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(71) Applicant and
(72) Inventor: **BROWN, David, James** [GB/GB]; 5 Clampitt Road, Ipplepen, Devon TQ12 5RJ (GB).

(74) Agent: **SPITTLE, Mark, Charles**; Urquhart-Dykes & Lord, Three Trinity Court, 21-27 Newport Road, Cardiff CF24 0AA (GB).

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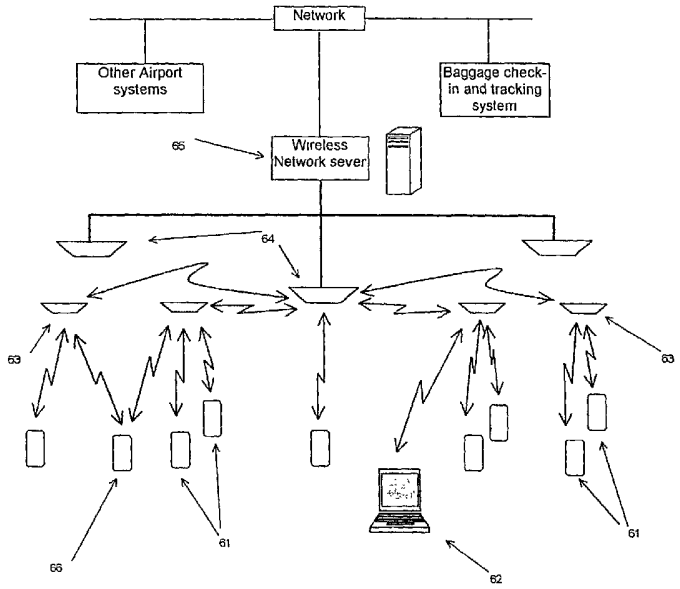

(57) Abstract: A method for establishing the location of one or more individuals within a facility, the method comprising installing a plurality of radio-frequency transceiver devices (63, 64) at fixed positions throughout the facility and issuing the or each individual with a respective portable radio-frequency transceiver device (61). Each of the fixed-position transceiver devices (63, 64) is operated to communicate the identity of any of said one or more portable transceiver devices (61) located within communications range thereof to centralised electronic processing means (65).

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Distributed Communications System

The present invention relates to a method and apparatus for establishing the location of an individual within a facility.

It is known to install, within a facility such as an airport, a radio-frequency receiver having a number of fixed-position aerials, between which the receiver can periodically switch to determine whether a portable radio-frequency transceiver carried by an individual is located within communications range of one of those aerials, the location of the portable transceiver and thus of the individual carrying that transceiver then being determined from whichever aerial receives an identification signal from the portable transceiver.

However, such a system is both inconvenient and expensive to install, as the required cabling between each of the antennas and the radio-frequency receiver must be electromagnetically shielded to prevent interference. The system also lacks versatility, firstly in that the communications range of each of the antennas is not independently adjustable, secondly in that inherent attenuation effects limit the distance that each antenna can be sited from the receiver and thirdly in that inherent phase distortion effects preclude the accurate measurement of time delays between signals transmitted and received by the receiver, which might otherwise be used to determine the distance of a potable transceiver from an aerial. Furthermore, as the communications channel between the receiver and the portable transceiver is only open intermittently, only a limited amount of data can be transferred between the two devices at any one time.

I have now devised an arrangement which overcomes the limitations of existing systems for establishing the location of an individual within a facility.

In accordance with the present invention, there is provided a method for establishing the location of one or more

individuals within a facility, the method comprising installing a plurality of radio-frequency transceiver devices at fixed positions throughout the facility, issuing the or each individual with a respective portable radio-frequency transceiver device, and operating each of the fixed-position transceiver devices to communicate the identity of any of said one or more portable transceiver devices located within communications range thereof to centralised electronic processing means.

It will be appreciated that such a method obviates the requirement for routing electromagnetically shielded connecting wires through the facility and the inherent attenuation and phase distortion effects associated therewith, can readily be adapted to suit differently configured facilities by independently adjusting the respective communications ranges of each of the fixed-position transceiver devices and provides a continuous communications channel between the or each of said one or more portable transceiver devices and said electronic processing means.

The method may be used, for example, to monitor the location of an isolated worker within the facility, e.g. for safety purposes, in which case the portable transceiver device issued to that worker may comprise means operable either by the worker or automatically, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

A video-surveillance system may be arranged to track the movements of a particular individual within the facility according to his location, either continuously or selectively, for example in the event of the individual entering the communications range of a particular fixed-position transceiver device or in response to a signal communicated to the electronic processing means by the portable transceiver device of that individual.

The electronic processing means may be arranged to

remotely control the operation of a device in the vicinity of a particular individual. For example, the electronic processing means may be arranged to select information to be displayed on a monitor in the vicinity of an individual, according to the identity of that individual.

The method may instead be used to monitor the respective locations of a plurality of travelers within an airport terminal building, for supervisory or administration purposes, by issuing each traveler checking-in for a flight with a respective portable transceiver device.

Preferably the reception sensitivity and/or the transmission power and/or the profile of the reception and/or transmission fields of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device. Adjustment may be made remotely, either by an operator of, or automatically by, said electronic processing means, for example to optimise coverage of a given area or to improve the locating accuracy of the system, and may be made continuously, for example to optimise the distribution of data traffic between fixed-position transceiver devices.

Preferably, the fixed-position transceiver devices are positioned and/or adjusted in range to have overlapping communications ranges and the electronic processing means are arranged to determine more accurately the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device. For example, it would be determined that a particular portable transceiver device lay within an overlapping region of the communication ranges of fixed-position transceiver devices A and B, if both of those fixed-position transceiver devices were to communicate to the electronic processing means the identity of the portable transceiver. Whereas, if only fixed-position

transceiver device B were to communicate the identity of the portable transceiver, then it would be determined that the portable transceiver lay within a region of the communications range of B which is outside of the communications range of A.

The location of an individual may be established by a triangulation-type process based on measurements of the distance of a portable transceiver device from each of a plurality of fixed-position transceiver devices, each distance measurement preferably being derived from the time taken for the portable transceiver device to respond to a signal transmitted by a respective fixed-position device.

