for all other mobile terminals
18 presently in the charger.

19
20 (It should be noted that in the absence of a locking mechanism, removal of
21 a mobile terminal may be possible by someone who does not have a
22 clinician's tag, and therefore it may be appropriate to detect this fact using
23 the process being described here. Even if this is not the case, such action
24 would nevertheless be detected as potentially suspicious motion by the
25 tagged equipment monitoring process 820 described above.)

26
27 Once the suggested mobile terminal is extracted by clinician 20*, the
28 controller 18 / 618 proceeds to step 1430, whereby authentication data is
29 awaited from clinician 20*, either in response to a request (such as may be
30 issued via a greeting message) or *sua sponte*. This represents an opportunity
31 for clinician 20* to authenticate himself / herself. If a suitable response is not
32 received within a predetermined amount of time (e.g., 3 seconds), the
33 controller 18 / 618 proceeds to step 1440, where it infers that the mobile
34 terminal has been taken by someone who, although equipped with clinician

1 20*'s tag (resulting in unlocking of the now extracted mobile terminal), is not
2 familiar with the need to authenticate oneself. Since this may arise in the
3 context of theft, an action is taken at step 1450 to signal a problem. For
4 example, an audible or visual alarm may be triggered at the charger, and
5 security personnel may be advised.

6

7 On the other hand, authentication data may be received at step 1430, in
8 which case the authentication process 70 previously described may be may
9 be executed at step 1460. If the result of the authentication process is a
10 failure, then at step 1450, similar action to the above may be taken (e.g.,
11 sounding of an alarm, etc.)

12

13 Assuming that the result of the authentication process is a success, then the
14 controller 18 / 618 proceeds to step 1470, where the clinician database 22 is
15 consulted, resulting in the acquisition of appropriate personalization or
16 customization parameters for the purposes of initializing the extracted mobile
17 terminal. The controller 18/ 618 then proceeds to step 1480, whereby if
18 there is a suspended session for clinician 20*, the controller 18 / 618 causes
19 the session to be resumed in the manner previously described in this
20 specification. Where there is no suspended session for clinician 20*, the
21 remaining steps as described herein above in the context of the session
22 establishment process 82 are performed in order to establish a session for
23 clinician 20*.

24

25 An alternative sequence of steps in the interaction between clinician 20* and
26 the charger, following detection of the state where clinician 20* is in
27 proximity to the charger but is not using a mobile terminal, is now described
28 with reference to Fig. 15. In this case, a locking mechanism is by default
29 engaged for all mobile terminals in the charger.

30

31 At step 1510, which is identical to step 1410 in Fig. 14, a signal is provided
32 to clinician 20* to suggest a particular mobile terminal that he or she may
33 use. This may be done by controlling (e.g., by way of colour or by blinking)
34 a light located on the outside of the suggested mobile terminal or causing the

1 display of a personalized greeting message on the suggested mobile terminal.
2 The suggested mobile terminal may be selected on the basis of charge
3 capacity or other parameter.

4
5 The controller 18 / 618 then proceeds to step 1520, whereby authentication
6 data is awaited from clinician 20*, either in response to a request or *sua*
7 *sponte*. If a suitable response is not received within a predetermined amount
8 of time (e.g., 3 seconds), then the controller 18 / 618 does not need to do
9 anything, since the locking mechanism remains engaged with respect to the
10 mobile terminals in the charger.

11
12 On the other hand, authentication data may be received at step 1520, in
13 which case the authentication process 70 previously described may be may
14 be executed at step 1530. If the result of the authentication process is a
15 failure then, again, the controller 18 / 618 does not need to do anything,
16 since the locking mechanism remains engaged with respect to the mobile
17 terminals in the charger.

18
19 However, assuming that the result of the authentication process is a success,
20 the controller 18 / 618 proceeds to step 1540, where the locking mechanism
21 is disengaged for the suggested mobile terminal, allowing the suggested
22 terminal to be extracted. Next, the controller 18 / 618 executes step 1550,
23 where the clinician database 22 is consulted, resulting in the acquisition of
24 appropriate personalization or customization parameters for the purposes of
25 initializing the extracted mobile terminal.

26
27 At this stage, clinician 20* is in possession of the suggested mobile terminal
28 and is in fact detected to be in proximity to the suggested mobile terminal,
29 which may trigger the various session establishment and session resumption
30 processes described above. For example, if there is a suspended session for
31 clinician 20*, the controller 18 / 618 causes the session to be resumed in the
32 manner previously described in this specification. Where there is no
33 suspended session for clinician 20*, the controller 18 / 618 causes the session
34 to be established in the manner previously described in this specification.

1 Since both of these processes require authentication of clinician 20*, it will be
2 seen that there are in fact two authentications that clinician 20* needs to
3 perform before gaining access to the HIS 12 in the embodiment of Fig. 15,
4 as opposed to one in the embodiment of Fig. 14. However, the embodiment
5 of Fig. 15 guarantees that a mobile terminal will not be taken by an
6 unauthorized individual and hence obviates the step of signaling an alarm
7 condition.

8

9 Thus, the present disclosure has shown how a healthcare information system
10 (HIS) such as a hospital or clinical information system which allows clinicians
11 access to various hospital databases including patients' electronic health
12 records (EHRs) can be made more efficient, effective, safe and functional by
13 the exploitation of location awareness.

14

15 It should be mentioned that the examples of proximity and remoteness
16 conditions have been simplified for the benefit of the reader. Those skilled in
17 the art will appreciate that the parameters used to define the various
18 proximity and remoteness conditions can be tailored to suit specific
19 operational requirements, and that additional parameters can be used.
20 Furthermore, different parameters can be used for declaring proximity or
21 remoteness of different types of terminals (e.g., fixed-wire vs. mobile),
22 different professional roles, different individual clinicians, different types of
23 medical devices, etc.

24

25 Those skilled in the art will appreciate that in some embodiments, certain
26 functionality or functional entities of the controller 18 / 618, the
27 authentication entity 28 and/or the HIS 12 may be implemented as pre-
28 programmed hardware or firmware elements (e.g., application specific
29 integrated circuits (ASICs), electrically erasable programmable read-only
30 memories (EEPROMs), etc.), or other related components. In other
31 embodiments, the controller 18 / 618, the authentication entity 28 and/or the
32 HIS 12 may comprise an arithmetic and logic unit (ALU) having access to a
33 code memory (not shown) which stores program instructions for the
34 operation of the ALU in order to implement the functional entities and execute

1 the various processes and functions described above. The program
2 instructions could be stored on a medium which is fixed, tangible and
3 readable directly by the controller 18 / 618, the authentication entity 28
4 and/or the HIS 12, (e.g., removable diskette, CD-ROM, ROM, or fixed disk),
5 or the program instructions could be stored remotely but transmittable to the
6 controller 18 / 618, the authentication entity 28 and/or the HIS 12 via a
7 modem or other interface device (e.g., a communications adapter) connected
8 to a network over a transmission medium. The transmission medium may be
9 either a tangible medium (e.g., optical or analog communications lines) or a
10 medium implemented using wireless techniques (e.g., microwave, infrared or
11 other transmission schemes).

12

13 Although various embodiments have been illustrated, this was for the purpose
14 of describing, but not limiting, the invention. Various modifications will
15 become apparent to those skilled in the art and are within the scope of the
16 present invention, which is defined by the attached claims.

WHAT IS CLAIMED IS:

1. A method of controlling RF interference in a healthcare establishment, said method comprising:
 - receiving data regarding a wirelessly detectable tag associated to a first piece of equipment within the healthcare establishment;
 - determining whether the first piece of equipment is positioned relative to a second piece of equipment within the healthcare establishment such that an RF interference constraint is violated, based at least in part on the data regarding the wirelessly detectable tag;
 - responsive to the RF interference constraint being violated, causing a variation in RF power transmitted by at least one of the first piece of equipment and the second piece of equipment.
2. A method as defined in claim 1, wherein the data regarding the wirelessly detectable tag comprises:
 - data indicative of an identifier of the wirelessly detectable tag; and
 - data indicative of a respective distance between the wirelessly detectable tag and each one of at least three detectors spatially distributed in the healthcare establishment, each one of the at least three detectors being operative to detect a signal provided by the wirelessly detectable tag.
3. A method as defined in claim 2, wherein the data indicative of a respective distance between the wirelessly detectable tag and each one of at least three detectors spatially distributed in the healthcare establishment comprises data indicative of a respective travel time of the signal detected by each one of the at least three detectors.
4. A method as defined in claim 2, wherein the data indicative of a respective distance between the wirelessly detectable tag and each one of at least three detectors spatially distributed in the healthcare establishment comprises data indicative of a respective intensity of the

- 1 signal detected by each one of the at least three detectors.
2
- 3 5. A method as defined in claim 1, wherein determining whether the first
4 piece of equipment is positioned relative to a second piece of equipment
5 within the healthcare establishment such that an RF interference
6 constraint is violated, based at least in part on the data regarding the
7 wirelessly detectable tag comprises:
8 - obtaining an indication of a location of the first piece of equipment
9 within the healthcare establishment based at least in part on the data
10 regarding the wirelessly detectable tag;
11 - obtaining an indication of a distance between the first piece of
12 equipment and the second piece of equipment based at least in part
13 on the location of the first piece of equipment and a location of the
14 second piece of equipment within the healthcare establishment;
15 - obtaining an indication of RF power transmitted by one of the first
16 piece of equipment and the second piece of equipment;
17 - obtaining an indication of an exposed RF field strength limit at the
18 other of the first piece of equipment and the second piece of
19 equipment;
20 - deriving an indication of an exposed RF field strength at the other of
21 the first piece of equipment and the second piece of equipment based
22 at least in part on the distance between the first piece of equipment
23 and the second piece of equipment and the RF power transmitted by
24 the one of the first piece of equipment and the second piece of
25 equipment; and
26 - concluding that the RF interference constraint is violated if the
27 exposed RF field strength at the other of the first piece of equipment
28 and the second piece of equipment exceeds the exposed RF field
29 strength limit at the other of the first piece of equipment and the
30 second piece of equipment.
31
- 32 6. A method as defined in claim 5, wherein the wirelessly detectable tag is
33 a first wirelessly detectable tag, said method further comprising, prior to
34 obtaining an indication of a distance between the first piece of equipment

- 1 and the second piece of equipment based at least in part on the location
2 of the first piece of equipment and a location of the second piece of
3 equipment within the healthcare establishment:
- 4 - receiving data regarding a second wirelessly detectable tag associated
5 to the second piece of equipment;
 - 6 - obtaining an indication of a location of the second piece of equipment
7 within the healthcare establishment based at least in part on the data
8 regarding the second wirelessly detectable tag.
- 9
- 10 7. A method as defined in claim 5, wherein obtaining an indication of RF
11 power transmitted by one of the first piece of equipment and the second
12 piece of equipment comprises consulting a database containing data
13 indicative of the RF power transmitted by the one of the first piece of
14 equipment and the second piece of equipment.
- 15
- 16 8. A method as defined in claim 5, wherein obtaining an indication of an
17 exposed RF field strength limit at the other of the first piece of
18 equipment and the second piece of equipment comprises consulting a
19 database containing data indicative of an exposed RF field strength limit
20 at the other of the first piece of equipment and the second piece of
21 equipment.
- 22
- 23 9. A method as defined in claim 5, wherein deriving an indication of an
24 exposed RF field strength at the other of the first piece of equipment and
25 the second piece of equipment based at least in part on the distance
26 between the first piece of equipment and the second piece of equipment
27 and the RF power transmitted by the one of the first piece of equipment
28 and the second piece of equipment, comprises deriving the indication of
29 an exposed RF field strength at the other of the first piece of equipment
30 and the second piece of equipment also based at least in part on data
31 regarding propagation of RF radiation within the healthcare
32 establishment.
- 33
- 34 10. A method as defined in claim 5, wherein deriving an indication of an

- 1 exposed RF field strength at the other of the first piece of equipment and
2 the second piece of equipment based at least in part on the distance
3 between the first piece of equipment and the second piece of equipment
4 and the RF power transmitted by the one of the first piece of equipment
5 and the second piece of equipment, comprises deriving the indication an
6 exposed RF field strength at the other of the first piece of equipment and
7 the second piece of equipment also based at least in part on
8 topographical and structural data regarding the healthcare
9 establishment.
- 10 -
- 11 11. A method as defined in claim 1, wherein causing a variation in RF power
12 transmitted by at least one of the first piece of equipment and the
13 second piece of equipment comprises causing a reduction in RF power
14 transmitted by at least one of the first piece of equipment and the
15 second piece of equipment.
- 16
- 17 12. A method as defined in claim 11, wherein causing a reduction in RF
18 power transmitted by at least one of the first piece of equipment and the
19 second piece of equipment comprises causing a reduction in RF power
20 transmitted such that the RF power transmitted is reduced to a specific
21 level.
- 22
- 23 13. A method as defined in claim 1, wherein causing a variation in RF power
24 transmitted by at least one of the first piece of equipment and the
25 second piece of equipment comprises causing generation of a signal to
26 effect the variation in RF power transmitted by at least one of the first
27 piece of equipment and the second piece of equipment.
- 28
- 29 14. A method as defined in claim 7, further comprising updating the
30 database containing data indicative of the RF power transmitted by the
31 one of the first piece of equipment and the second piece of equipment
32 following to reflect the variation in RF power transmitted by at least one
33 of the first piece of equipment and the second piece of equipment.
- 34

- 1 15. A method as defined in claim 5, wherein the healthcare establishment
2 includes a communications network having a healthcare information
3 system, wherein the one of the first piece of equipment and the second
4 piece of equipment is a terminal supporting a session with the healthcare
5 information system, said method further comprising, prior to causing a
6 variation in RF power transmitted by at least one of the first piece of
7 equipment and the second piece of equipment, causing a variation in a
8 rate of transmission of data from the terminal to the healthcare
9 information system.
10
- 11 16. A method as defined in claim 15, wherein causing a variation in RF power
12 transmitted by at least one of the first piece of equipment and the
13 second piece of equipment comprises causing a reduction in RF power
14 transmitted by at least one of the first piece of equipment and the
15 second piece of equipment, and wherein causing a variation in a rate of
16 transmission of data from the terminal to the healthcare information
17 system comprises causing a reduction in a rate of transmission of data
18 from the terminal to the healthcare information system.
19
- 20 17. A method as defined in claim 1, further comprising:
21 - responsive to the RF interference constraint not being violated,
22 determining whether a hypothetical increase in RF power transmitted
23 by at least one of the first piece of equipment and the second piece
24 of equipment would result in the RF interference constraint being
25 violated; and
26 - responsive to determining that the hypothetical increase in RF power
27 transmitted by at least one of the first piece of equipment and the
28 second piece of equipment would not result in the RF interference
29 constraint being violated, causing an increase in RF power
30 transmitted by at least one of the first piece of equipment and the
31 second piece of equipment in accordance with the hypothetical
32 increase.
33
- 34 18. A method as defined in claim 15, wherein the terminal is a mobile

- 1 terminal.
- 2
- 3 19. A method as defined in claim 18, wherein the mobile terminal is a hand-
- 4 held device.
- 5
- 6 20. A method as defined in claim 15, wherein the terminal is a stationary
- 7 terminal.
- 8
- 9 21. A method as defined in claim 1, wherein the healthcare establishment
- 10 includes a communications network, wherein at least one of the first
- 11 piece of equipment and the second piece of equipment is a terminal of
- 12 the communications network.
- 13
- 14 22. A method as defined in claim 21, wherein the terminal is a mobile
- 15 terminal.
- 16
- 17 23. A method as defined in claim 22, wherein the mobile terminal is a hand-
- 18 held device.
- 19
- 20 24. A method as defined in claim 21, wherein the terminal is a stationary
- 21 terminal.
- 22
- 23 25. A method as defined in claim 1, wherein the healthcare establishment
- 24 includes a communications network, wherein at least one of the first
- 25 piece of equipment and the second piece of equipment is a wireless local
- 26 area network phone of the communications network.
- 27
- 28 26. A method as defined in claim 1, wherein at least one of the first piece of
- 29 equipment and the second piece of equipment is a wireless telephone.
- 30
- 31 27. A system for controlling RF interference in a healthcare establishment,
- 32 comprising:
- 33 - a first functional entity adapted to receive location data regarding a
- 34 medical device and location data regarding a mobile communication

- 1 device that transmits RF power at a certain level, the location data
2 regarding the mobile communication device being determined on a
3 basis of signals received from a wirelessly detectable tag associated
4 with the mobile communication device;
- 5 - a second functional entity adapted to determine, at least partly based
6 on the location data regarding the mobile communication device and
7 the location data regarding the medical device, whether the mobile
8 communication device and the medical device are positioned relative
9 to one another such that a RF interference condition is met; and
10 - a third functional entity adapted to cause the mobile communication
11 device to reduce the level at which it transmits RF power in response
12 to the RF interference condition being met.
13
- 14 28. The system defined in claim 27, wherein the location data regarding the
15 medical device is determined on a basis of signals received from a
16 wirelessly detectable tag associated with the mobile communication
17 device.
18
- 19 29. The system defined in claim 27, wherein the mobile communication
20 device transmits data at a certain rate over a communications network
21 of the healthcare establishment, the third functional entity being further
22 adapted to cause the mobile communication device to reduce the rate at
23 which it transmits data.
24
- 25 30. The system defined in claim 27, wherein the mobile communication
26 device transmits data at a certain rate over a communications network
27 of the healthcare establishment, the third functional entity being further
28 adapted to cause the mobile communication device to reduce the rate at
29 which it transmits data prior to causing the mobile communication device
30 to reduce the level at which it transmits RF power.
31
- 32 31. A computer-readable storage medium comprising a program element for

- 1 execution by a computing device to control RF interference in a
2 healthcare establishment, the program element including:
- 3 - computer-readable program code for receiving location data
4 regarding a medical device and location data regarding a mobile
5 communication device that transmits RF power at a certain level, the
6 location data regarding the mobile communication device being
7 determined on a basis of signals received from a wirelessly detectable
8 tag associated with the mobile communication device;
 - 9 - computer-readable program code for determining, at least partly
10 based on the location data regarding the mobile communication
11 device and the location data regarding the medical device, whether
12 the mobile communication device and the medical device are
13 positioned relative to one another such that a RF interference
14 condition is met; and
 - 15 - computer-readable program code for causing the mobile
16 communication device to reduce the level at which it transmits RF
17 power in response to the RF interference condition being met.

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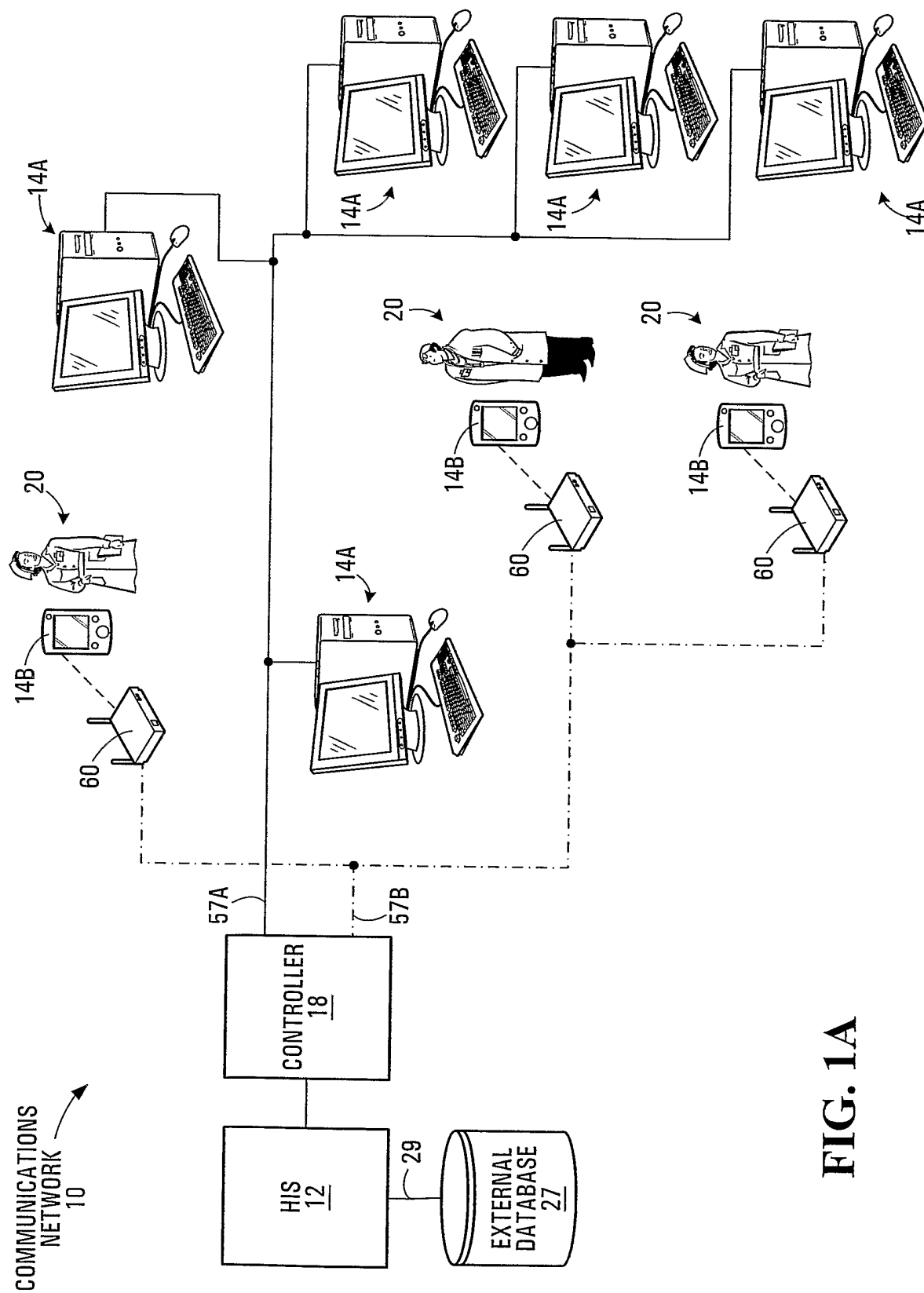


FIG. 1A

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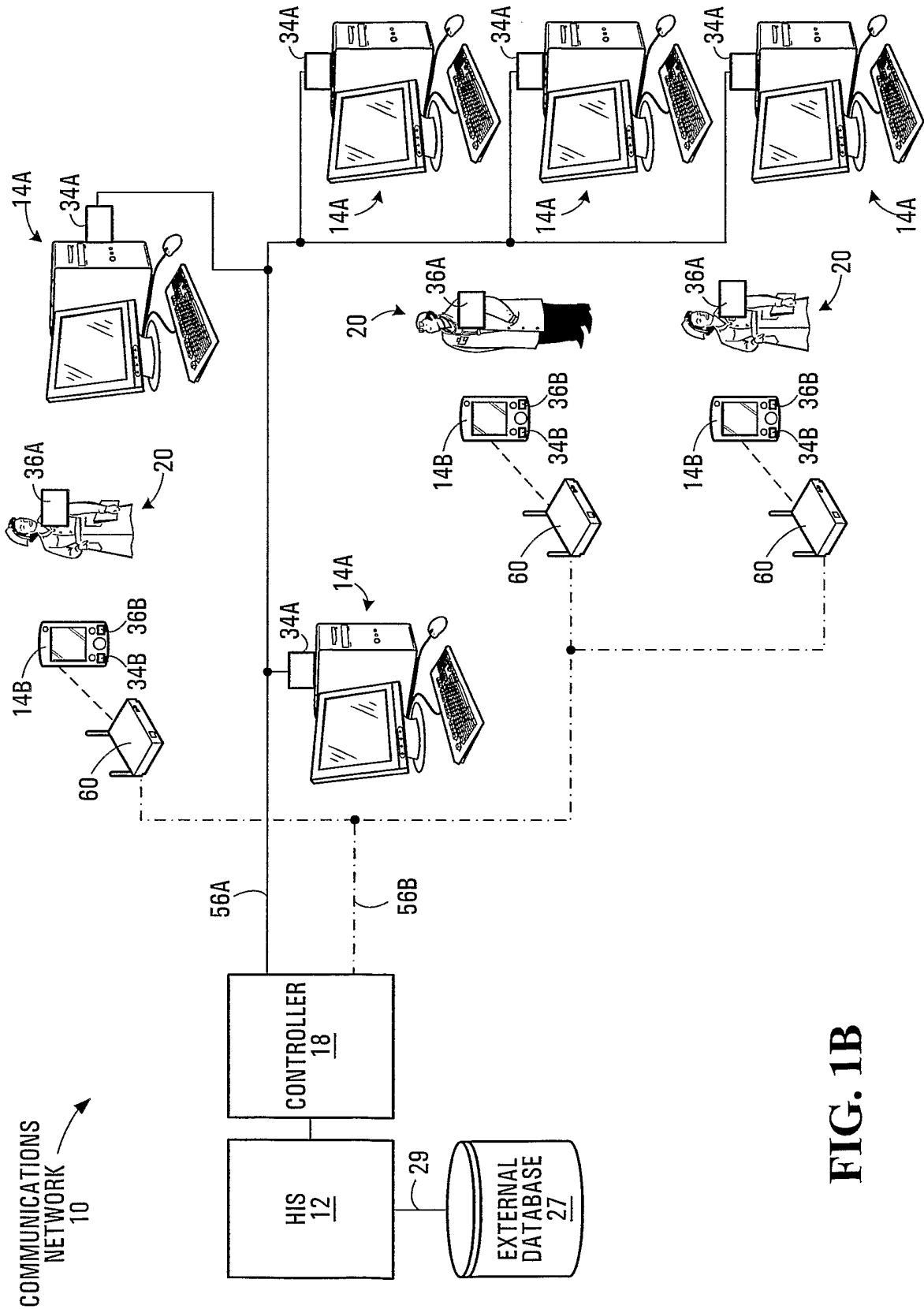


FIG. 1B

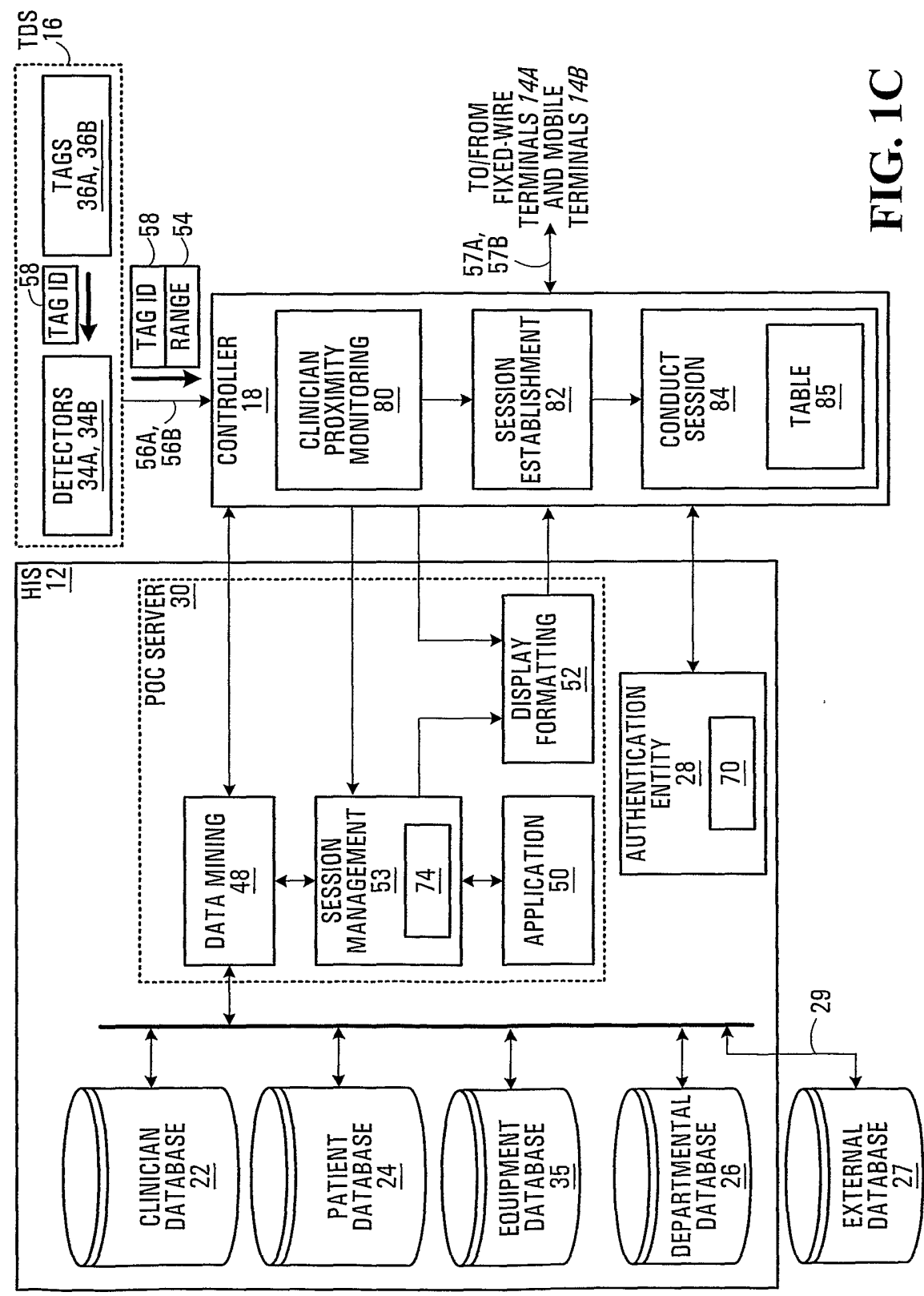


FIG. 1C

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EQUIPMENT ID <u>103</u>	EQUIPMENT-SPECIFIC TAG ID <u>105</u>	EQUIPMENT TYPE <u>107</u>	DISPLAY CAPABILITY <u>109</u>	35