Preferably the fixed-position transceiver devices ("pico-net masters") are arranged in one or more cells, each cell comprising a plurality of pico-net masters, the or each cell lying within communications range of a further respective fixed-position radio-frequency transceiver device (a "scatter-net master") arranged to relay communication signals from the pico-net masters of that cell to said electronic processing means.

Preferably the communications range of the or each scatter-net master extends beyond the combined range of its associated pico-net masters for communicating the identity of any of said one or more portable transceiver devices located outside of said combined communications range to said centralised electronic processing means. Preferably the electronic processing means are arranged to determine the location of a particular portable transceiver device, from whether the identity of that device is communicated to it by one of the pico-net masters and/or by a scatter-net master.

Preferably the or each portable transceiver device and the or each fixed-position transceiver device comprises a respective Bluetooth ® transceiver device, i.e. a device configured to transmit and receive data in accordance with the Bluetooth ® communications protocol.

According to a second aspect of the present invention,

there is provided a facility equipped with means for establishing the location of one or more individuals therein, said means comprising at least one portable radio-frequency transceiver device for issuing to the or each individual and a plurality of radio-frequency transceiver devices installed at fixed positions within the facility, each fixed-position transceiver devices being arranged to communicate the identity of any of said one or more portable transceiver devices located within communications range thereof to centralised electronic processing means.

According to a third aspect of the present invention, there is provided an apparatus for establishing the location of at least one individual within a facility, the apparatus comprising at least one portable radio-frequency transceiver device for issuing to the or each individual and a plurality of radio-frequency transceiver devices for installing at fixed positions within the facility to communicate the identity of any of said one or more portable transceiver devices located within their respective communication ranges to centralised electronic processing means.

Embodiments of the present invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic plan view of an airport terminal building, installed with a distributed communications system in accordance with the present invention;

Figure 2 is a schematic plan view of a floor of an office building, installed with a distributed communications system in accordance with the present invention;

Figure 3 is a schematic diagram illustrating the communications fields of a plurality of radio-frequency transceiver devices of a distributed communications system in accordance with the present invention; and

Figure 4 is block diagram of the distributed communications system of Figure 1.

The preferred distributed communications systems to be described hereinafter each utilise Bluetooth ® communications devices.

Bluetooth ® is a well known, short-range wireless standard intended to replace cables between devices such as a personal computer and printer. A Bluetooth ® access node allows users of Bluetooth ® enabled devices to access networks wirelessly in a similar way as connecting a computer to a Local Area Network (LAN).

In the present disclosure the Bluetooth ® enabled device is similar to a pager. By dispersing Bluetooth ® nodes throughout a building and maintaining a small coverage area per node, knowledge of the pager's location is obtained from the location of the node being used.

In addition, the Bluetooth ® technology provides a two-way data and voice capable network. The Bluetooth ® pagers do not behave as just transponders; the pagers can initiate a two-way data or voice link to an access node.

The Bluetooth ® pager network based on the Bluetooth ® specification offers many advantages including:

A frequency hop transceiver is applied to combat interference and fading;

A binary modulation is applied to minimise transceiver complexity;

A Time -Division Duplex (TDD) scheme is used to allow for duplex transmission;

The Bluetooth ® protocol uses a combination of circuit and packet switching. An asynchronous data channel or multiple voice channels or a combination of data and voice can be supported. This allows the pager to have many features not normally available with existing tags, transponders or pagers;

The Bluetooth ® system provides for a point-to-point connection, or a point to multipoint connection used in the pager network. In the point to multipoint connection, the channel is shared among several Bluetooth ® units forming a

Pico-net. One Bluetooth ® unit (the access node) acts as a master whereas the other units (pager) act as slaves. There can be up to seven slaves active in the Pico-net, in addition up to 256 slaves can be locked to the master in what is termed a parked state. Using the parked state, one access node can have sufficient capacity to handle a large number of pagers in applications such as an airport. Slaves (pagers) can ask the master (access node) to leave the parked mode in order to initiate a communication;

Multiple Pico-nets with overlapping coverage areas form a scatter-net. Each Pico-net can only have a single master. However, slaves can participate in different Pico-nets on a time division basis. This allows measurements to be made by each master (access node) on the target slave (pager) to improve the position information;

A master in one Pico-net can be a slave in another Pico-net. The data bandwidth required by the pager system is relatively small compared to the maximum available; therefore a number of Pico-nets can be connected to form a Scatter-net. This can be used to minimise the cabling required between the access nodes and the controller (server in figure 4); and

Features are built into Bluetooth ® to ensure low power operation thereby extending the pagers battery life. These features include modes such as Sniff, Park and Hold.

Utilising the Pico-net and Scatter net structure allowed in Bluetooth ® reduces the cabling between nodes, only power need be provided to certain nodes.

The wireless connection between Pico-net masters and the Scatter-net masters can be provided either with a Bluetooth ® link or utilising another wireless technology such as IEEE 802.11. In order to minimise cabling within buildings IEEE 802.11 could also be used between the Scatter-net masters and the Wireless network server.

Applications for the Bluetooth ® Pager network include the following -

Loan worker application

There are many occasions that workers are required to work alone, such as security officers patrolling a building after the remainder of the staff have left the building, industrial workers operating machinery at remote locations in a factory complex.

A loan worker alarm traditionally consists of an alarm trigger connected to a transmitter, which communicates the alert to a receiver that in turn is configured to relay the alert to such personnel that can take the appropriate action. The alarm trigger can be a tilt switch to detect the carrier lying horizontal, a panic button or may be a movement detector, which will activate after a time out period.

To be effective the loan worker alarm has to also transmit the location of the worker, this is traditionally accomplished by installing an infrared beacon in each room. To alert other employees within the building a pager system may also be operational. A Bluetooth ® pager with the ability to determine the pager location within the building combined with an alarm trigger removes the requirement for the infrared beacon, and separate systems for alarm and assistance call.

Retail sector application

Shopping malls and large shopping complexes employ a number of security staff that constantly move around the retail area. The security staff and retail staff are constantly on the look out for potential shoplifters and they themselves can be the targets for violence.

To equip all retail staff and security staff with a two-way radio would not be appropriate. A Bluetooth ® pager carried by each member of staff would provide a covert and cost effective two-way data link between staff and a security control centre. The staff in the security control centre can

carry out surveillance of the mall with the use of CCTV, when an offender is identified, staff in the locality can be identified by the location provided by the pager, the staff members can be alerted with instructions and/or description being transmitted over the pager link. In the case that a member of staff identifies an offender or is under attack the control centre can be alerted. No time is lost searching via the CCTV, as the location of the pager is known.

An additional improvement will be to use the pager location to directly control the CCTV camera closest to the incident.

Airport check-in application

As will be described in more detail below in reference to Figure 1, passengers arriving at an airport first have to check in at the airlines check-in desk, then at the appropriate time present them selves at the boarding gate, to board the aircraft. At the check-in desk the passenger receives a boarding-pass, which has printed on it, flight details and gate details.

Often the gate details are not known at the time of check in, in which case the passenger will have to monitor the departures board in the lounge. There is often a period of an hour or more before check-in and departure, during which time the passenger can visit the shops, restaurants and bars in the airport. During this time passengers can be distracted and as a consequence arrive late at the gate, causing the flight to be delayed, possibly missing a take off slot or cause their baggage to be off loaded at the expense of the airline and other passengers.

If instead of a boarding pass the passenger is given a Bluetooth ® boarding pager at the check-in desk. The pager is programmed by the check in computer with the passenger's details, flight details and gate number if known. The pager is

entered into a database together with the passenger and flight details. The passenger is then free to visit the airport shops and restaurants. During this time the Bluetooth ® boarding pager can be continuously updated with any changes to the flight times or gate number. The pager location within the airport can also be displayed on monitors at the gate or anywhere else for use by the airline staff.

At a time before boarding has to commence, the airline personnel can view the whereabouts of all the passengers and time the call to the boarding gate accordingly. After a call to the boarding gate the airline staff can view the movement of the passengers through the airport. Passengers not progressing to the gate can be paged or, due to their location being known, airline personnel dispatched to ensure they are at the gate in sufficient time.

Often passengers have to clear security checks between check-in and boarding, instead of being challenged by security personnel the Bluetooth ® boarding pager can be interrogated.

At the boarding gate the passenger will hand back the Bluetooth ® boarding pager to the airline personnel to enable it to be logged off the database. The Bluetooth ® boarding pager would be returned to the check-in desk for reuse and reprogramming.

The Bluetooth ® pager database can be integrated with other databases such as baggage handling, immigration (see the description below in respect of Figure 4).

An addition to the Bluetooth ® boarding pass is the inclusion of a display on the device sufficient to show the layout of the airport and the path the passenger has to take to get to the gate from their location.

An addition to the above is to include an airport directory/menu facility to enable the passenger to ask for information and the whereabouts of facilities within the airport.

A further addition is the inclusion of an assistance

feature to enable the passenger to summon help from emergency services to their location.

In addition to the Bluetooth ® boarding pass system the installed Bluetooth ® infrastructure can support Bluetooth ® pagers carried by airport personnel for communication and location purposes.

In addition to the Bluetooth ® boarding pass system the installed Bluetooth ® infrastructure can provide support for other Bluetooth ® enabled devices, such as laptop computers, if the correct privileges are provided to the passenger.

A similar system based on transponders and sequencing of antennas connected to an interrogator has been previously been proposed. However, this system is intended for passengers already in possession of a transponder when arriving at the airport to provide automatic check-in. The system relies on multiplexing antennas throughout the airport, only one antenna being active at any one time. The Bluetooth ® access nodes will constantly be active.

Figure 1 shows the basic areas within an airport, airport entrance 29, main terminal area 28, security check area 24, terminal concourse area 32, the departure lounges 34, and the jet-ways 31.

The main terminal area includes the check-in desks 24 where the passenger checks in for a flight and will receive the Bluetooth ® boarding pager. Bluetooth access nodes 23 and 25 at the security check point 24 or the air terminal entrance 29 will detect when the pager leaves the main terminal area.

Throughout the airport terminal, Bluetooth ® access nodes 20, 21, 22, 23, 24 and 25 provide continuous coverage. Also in the main terminal area are shops and restaurants 26 and 27, each with an access node. Access nodes 20 are the master nodes for the Scatter-nets, access nodes 21, 22, 23, 24 and 25 are the master nodes for the Pico-nets. Access nodes at the check-in desk can be used to program the Bluetooth ® pager.

Once through the security check 24 the passenger enters

the concourse area 32 where again there may be restaurants shops and rest rooms (not shown in Figure 1).

At a prescribed time before the flight the passengers are called to the departure lounge 34. Before entering the departure lounge the passengers pass through the boarding gate 35 and return their Bluetooth ® boarding pager to the airline personnel at the gate. The pager is then logged off the system via a computer terminal and access node 22.

The access nodes 33 at the end of the jet-way 31 ensure that passengers no longer have their Bluetooth ® boarding pager when boarding the aircraft but they do allow the Bluetooth ® pagers carried by the airport personnel to be in contact when in the vicinity of the plane.

Figure 2 shows an office installation, in particular how the range of each access node is modified to match the accommodation, this is accomplished by selecting antenna patterns, transmitter power and receiver sensitivity. Access nodes 41 and 42 are the Pico-net master, access node 43 is the Scatter-net master. The antennas are placed either high up on the wall or the ceiling of the office or corridor.

Figure 3 shows the application of several Pico-nets forming a Scatter-net. MPnx 51, 52 and 56 are the masters for the Pico-nets as well as slaves for the master of the Scatter-net, MSnx 57.

The slaves 54 represent the boarding pager carried by the passengers in the airport application, each working with a Pico-net master. As the passenger moves around the airport the slave will attach it self to a different Pico-net master.