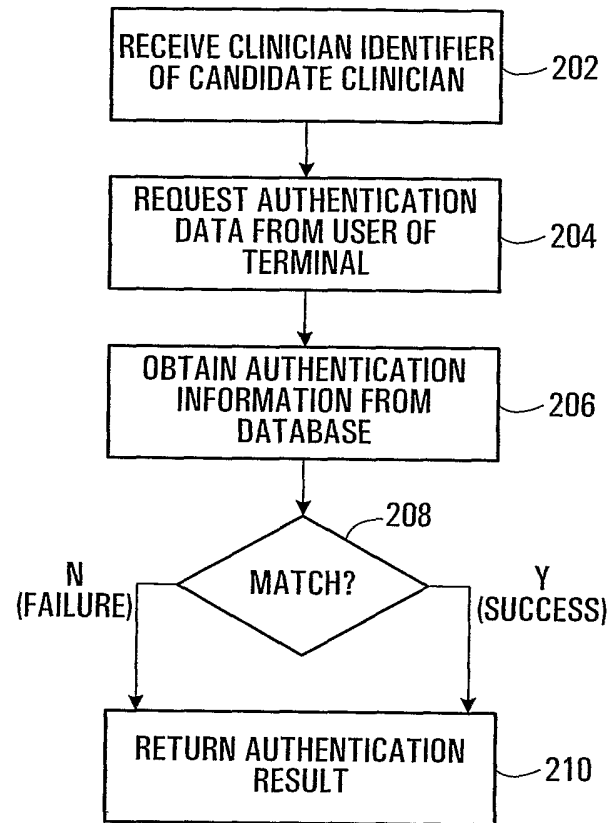
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PATIENT	HEALTH HISTORY	DIAGNOSTICS	TEST RESULTS	ADMISSIONS RECORD	47

FIG. 1D

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200

**FIG. 2A**

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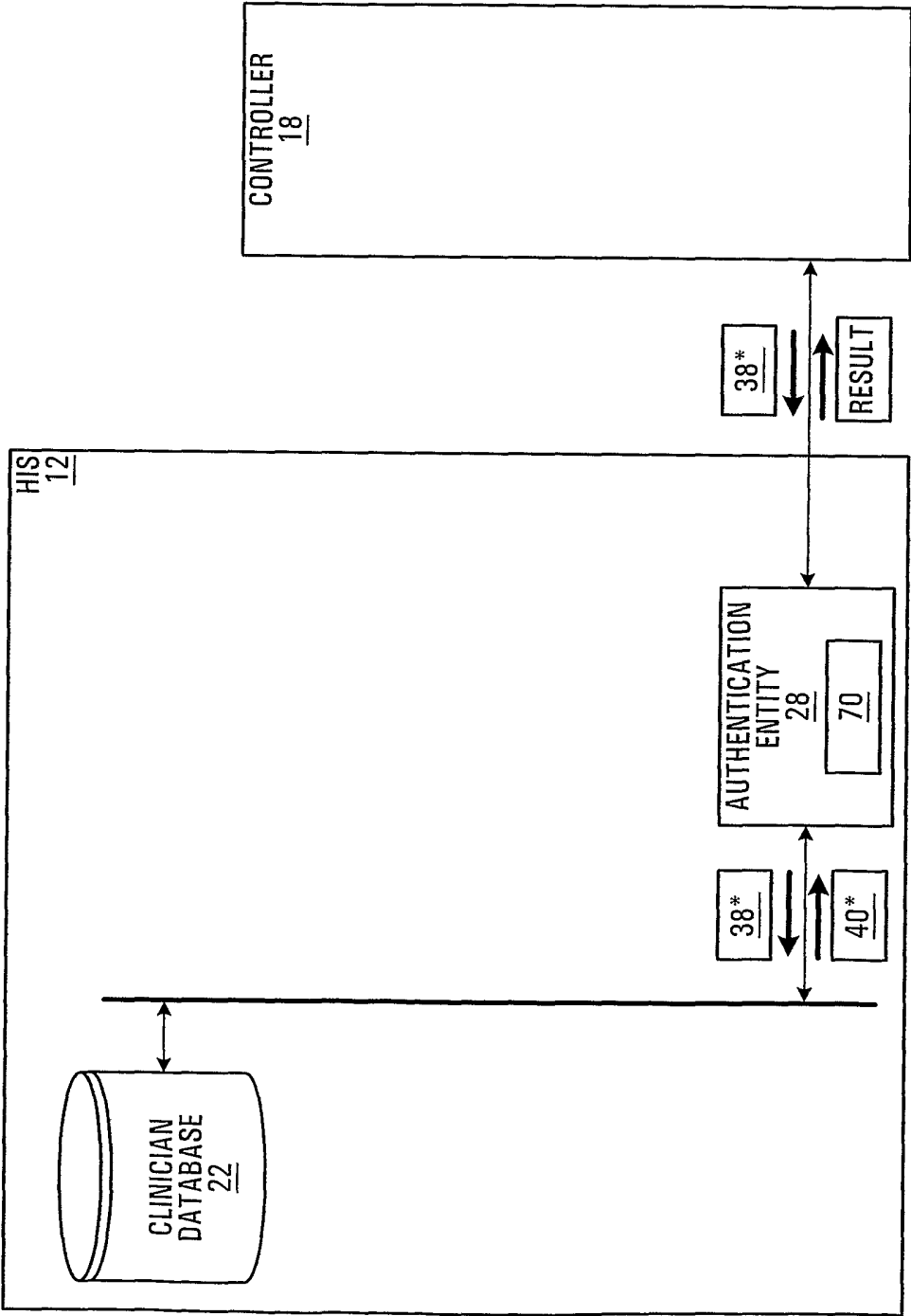


FIG. 2B

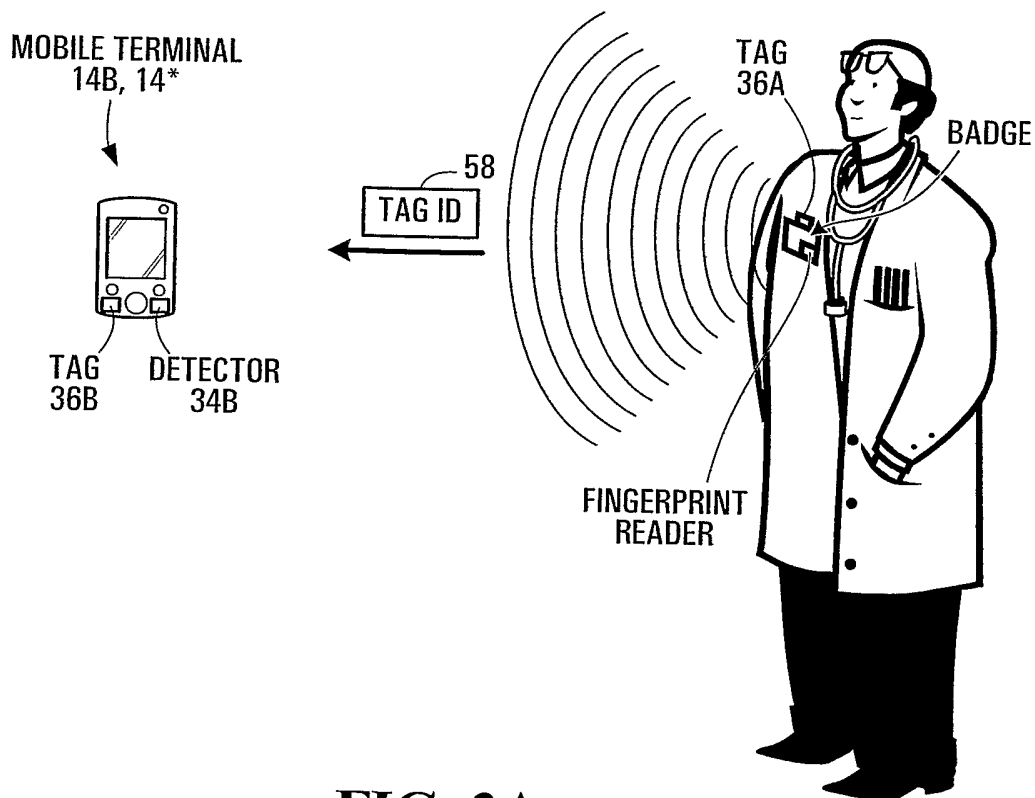
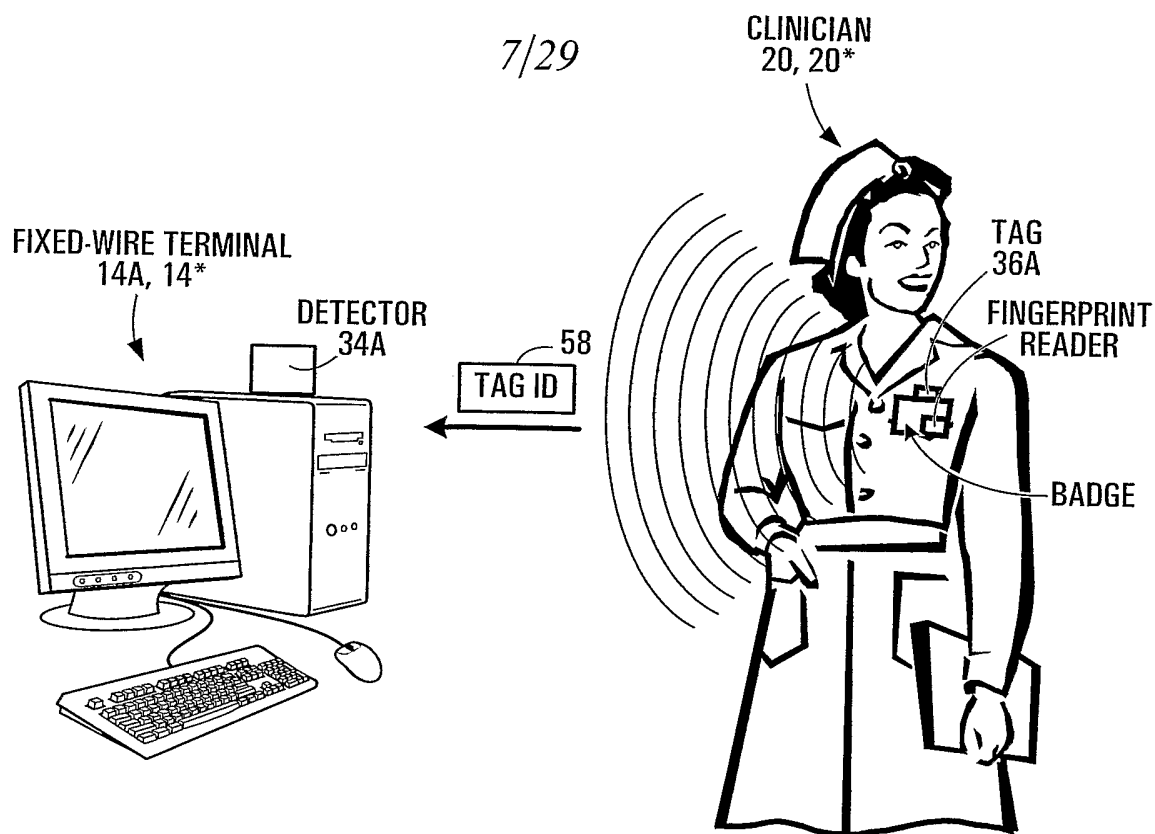
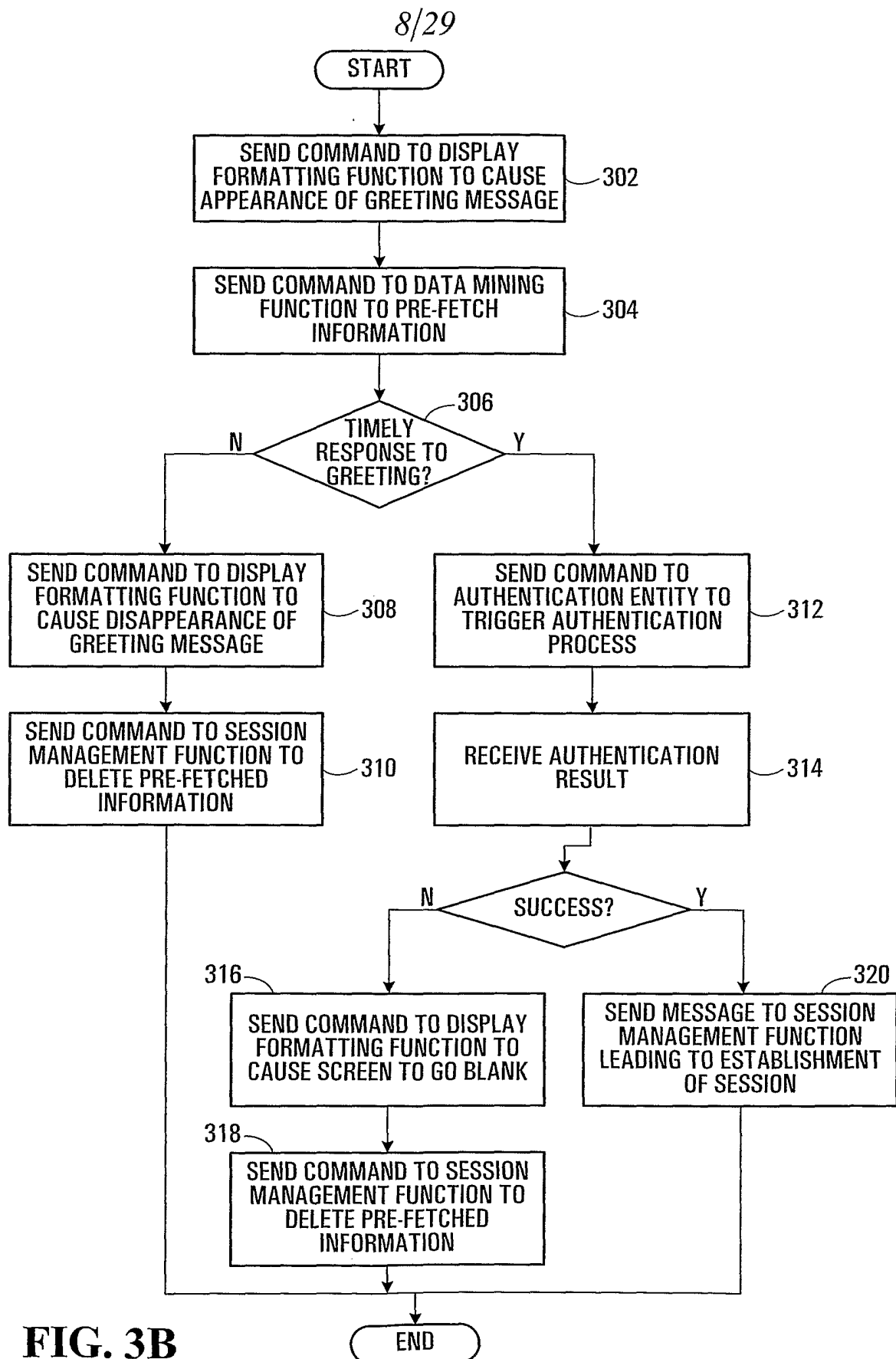