The master of the Scatter-net 57 is generally higher power than the Pico-net masters to encompass the selected Pico-net masters and allow certain slaves 53 to operate outside the normal operational area (such as security staff) or to accept a slave that cannot locate a Pico-net master.

Slave 55 has two masters 51 and 56, by using methods such as triangulation the system can better resolve its

location.

Figure 4 is a block diagram of the system shown in Figure 1, showing the integration with the other airport services. The pagers carried by the passengers 61 communicate with access nodes 63, which in turn, via Bluetooth ® or other wireless technology, communicate with high power access nodes 64. These in turn are connected to the Wireless Network server 65. Each of the (Pico-net) access nodes 63 can be connected to the server 65, without the (Scatter-net) access nodes 64. The connections between the access nodes and the server can be either wireless or cable based LAN such as Ethernet.

The function of the server 65 includes, providing a fire wall between the wireless network and the high integrity airport network, the mapping of the pagers on to the buildings plan, resolving the position of pagers that are communicating with more that one access node, resolving any illegal locations.

The Bluetooth ® enabled lap top computer 62 could be one of a variety of devices with permission to access the wireless network. The laptop could belong to a passenger or service personnel.

The systems thus described provide a cost effective and versatile means for establishing the location of an individual within a facility.

Claims

1) A method for establishing the location of one or more individuals within a facility, the method comprising installing a plurality of radio-frequency transceiver devices at fixed positions throughout the facility, issuing the or each individual with a respective portable radio-frequency transceiver device, and operating each of the fixed-position transceiver devices to communicate the identity of any of said one or more portable transceiver devices located within communications range thereof to centralised electronic processing means.

2) A method as claimed in Claim 1, used to monitor the location of an isolated worker within the facility, wherein the portable transceiver device issued to that worker comprises means operable by the worker, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

3) A method as claimed in Claim 1, used to monitor the location of an isolated worker within the facility, wherein the portable transceiver device issued to that worker comprises means operable automatically, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

4) A method as claimed in any preceding claim, wherein a video-surveillance system is arranged to continuously track the movements of a particular individual within the facility according to his location.

5) A method as claimed in any of Claims 1 to 3, wherein a video-surveillance system is arranged to selectively track the movements of a particular individual within the facility

according to his location.

6) A method as claimed in Claim 4 or Claim 5, wherein the movements of the individual are tracked, in the event of the individual entering the communications range of a particular fixed-position transceiver device.

7) A method as claimed in Claim 4 or Claim 5, wherein the movements of the individual are tracked, in response to a signal communicated to the electronic processing means by the portable transceiver device of that individual.

8) A method as claimed in any preceding claim, wherein the electronic processing means are arranged to remotely control the operation of a device in the vicinity of a particular individual.

9) A method as claimed in Claim 8, wherein said device comprises a monitor, the electronic processing means being arranged to select information to be displayed on the monitor, according to the identity of the individual in the vicinity thereof.

10) A method as claimed in Claim 1, used to monitor the respective locations of a plurality of travelers within an airport terminal building, for supervisory or administration purposes, wherein each traveler checking-in for a flight is issued with a respective portable transceiver device.

11) A method as claimed in any preceding claim, wherein the reception sensitivity of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

12) A method as claimed in any preceding claim, wherein the transmission power of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

13) A method as claimed in any preceding claim, wherein the transmission field of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

14) A method as claimed in any of Claims 11 to 13, wherein said adjustment is made remotely by an operator of said electronic processing means.

15) A method as claimed in any of Claims 11 to 13, wherein said adjustment is made remotely and automatically by said electronic processing means.

16) A method as claimed in Claim 14 or Claim 15, wherein said adjustment is made to optimise coverage of a given area.

17) A method as claimed in Claim 14 or Claim 15, wherein said adjustment is made to improve the locating accuracy of the system.

18) A method as claimed in Claim 16 or Claim 17, wherein said adjustment is made continuously.

19) A method as claimed in Claim 18, wherein said adjustment is made to optimise the distribution of data traffic between fixed-position transceiver devices.

20) A method as claimed in any preceding claim, wherein the

fixed-position transceiver devices are positioned to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

21) A method as claimed in any preceding claim, wherein the fixed-position transceiver devices are adjusted in range to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

22) A method as claimed in any preceding claim, wherein the location of an individual is established by a triangulation-type process based on measurements of the distance of a portable transceiver device from each of a plurality of fixed-position transceiver devices

23) A method as claimed in Claim 22, wherein each distance measurement is derived from the time taken for the portable transceiver device to respond to a signal transmitted by a respective fixed-position device.

24) A method as claimed in any preceding claim, wherein the fixed-position transceiver devices ("pico-net masters") are arranged in one or more cells, each cell comprising a plurality of pico-net masters, the or each cell lying within communications range of a further respective fixed-position radio-frequency transceiver device (a "scatter-net master") arranged to relay communication signals from the pico-net masters of that cell to said electronic processing means.

25) A method as claimed in Claim 24, wherein the communications range of the or each scatter-net master extends beyond the combined range of its associated pico-net masters for communicating the identity of any of said one or more portable transceiver devices located outside of said combined communications range to said centralised electronic processing means.

26) A method as claimed in Claim 24, wherein the electronic processing means are arranged to determine the location of a particular portable transceiver device, from whether the identity of that device is communicated to it by one of the pico-net masters and/or by a scatter-net master.

27) A method as claimed in any preceding Claim, wherein the or each portable transceiver device and the or each fixed-position transceiver device comprises a respective Bluetooth ® transceiver device.

28) A facility equipped with means for establishing the location of one or more individuals therein, said means comprising at least one portable radio-frequency transceiver device for issuing to the or each individual and a plurality of radio-frequency transceiver devices installed at fixed positions within the facility, each fixed-position transceiver device being arranged to communicate the identity of any of said one or more portable transceiver devices located within communications range thereof to centralised electronic processing means.

29) A facility as claimed in Claim 28, wherein the centralised electronic means are arranged for monitoring the location of an isolated worker within the facility, the portable transceiver device issued to that worker comprising means operable by the worker, in the event of an emergency, to

communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

30) A facility as claimed in Claim 28, wherein said centralised electronic means are arranged for monitoring the location of an isolated worker within the facility, the portable transceiver device issued to that worker comprising means operable automatically, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

31) A facility as claimed in any of Claims 28 to 30, comprising a video-surveillance system arranged to continuously track the movements of a particular individual within the facility according to his location.

32) A facility as claimed in any of Claims 28 to 30, comprising a video-surveillance system arranged to selectively track the movements of a particular individual within the facility according to his location.

33) A facility as claimed in Claim 31 or 32, wherein the movements of the individual are tracked, in the event of the individual entering the communications range of a particular fixed-position transceiver device.

34) A facility as claimed in Claim 31 or 32, wherein the movements of the individual are tracked, in response to a signal communicated to the electronic processing means by the portable transceiver device of that individual.

35) A facility as claimed in any or Claims 28 to 34, wherein the electronic processing means are arranged to remotely control the operation of a device in the vicinity of a particular individual.

36) A facility as claimed in Claim 35, wherein said device comprises a monitor, the electronic processing means being arranged to select information to be displayed on the monitor, according to the identity of the individual in the vicinity thereof.

37) A facility as claimed in Claim 28, wherein the electronic processing means are arranged for monitoring the respective locations of a plurality of travelers within an airport terminal building, for supervisory or administration purposes, each traveler checking-in for a flight being issued with a respective portable transceiver device.

38) A facility as claimed in any of Claims 28 to 37, wherein the reception sensitivity of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

39) A facility as claimed in any of Claims 28 to 38, wherein the transmission power of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

40) A facility as claimed in any of Claims 28 to 39, wherein the transmission field of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

41) A facility as claimed in any of Claims 38 to 40, wherein said adjustment is made remotely by an operator of said electronic processing means.

42) A facility as claimed in any of Claims 38 to 40, wherein said adjustment is made remotely and automatically by said electronic processing means.

43) A facility as claimed in Claim 41 or Claim 42, wherein said adjustment is made to optimise coverage of a given area.

44) A facility as claimed in Claim 41 or Claim 42, wherein said adjustment is made to improve the locating accuracy of the system.

45) A facility as claimed in Claim 43 or Claim 44, wherein said adjustment is made continuously.

46) A facility as claimed in Claim 45, wherein said adjustment is made to optimise the distribution of data traffic between fixed-position transceiver devices.

47) A facility as claimed in any of Claims 28 to 46, wherein the fixed-position transceiver devices are positioned to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

48) A facility as claimed in of Claims 28 to 47, wherein the fixed-position transceiver devices are adjusted in range to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

49) A facility as claimed in any of Claims 28 to 28,

wherein the location of an individual is established by a triangulation-type process based on measurements of the distance of a portable transceiver device from each of a plurality of fixed-position transceiver devices

50) A facility as claimed in Claim 49, wherein each distance measurement is derived from the time taken for the portable transceiver device to respond to a signal transmitted by a respective fixed-position device.

51) A facility as claimed in any of Claims 28 to 50, wherein the fixed-position transceiver devices ("pico-net masters") are arranged in one or more cells, each cell comprising a plurality of pico-net masters, the or each cell lying within communications range of a further respective fixed-position radio-frequency transceiver device (a "scatter-net master") arranged to relay communication signals from the pico-net masters of that cell to said electronic processing means.

52) A facility as claimed in Claim 51, wherein the communications range of the or each scatter-net master extends beyond the combined range of its associated pico-net masters for communicating the identity of any of said one or more portable transceiver devices located outside of said combined communications range to said centralised electronic processing means.

53) A facility as claimed in Claim 51, wherein the electronic processing means are arranged to determine the location of a particular portable transceiver device, from whether the identity of that device is communicated to it by one of the pico-net masters and/or by a scatter-net master.

54) A facility as claimed in any of Claims 28 to 53,

wherein the or each portable transceiver device and the or each fixed-position transceiver device comprises a respective Bluetooth ® transceiver device.

55) An apparatus for establishing the location of at least one individual within a facility, the apparatus comprising at least one portable radio-frequency transceiver device for issuing to the or each individual and a plurality of radio-frequency transceiver devices for installing at fixed positions within the facility to communicate the identity of any of said one or more portable transceiver devices located within their respective communication ranges to centralised electronic processing means.

56) An apparatus as claimed in Claim 55, wherein the centralised electronic means are arranged for monitoring the location of an isolated worker within the facility, the portable transceiver device issued to that worker comprising means operable by the worker, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

57) An apparatus as claimed in Claim 55, wherein said centralised electronic means are arranged for monitoring the location of an isolated worker within the facility, the portable transceiver device issued to that worker comprising means operable automatically, in the event of an emergency, to communicate a signal to said electronic processing means, via a fixed-position transceiver device, for summoning assistance.

58) An apparatus as claimed in any of Claims 55 to 57, comprising a video-surveillance system arranged to continuously track the movements of a particular individual within the facility according to his location.

59) An apparatus as claimed in any of Claims 55 to 57, comprising a video-surveillance system arranged to selectively track the movements of a particular individual within the facility according to his location.

60) An apparatus as claimed in Claim 58 or 59, wherein the movements of the individual are tracked, in the event of the individual entering the communications range of a particular fixed-position transceiver device.

61) An apparatus as claimed in Claim 58 or 59, wherein the movements of the individual are tracked, in response to a signal communicated to the electronic processing means by the portable transceiver device of that individual.

62) An apparatus as claimed in any or Claims 55 to 61, wherein the electronic processing means are arranged to remotely control the operation of a device in the vicinity of a particular individual.

63) An apparatus as claimed in Claim 62, wherein said device comprises a monitor, the electronic processing means being arranged to select information to be displayed on the monitor, according to the identity of the individual in the vicinity thereof.

64) An apparatus as claimed in Claim 55, wherein the electronic processing means are arranged for monitoring the respective locations of a plurality of travelers within an airport terminal building, for supervisory or administration purposes, each traveler checking-in for a flight being issued with a respective portable transceiver device.