FIG. 3A

**FIG. 3B**

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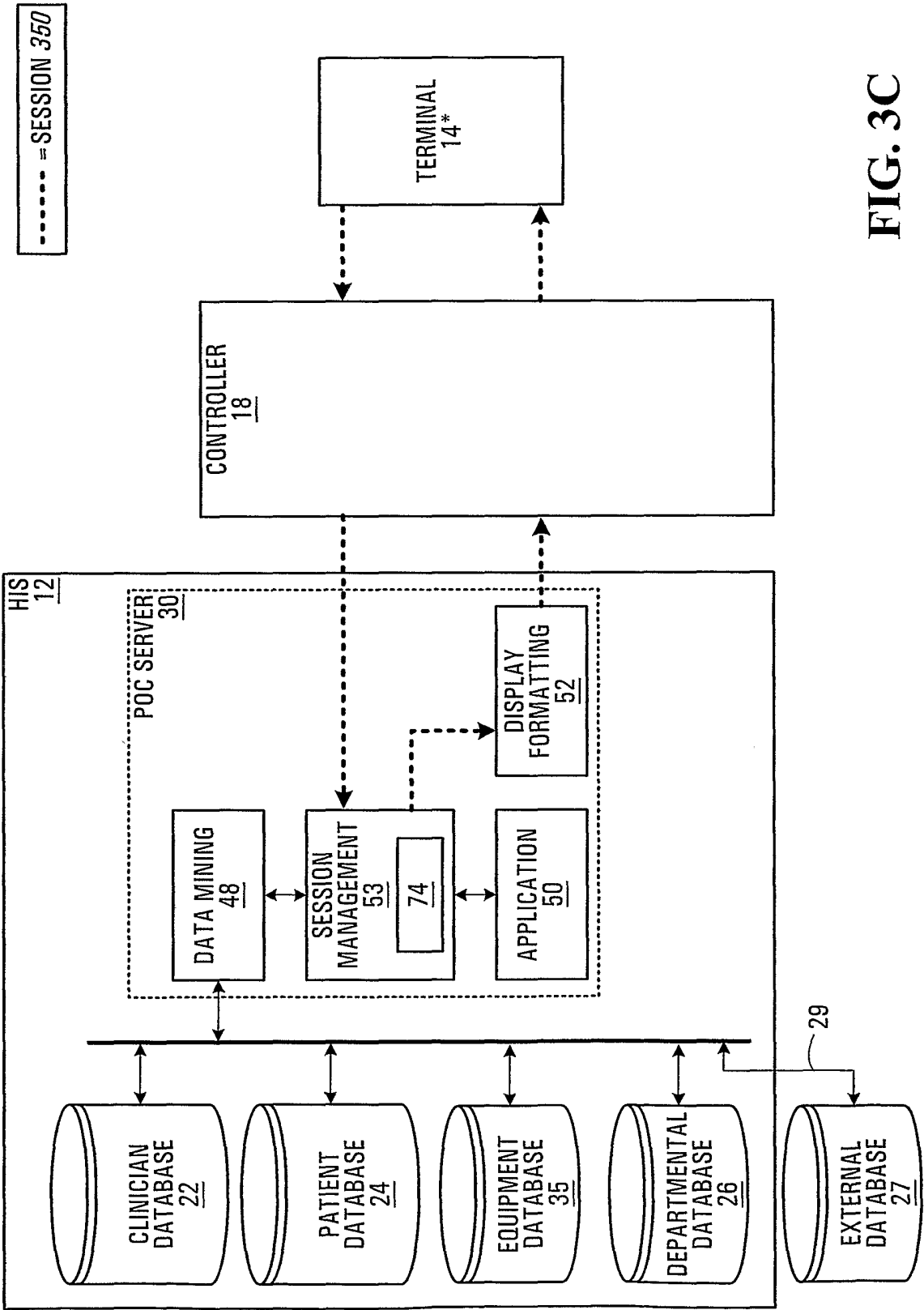
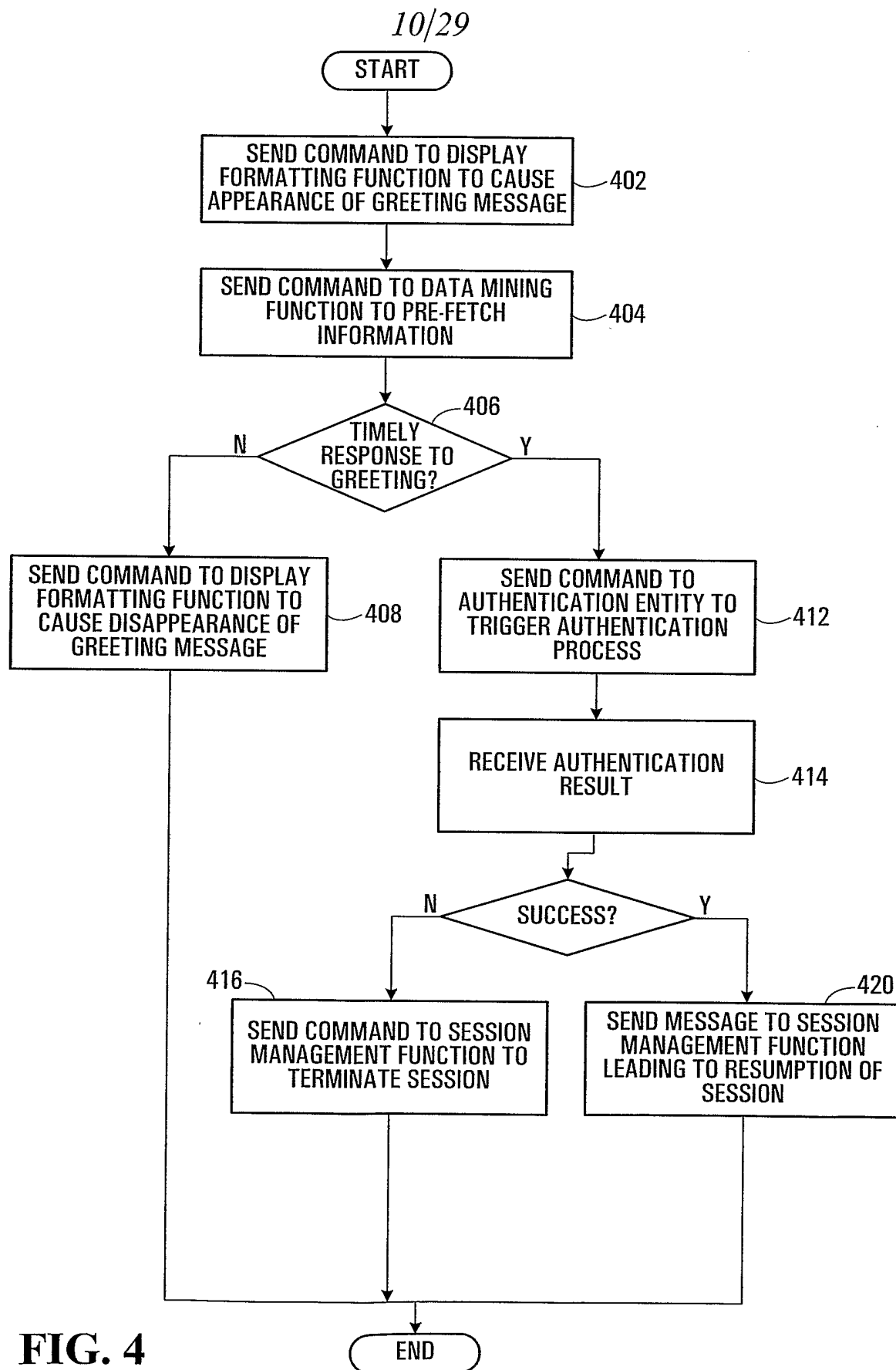


FIG. 3C



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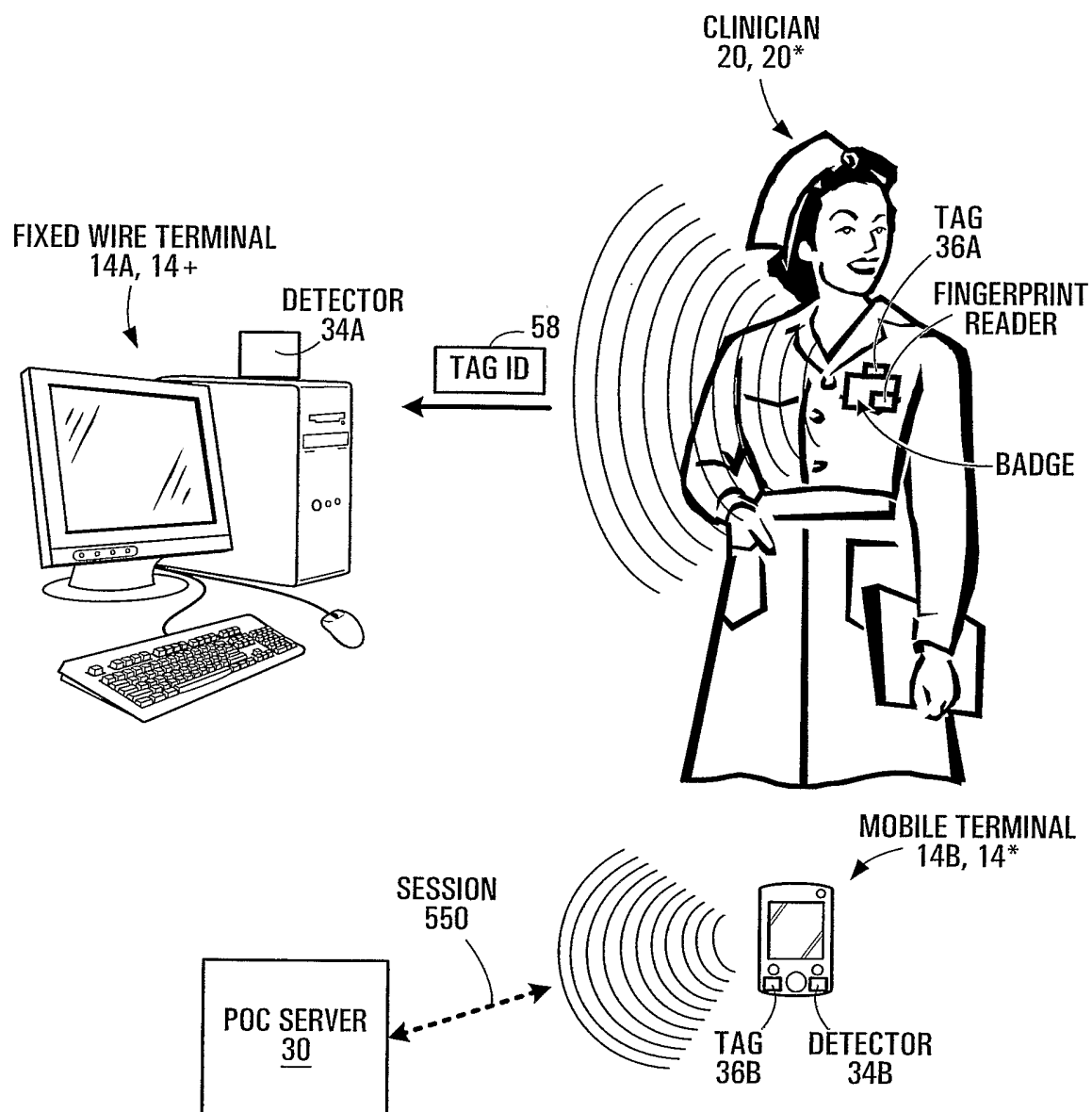
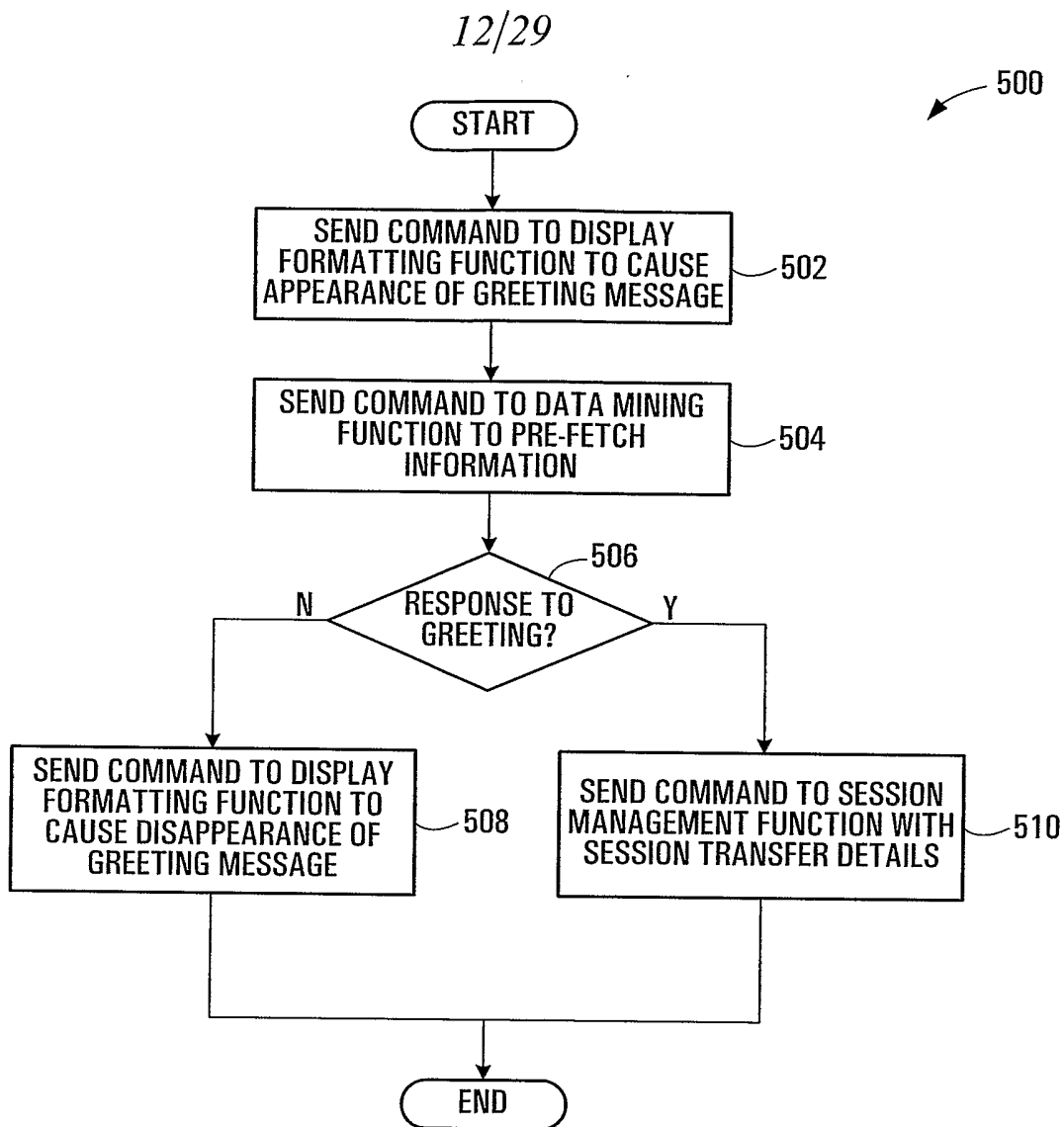
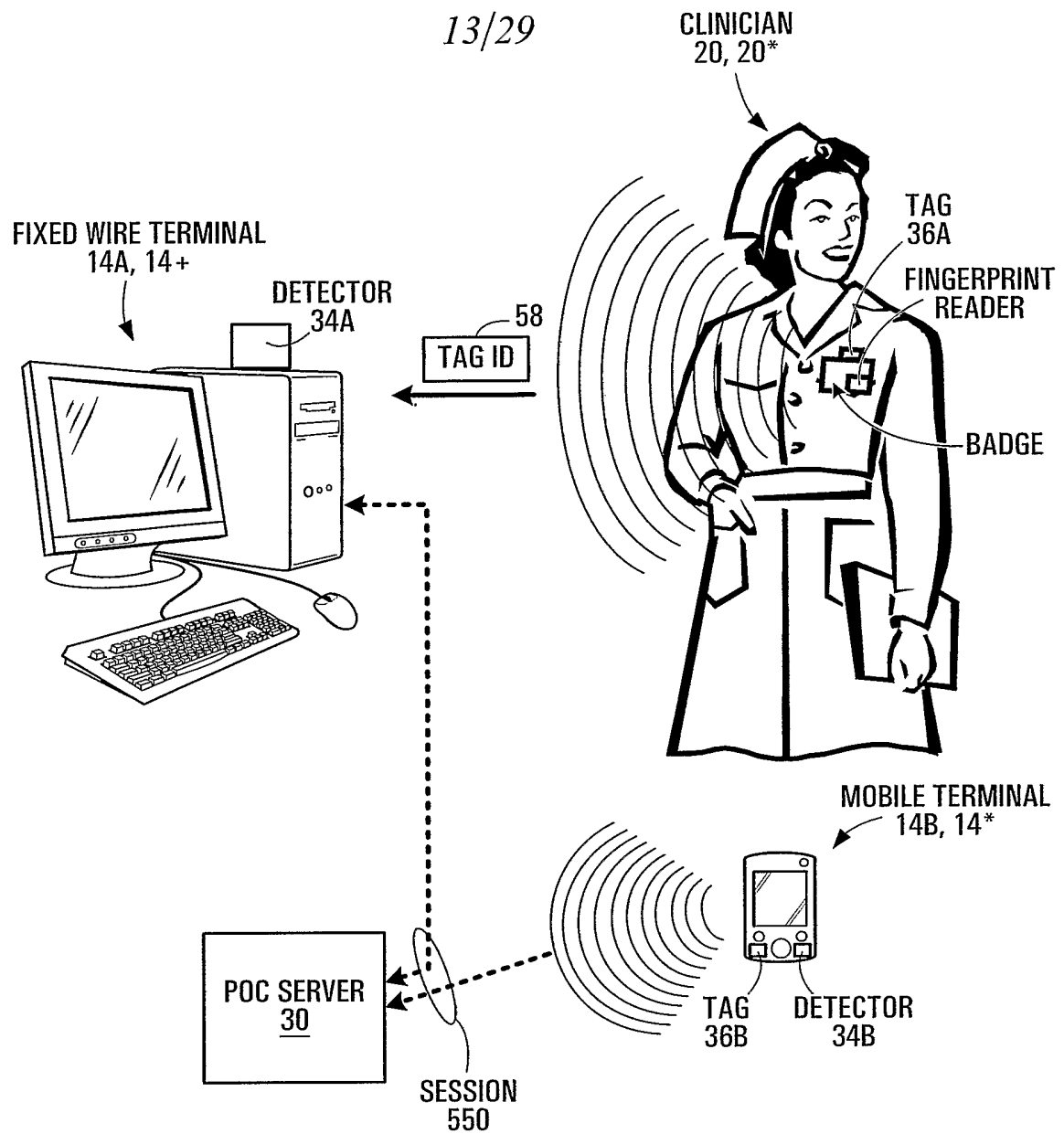
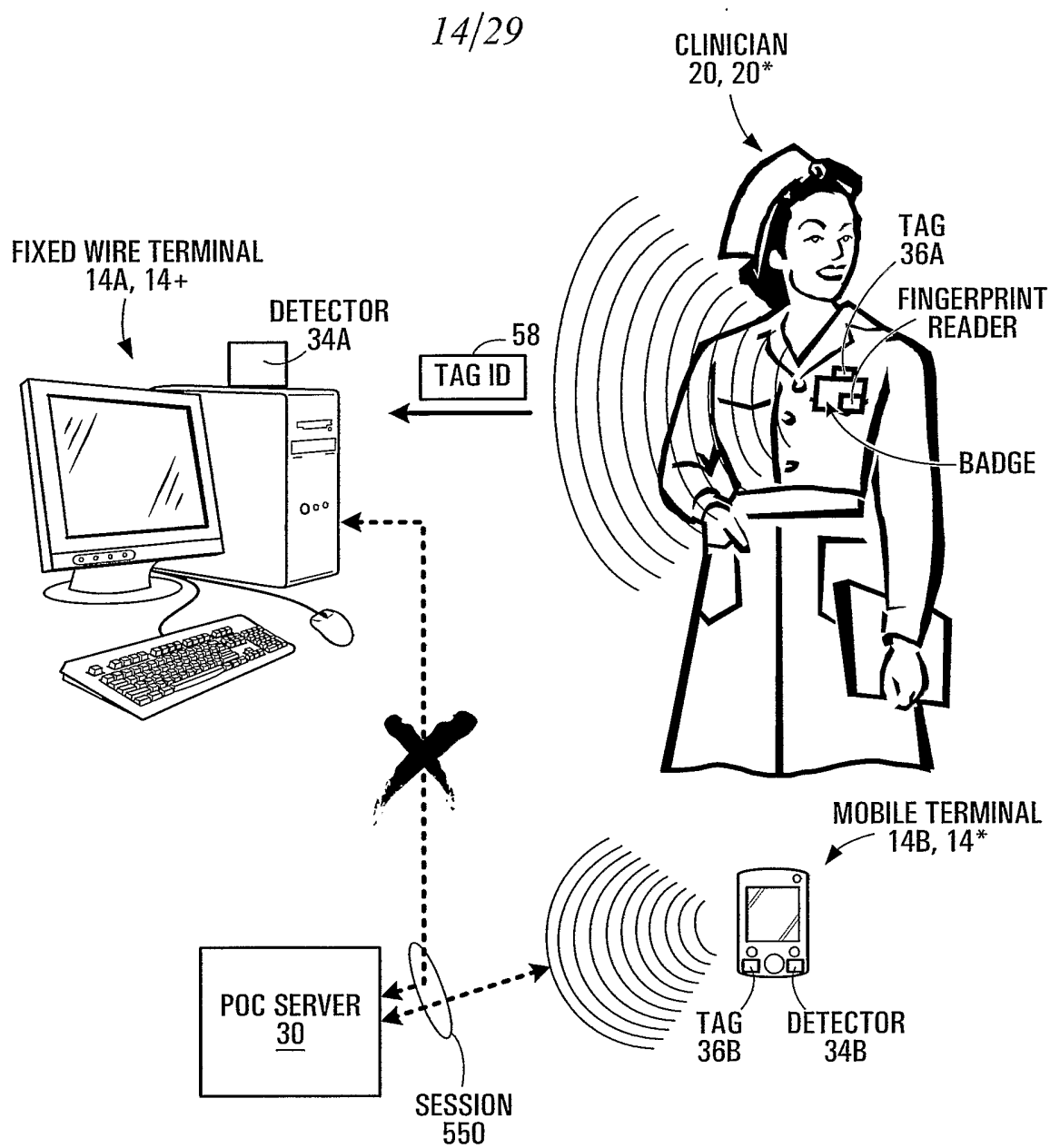


FIG. 5A

**FIG. 5B**

**FIG. 5C**

**FIG. 5D**

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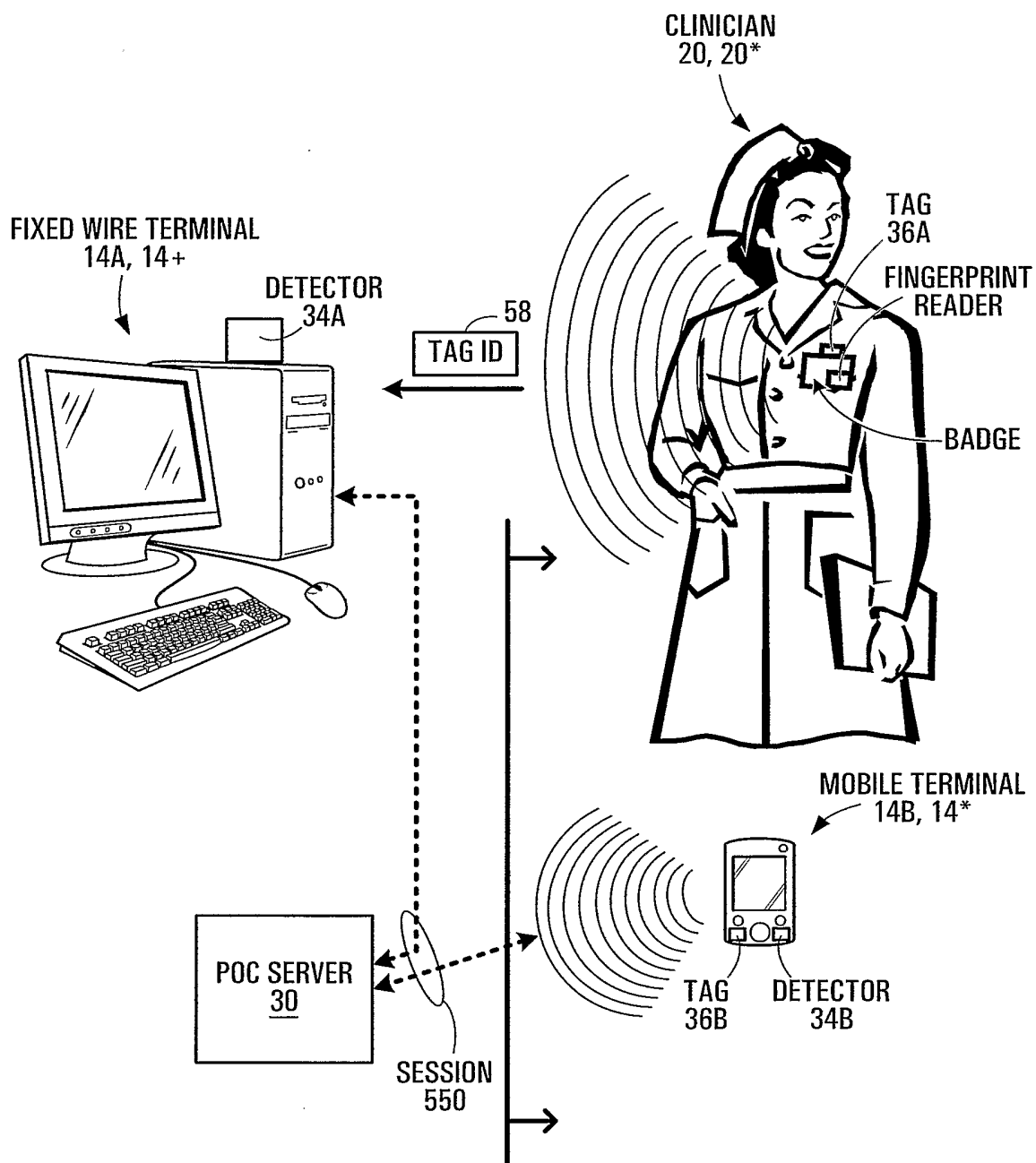
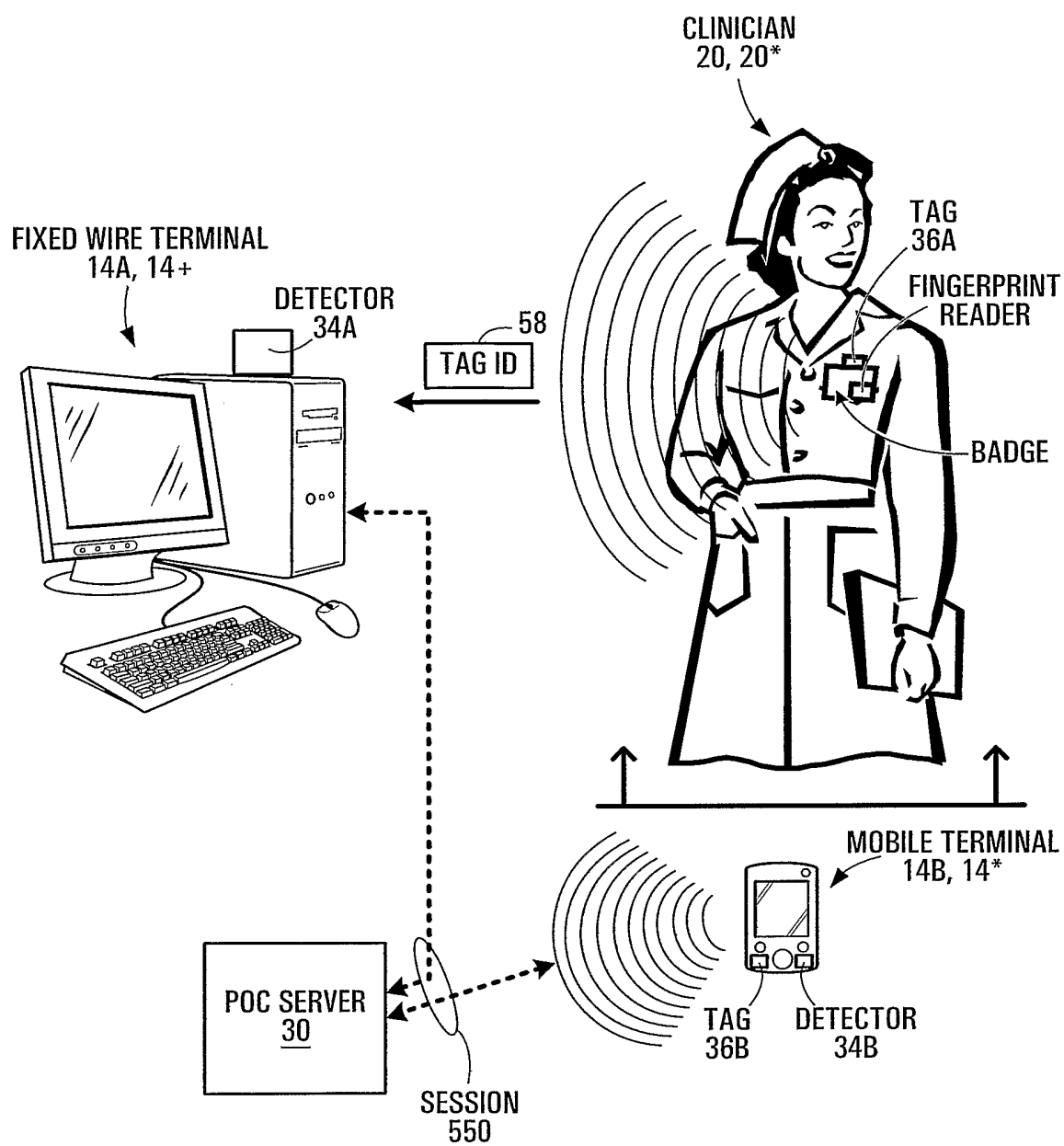