65) An apparatus as claimed in any of Claims 55 to 64, wherein the reception sensitivity of each fixed-position

transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

66) An apparatus as claimed in any of Claims 55 to 65, wherein the transmission power of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

67) An apparatus as claimed in any of Claims 55 to 66, wherein the transmission field of each fixed-position transceiver device is independently adjusted to cover a pre-defined area of the facility, according to the chosen transmission power of the or each portable transceiver device.

68) An apparatus as claimed in any of Claims 65 to 67, wherein said adjustment is made remotely by an operator of said electronic processing means.

69) An apparatus as claimed in any of Claims 65 to 67, wherein said adjustment is made remotely and automatically by said electronic processing means.

70) An apparatus as claimed in Claim 68 or Claim 69, wherein said adjustment is made to optimise coverage of a given area.

71) An apparatus as claimed in Claim 68 or Claim 69, wherein said adjustment is made to improve the locating accuracy of the system.

72) An apparatus as claimed in Claim 70 or Claim 71, wherein said adjustment is made continuously.

73) An apparatus as claimed in Claim 72, wherein said adjustment is made to optimise the distribution of data traffic between fixed-position transceiver devices.

74) An apparatus as claimed in any of Claims 55 to 73, wherein the fixed-position transceiver devices are positioned to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

75) An apparatus as claimed in of Claims 55 to 74, wherein the fixed-position transceiver devices are adjusted in range to have overlapping communications ranges and the electronic processing means are arranged to determine the position of a portable transceiver device, from whichever fixed-position transceiver device(s) communicate to the electronic processing means the identity of that portable transceiver device.

76) An apparatus as claimed in any of Claims 55 to 75, wherein the location of an individual is established by a triangulation-type process based on measurements of the distance of a portable transceiver device from each of a plurality of fixed-position transceiver devices

77) An apparatus as claimed in Claim 76, wherein each distance measurement is derived from the time taken for the portable transceiver device to respond to a signal transmitted by a respective fixed-position device.

78) An apparatus as claimed in any of Claims 55 to 77, wherein the fixed-position transceiver devices ("pico-net masters") are arranged in one or more cells, each cell comprising a plurality of pico-net masters, the or each cell

lying within communications range of a further respective fixed-position radio-frequency transceiver device (a "scatter-net master") arranged to relay communication signals from the pico-net masters of that cell to said electronic processing means.

79) An apparatus as claimed in Claim 78, wherein the communications range of the or each scatter-net master extends beyond the combined range of its associated pico-net masters for communicating the identity of any of said one or more portable transceiver devices located outside of said combined communications range to said centralised electronic processing means.

80) An apparatus as claimed in Claim 78, wherein the electronic processing means are arranged to determine the location of a particular portable transceiver device, from whether the identity of that device is communicated to it by one of the pico-net masters and/or by a scatter-net master.

81) An apparatus as claimed in any of Claims 55 to 80, wherein the or each portable transceiver device and the or each fixed-position transceiver device comprises a respective Bluetooth ® transceiver device.

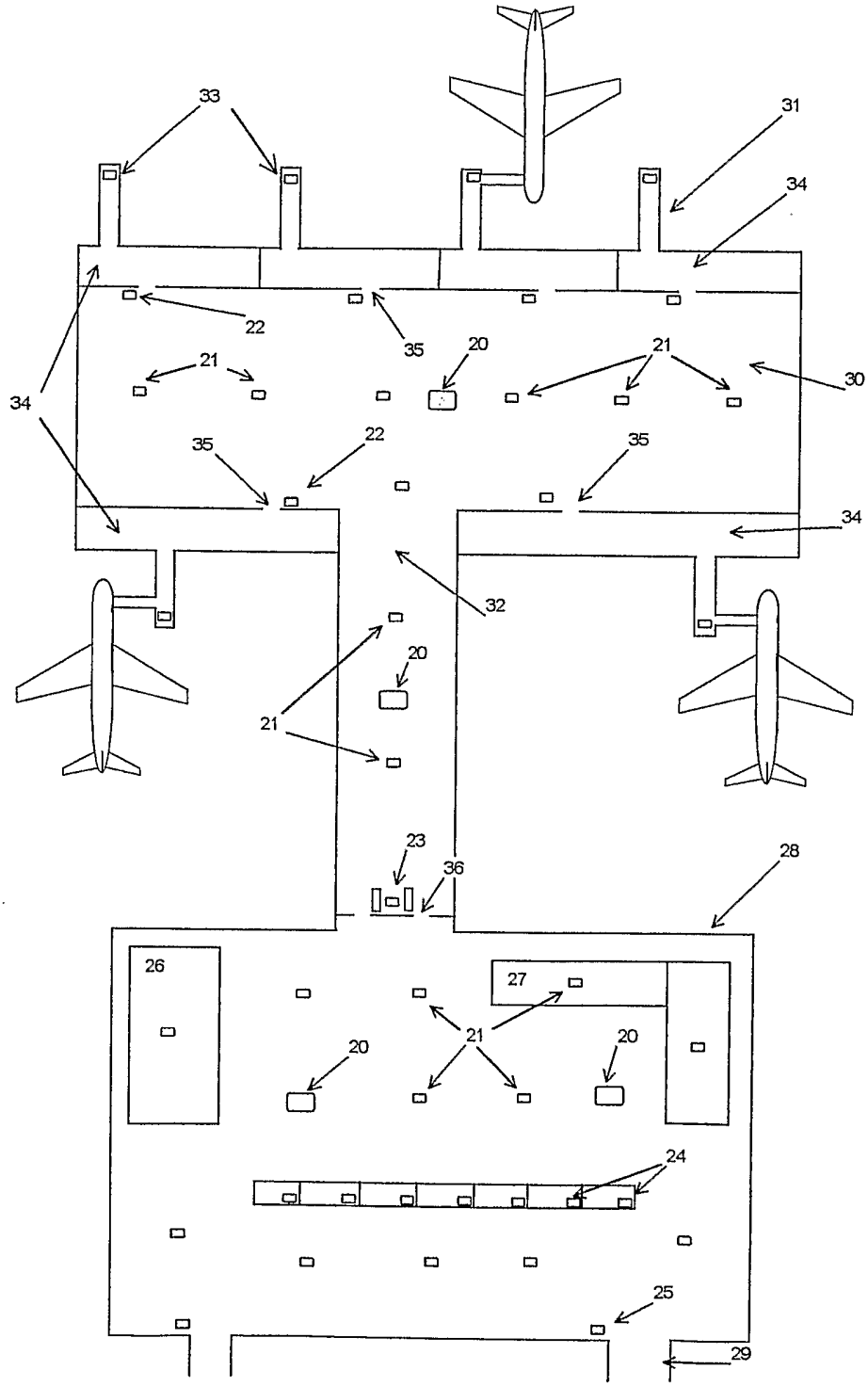
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Figure 1