FIG. 5E

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**FIG. 5F**

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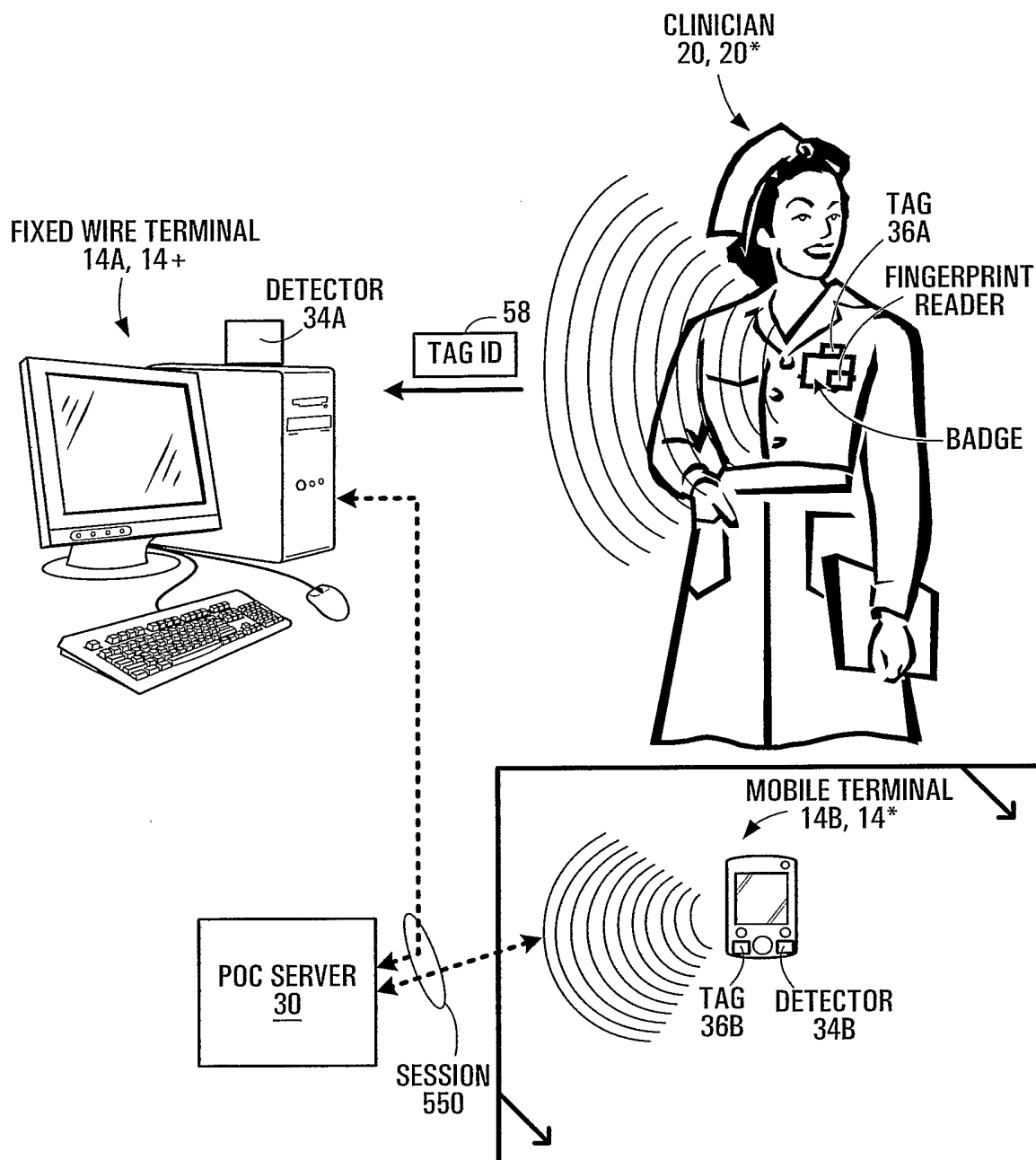
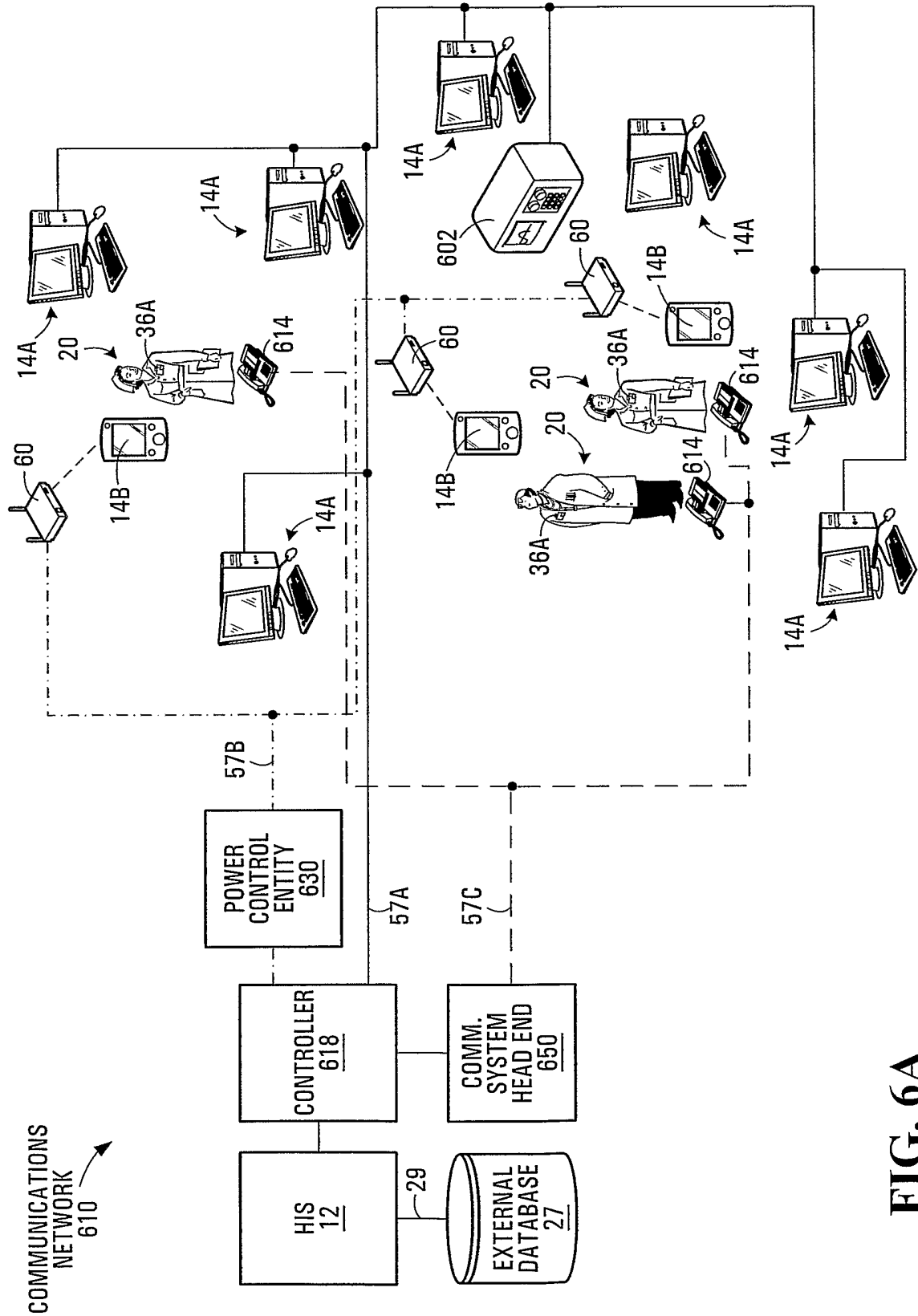
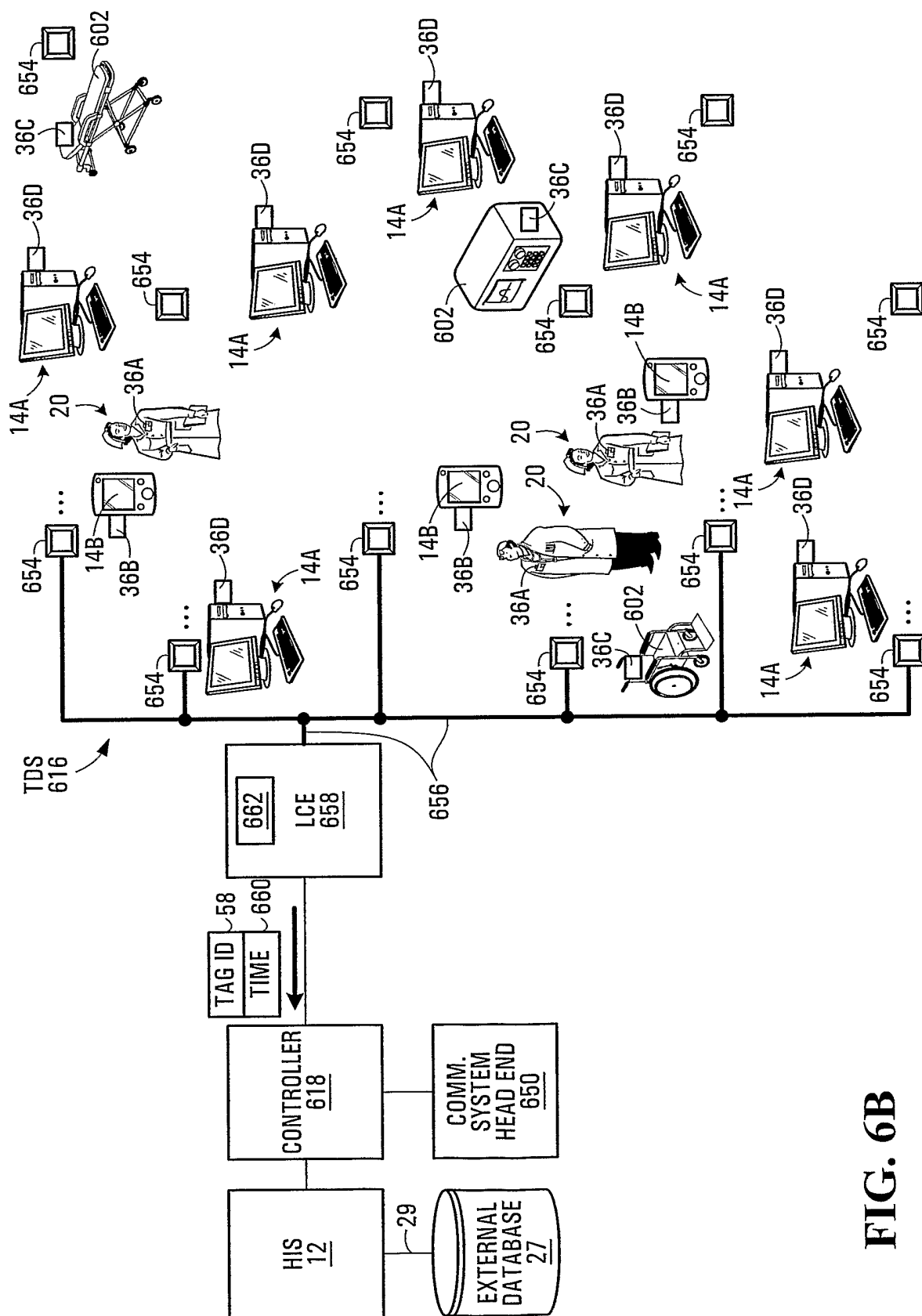