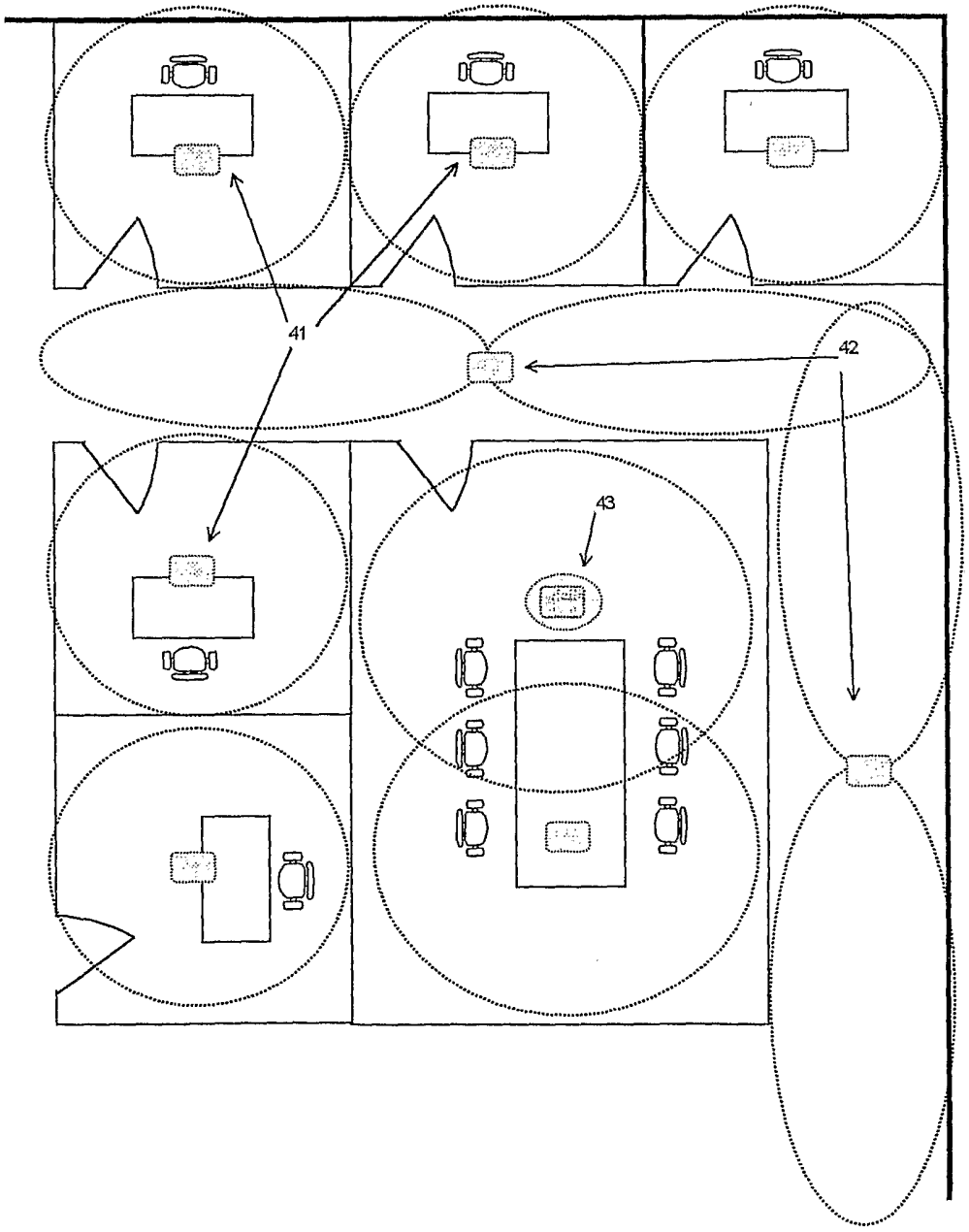

Figure 2

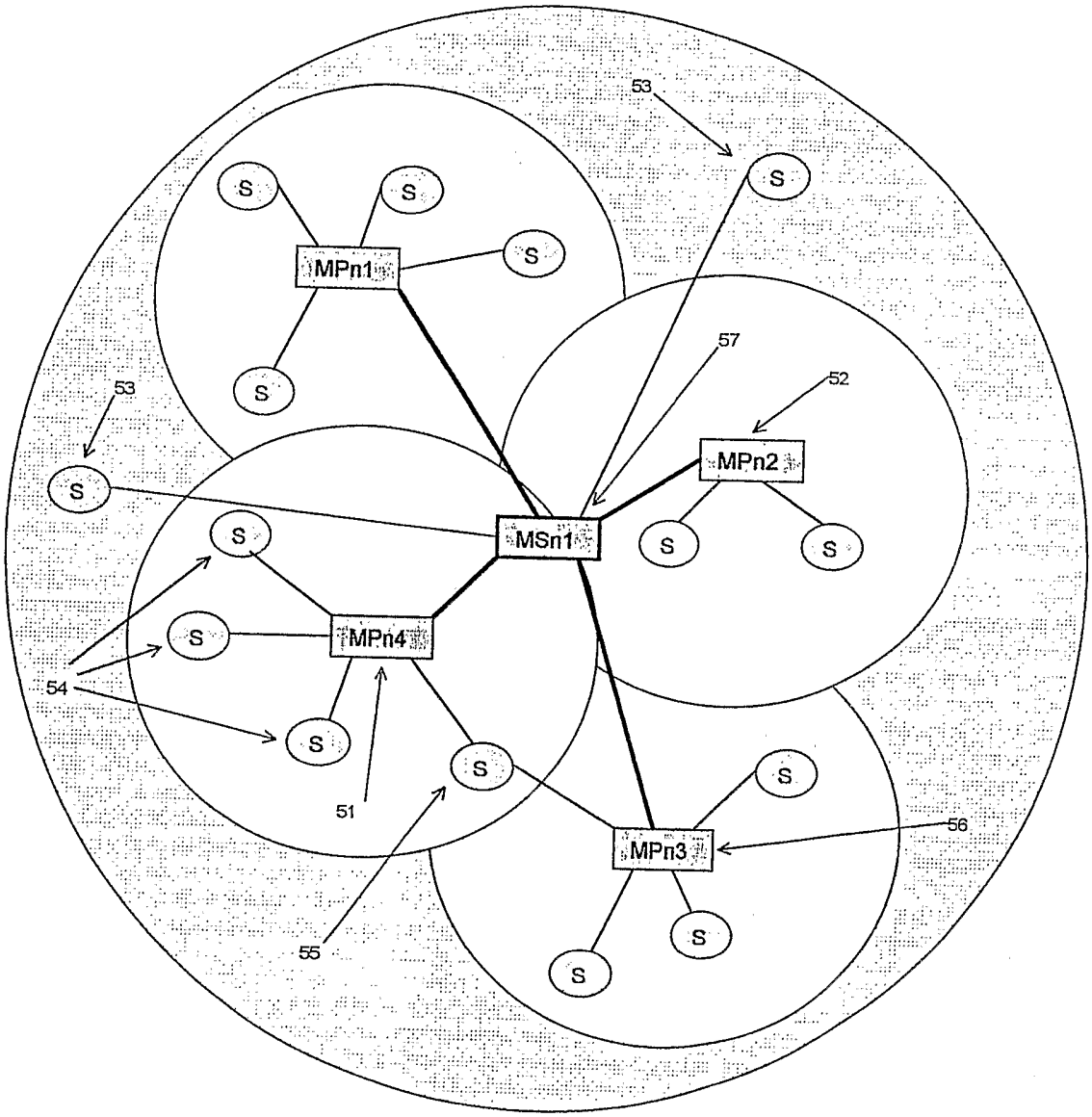
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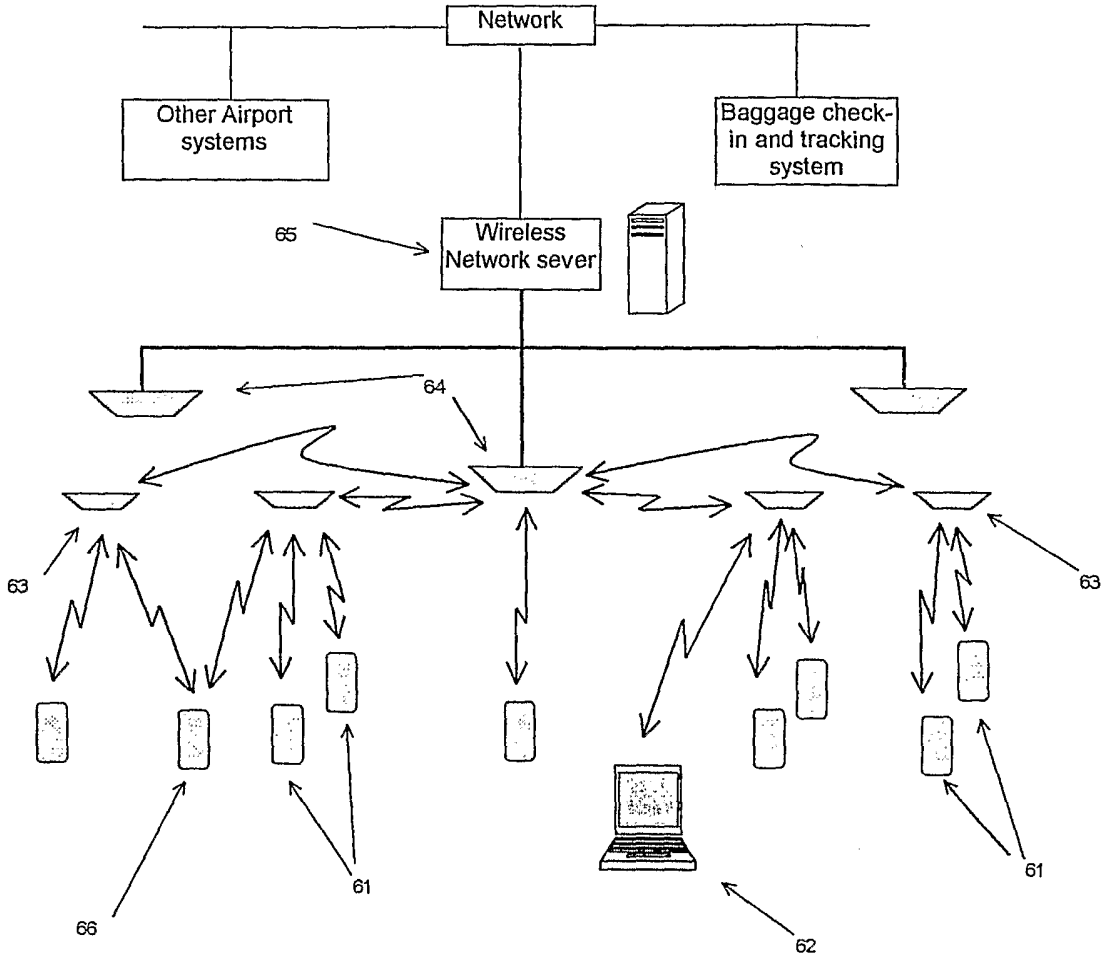
Figure 3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Other Airport systems
Baggage check-in and tracking system
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Wireless Network sever
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Figure 4