FIG. 5G

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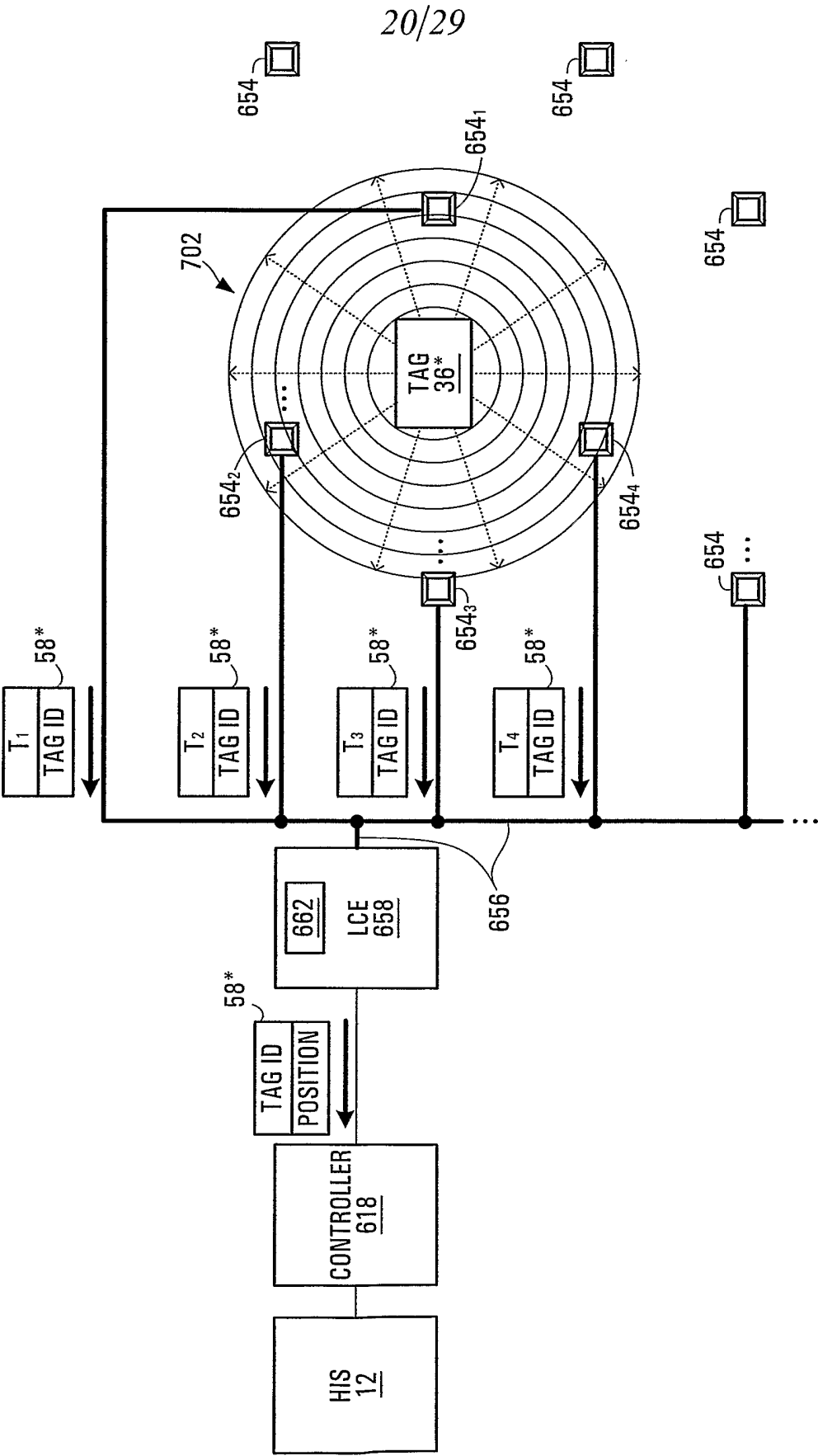
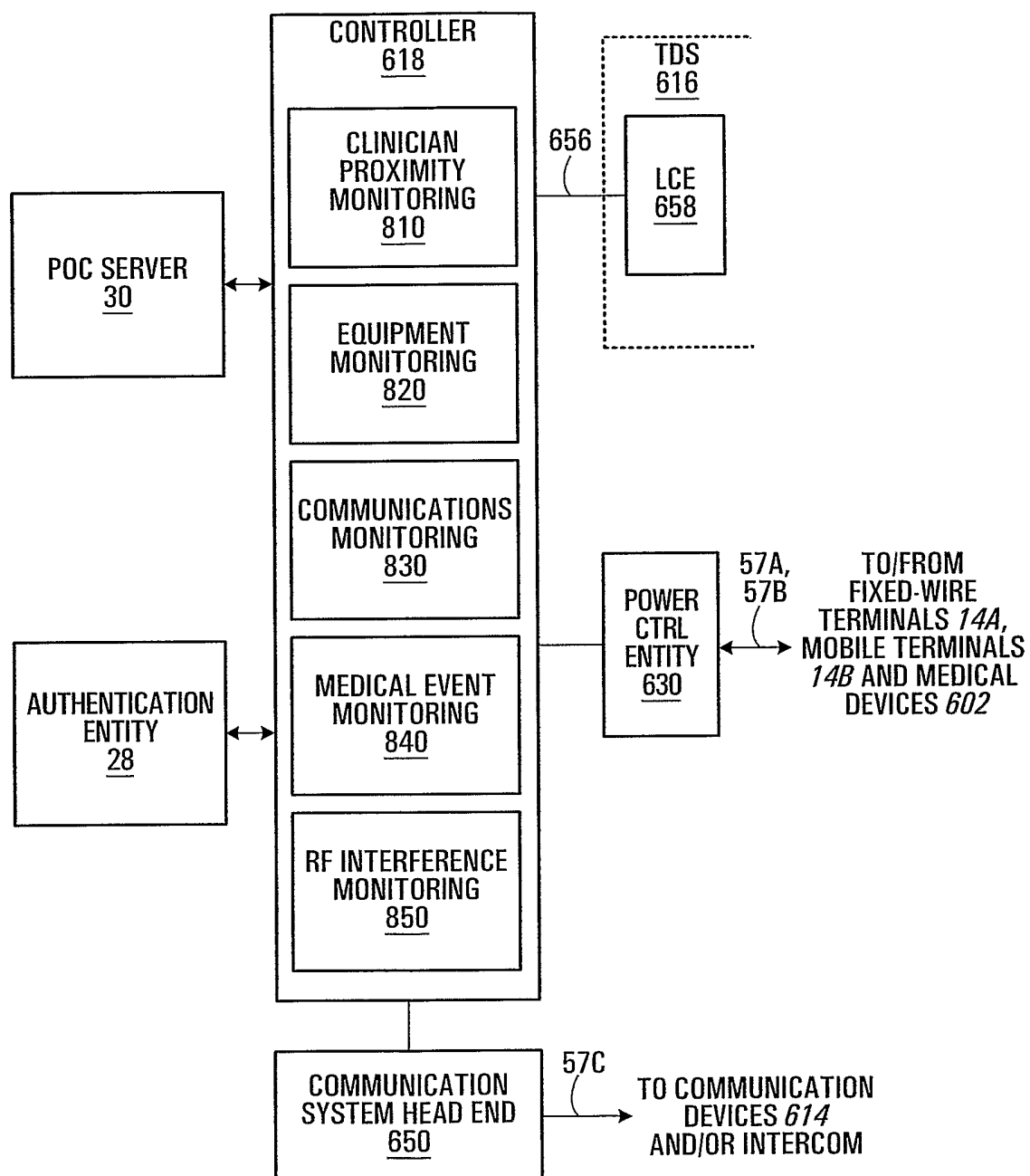
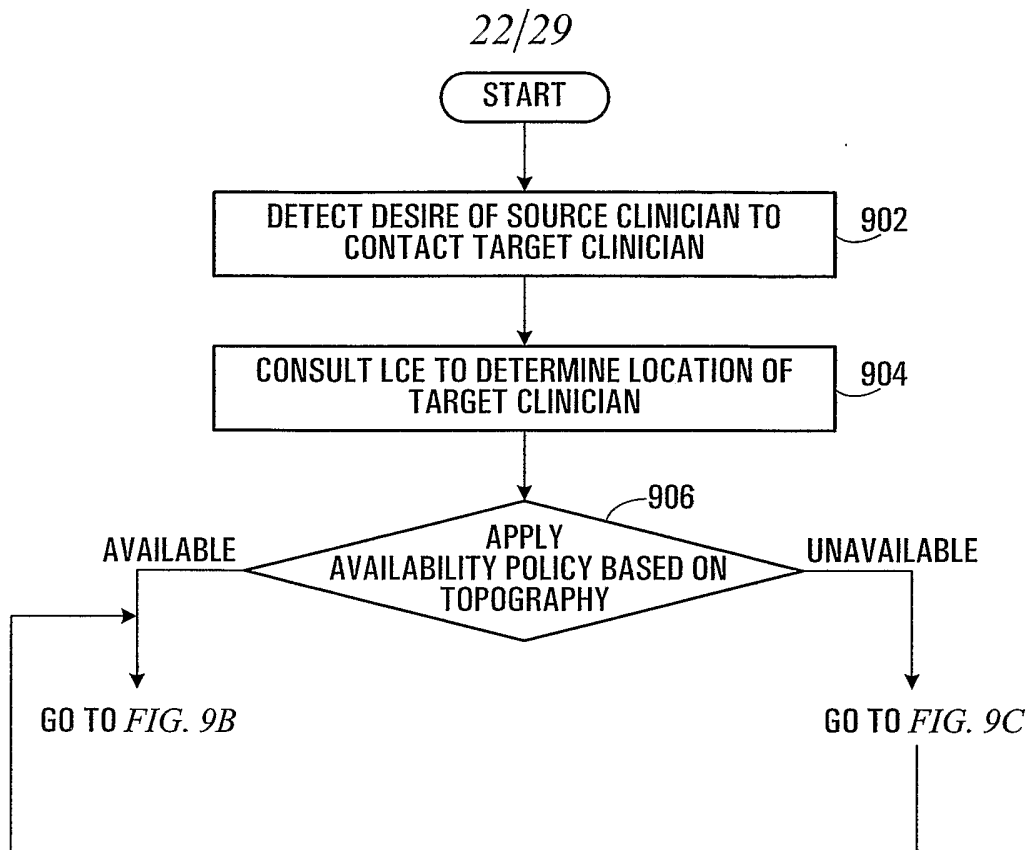


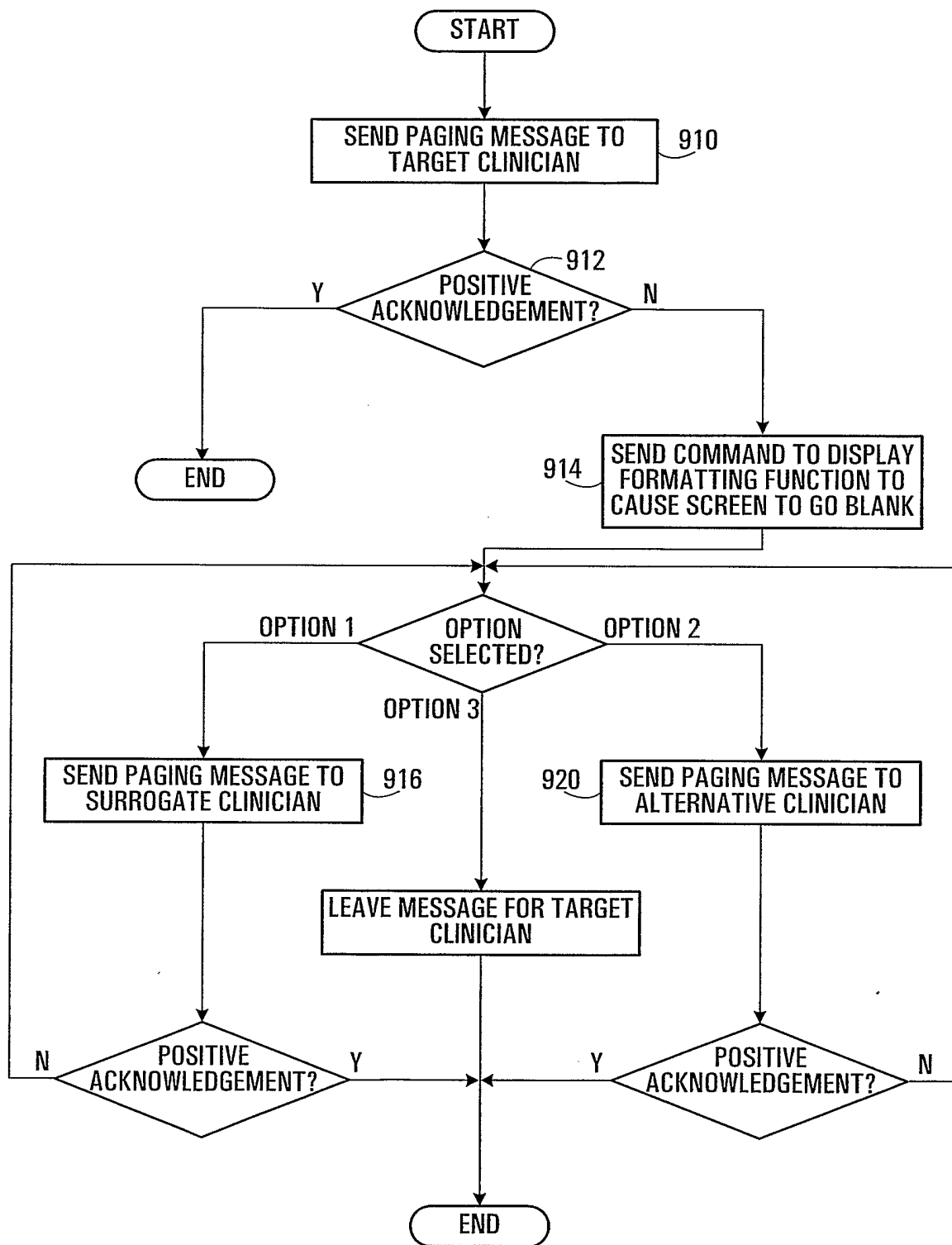
FIG. 7

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**FIG. 8**

**FIG. 9A**

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**FIG. 9B**

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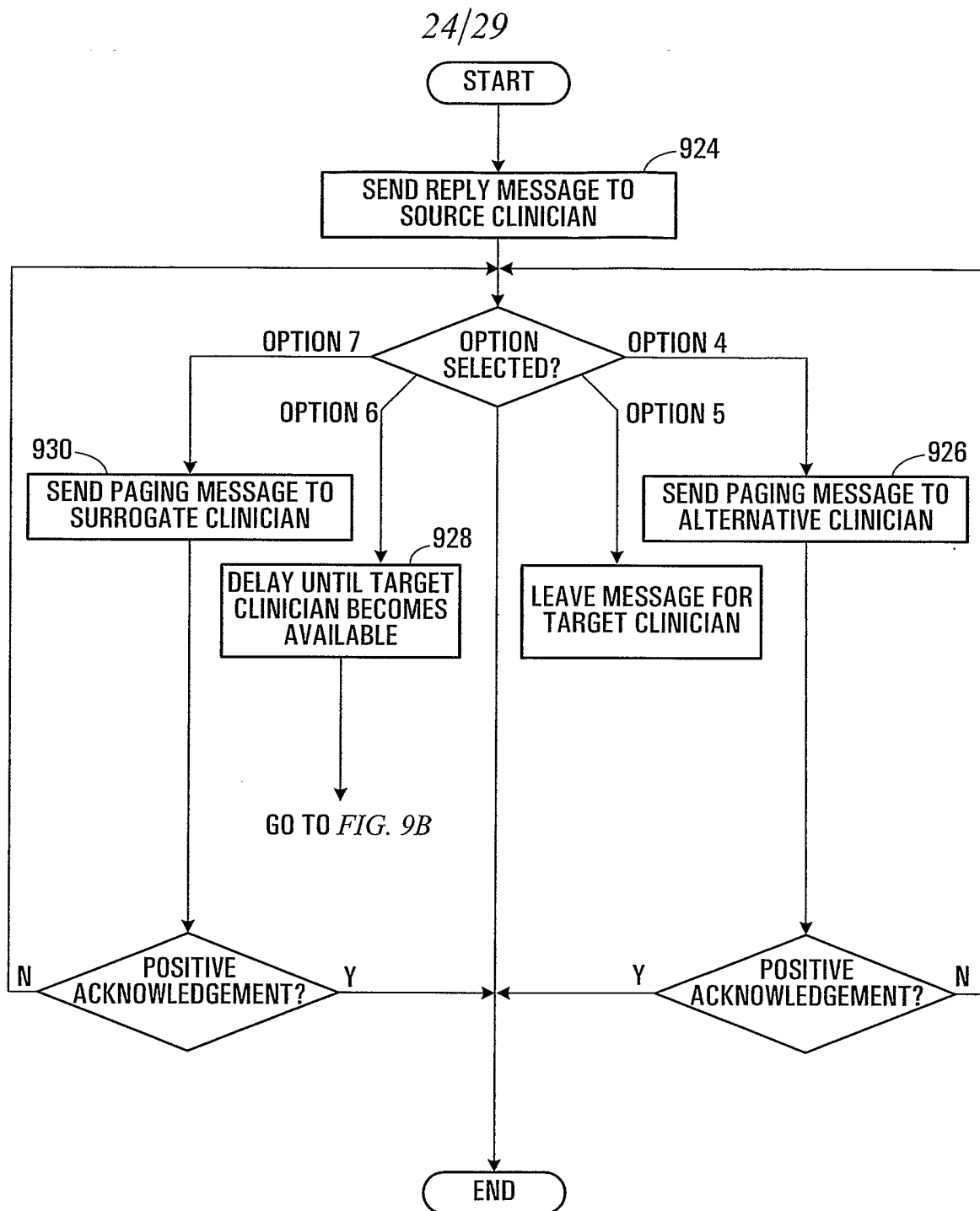
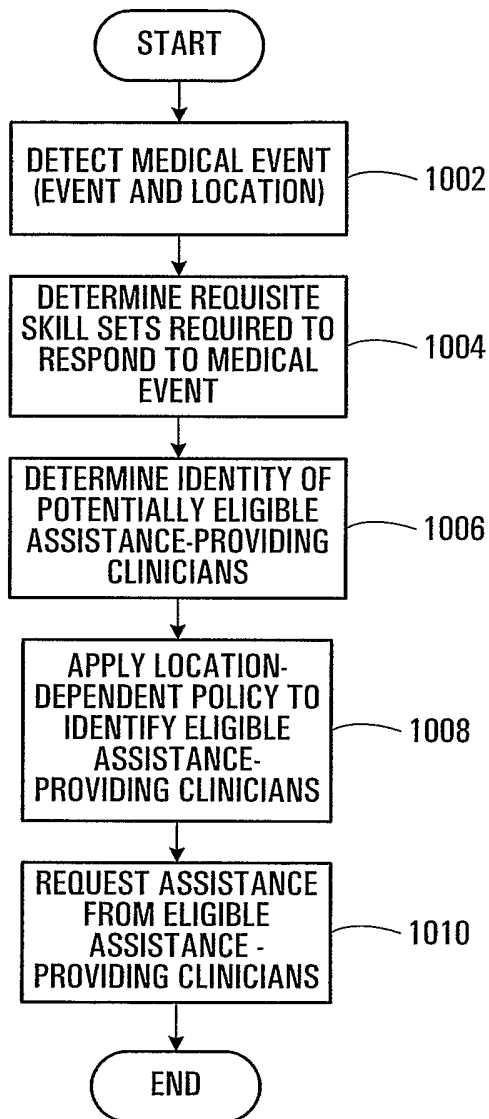


FIG. 9C

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**FIG. 10**

1135

EQUIPMENT ID 103	EQUIPMENT-SPECIFIC TAG ID 105	EQUIPMENT TYPE 107	DISPLAY CAPABILITY 109	AUTHORIZED USERS 1110	PHYSICAL BOUNDARIES 1112

FIG. 11

1235

EQUIPMENT ID 103	EQUIPMENT-SPECIFIC TAG ID 105	EQUIPMENT TYPE 107	DISPLAY CAPABILITY 109	MAXIMUM TRANSMITTED RF POWER 1210	EXPOSED RF FIELD STRENGTH LIMIT 1220

FIG. 12

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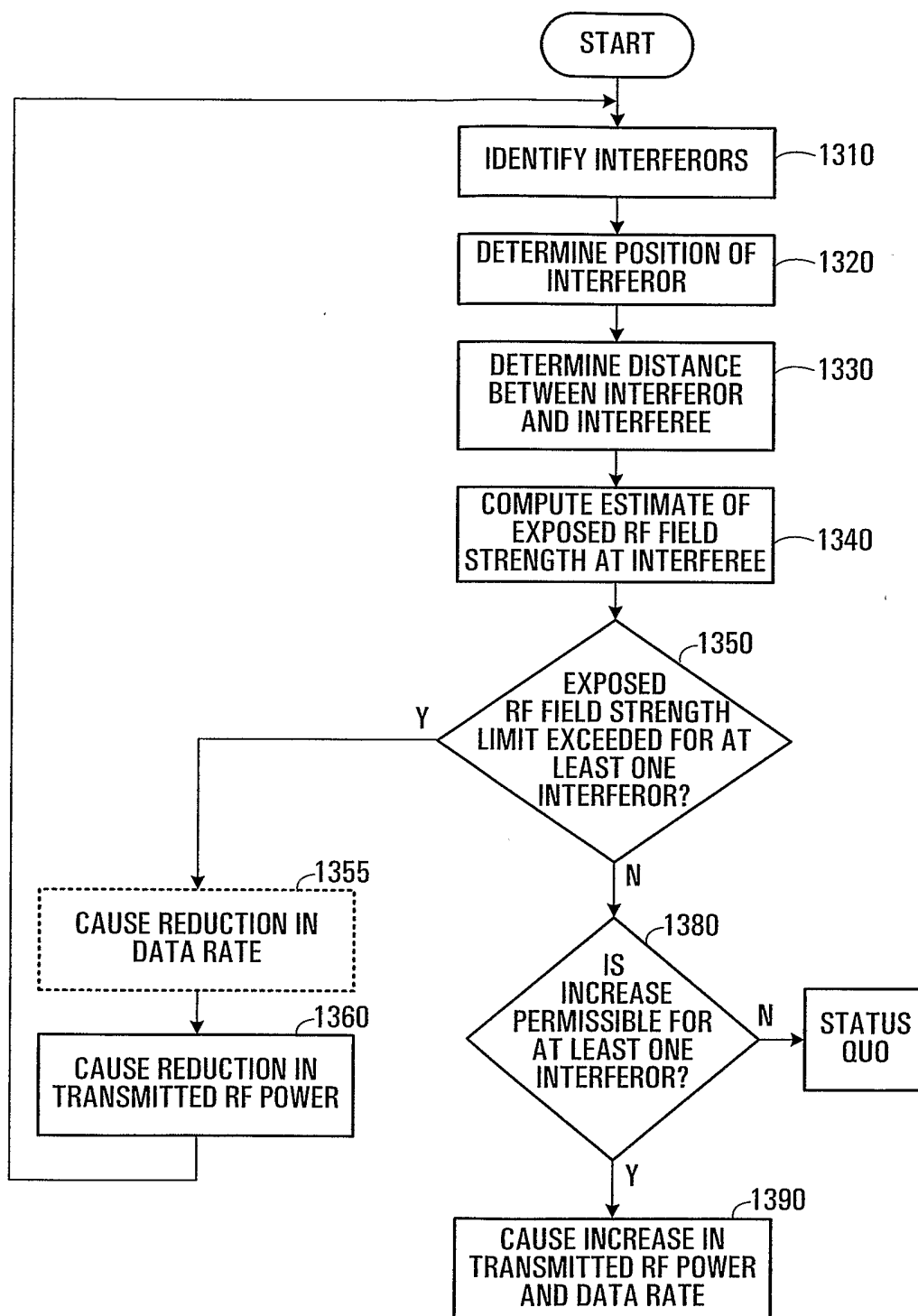
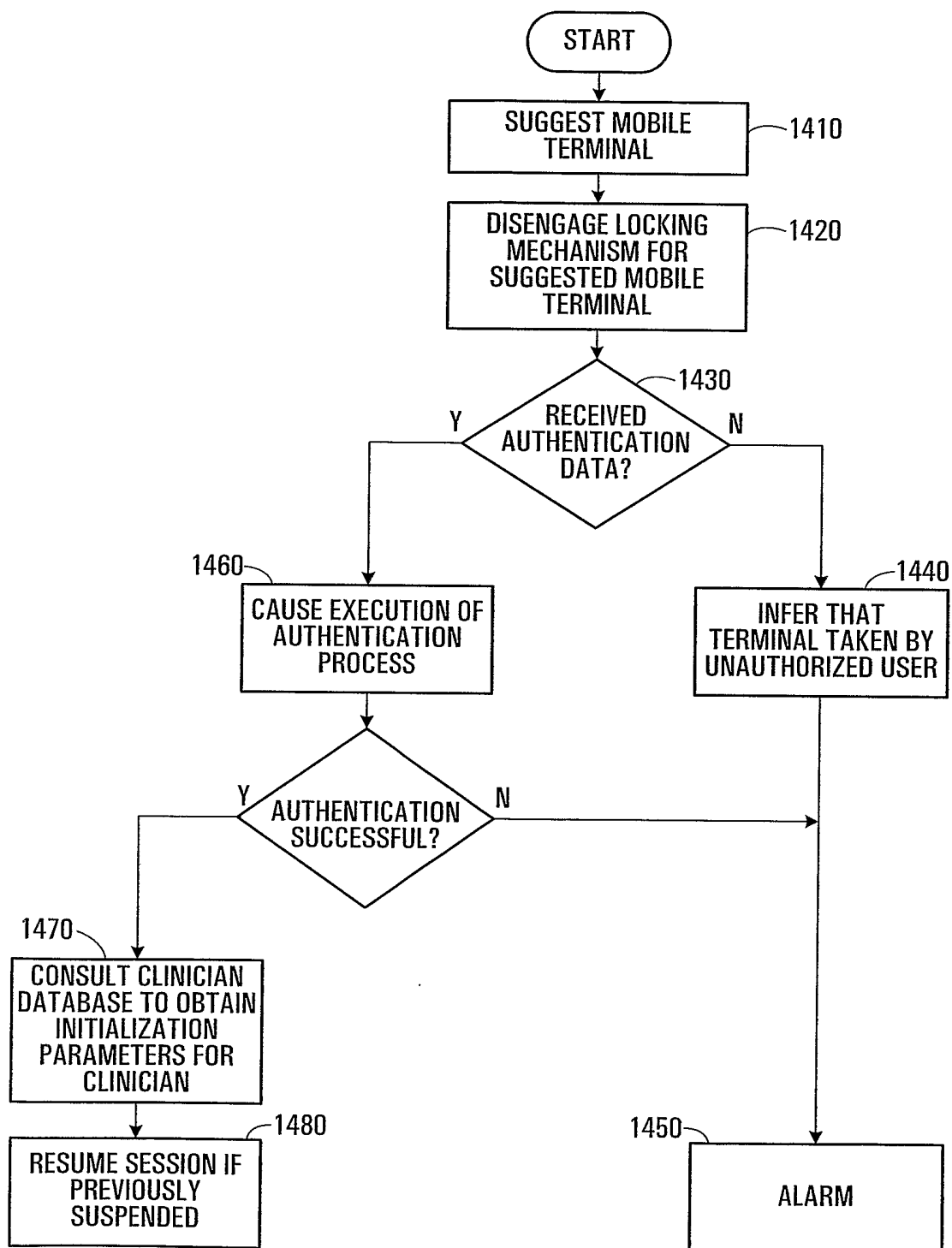
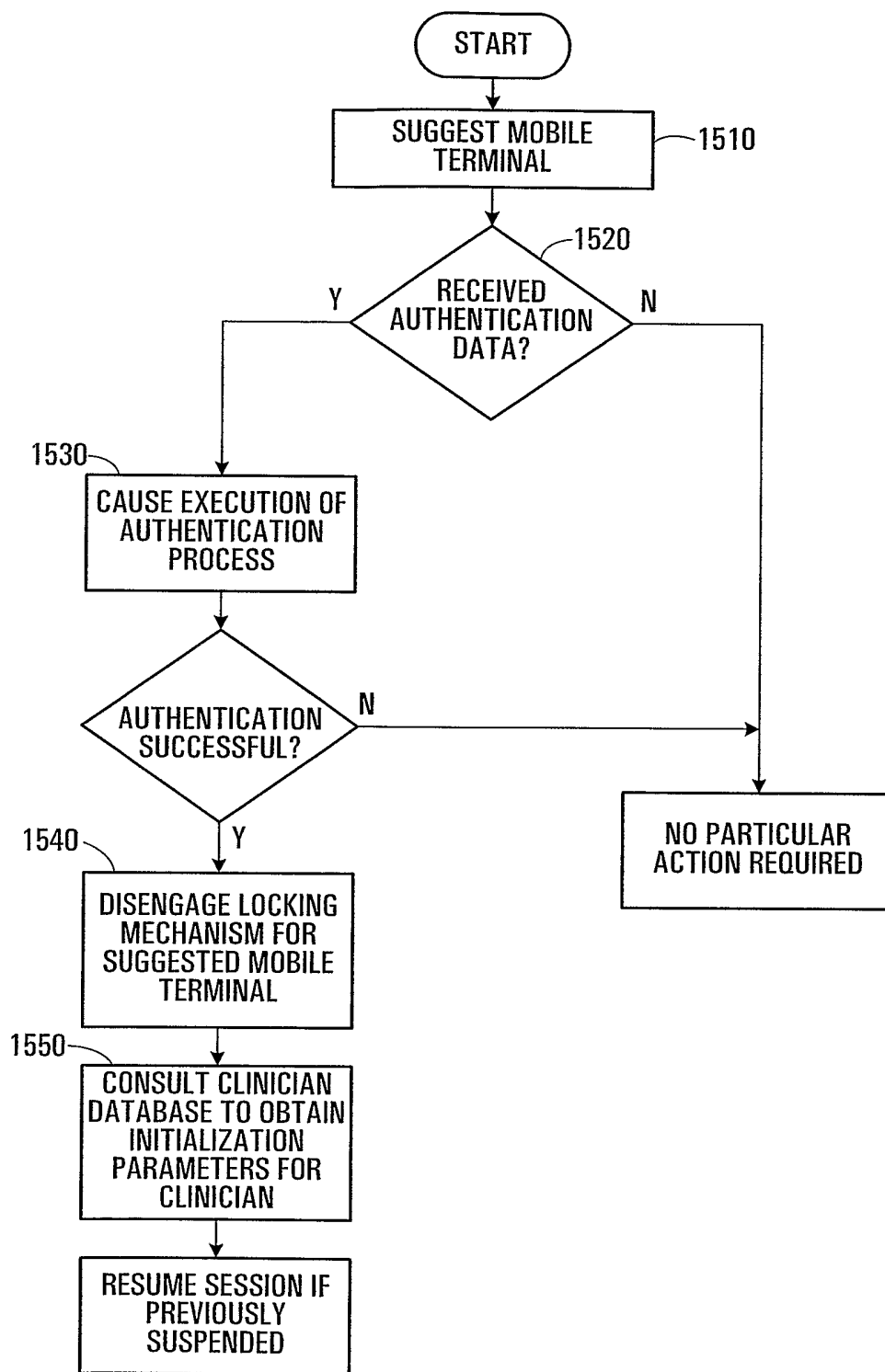


FIG. 13

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**FIG. 14**

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**FIG. 15**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2006/000203

1. CLASSIFICATION OF SUBJECT MATTER

IPC : *H04B-15/02* (2006.01) ; *G08C-17/02* (2006.01) ; *A61N-1/16* (2006.01) ; *H04B-7/005* (2006.01) ; *H04Q-7/20* (2006.01)
H04Q 7/08 (2006.01) ; *A61G-99/00* (2006.01)

2. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04B-15/02; G08C-17/02; A61N-1/16; H04B-7/005; H04Q-7/20; H04Q-7/98; A61G-99/00; Canadian Classes 325; 326/2;

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used) :

Databases : Deiphion, West, USPTO, Espacenet, Canadian Patent Database**Keywords :** RFID tags; RF interference; equipment proximity; power limiting/reduction; hospitals; health care

3. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5910776 (BLACK) 8 June 1999 (08.06.1999), abstract; columns 4-5; figures 3-5	1-31
A	CA 2362635 (BAHR et al.) 31 August 2000 (31.08.2000), abstract; figures 1, 5A-5E; claim 1	1-31
A	US 6823199 (GOUGH) 23 November 2004 (23.11.2004), abstract; columns 2-3	1-31

Further documents are listed in the continuation of Box C.

Patent family members are listed in annex. [X]

* Special categories of cited documents :	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international-type search
29 May 2006 (29-05-2006)Date of mailing of the international-type search report
1 June 2006 (01-06-2006)

Name and mailing address of the ISA/
Commissioner of Patents
Canadian Patent Office - PCT
Ottawa/Gatineau K1A 0C9
 Facsimile No. 1-819-953-9358

Authorized officer
 Terry Cartile (819) 997-2951

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2006/000203

Patent Document Cited in the Search Report	Publication Date (dd.mm.yyyy)	Patent Family Members	Publication Date(s) (dd.mm.yyyy)
A US 5910776	08.06.1999	None	
A CA 2362635	31.08.2000	WO 00/50849 A1 US 7034660 US 6806808 US 6617963 JP 2002538519 A2 EP 1155288 A1	31.08.2000 25.04.2006 19.10.2004 09.09.2003 12.11.2002 21.11.2001
A US 6823199	23.11.2004	US 20050064914 A1 US 20030003965 A1	24.03.2005 02.01.2003