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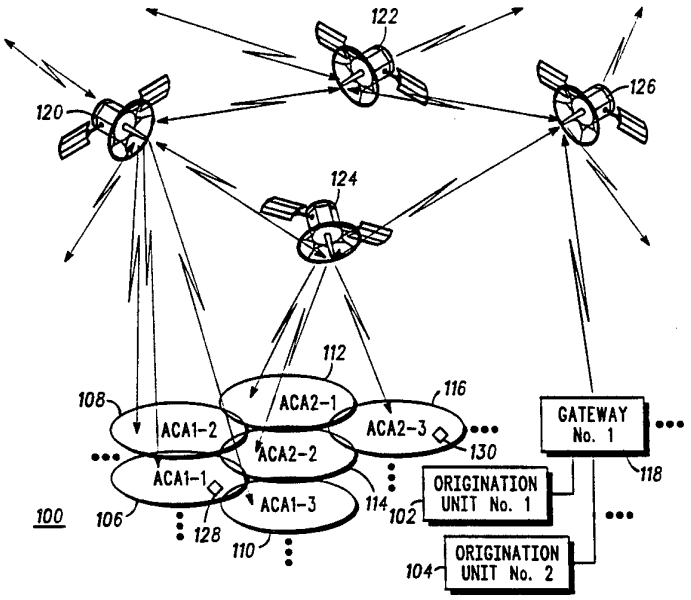

(57) Abstract

The present invention includes a low-earth satellite-based paging broadcast system (100) and method (200, 300) that maximizes spectral efficiency and minimizes power expenditure for the broadcast of paging messages by broadcasting the messages to terminator- or originator-selectable portions of the total system coverage area. The terminator selects a long-term preferred geographic area (LTPGA), and optionally, a short-term preferred geographic area (STPGA). The originator provides the terminator ID, the message, and optionally provides a customized preferred geographic area (CPGA). Terminators and originators can easily modify the selectable geographic areas (SGA(s)): LTPGA(s), STPGA(s), and CPGA(s). The gateway converts the SGA(s) to addressable coverage areas (ACA(s)), and transmits a signal including the paging information, and ACA(s) to at least a first communication satellite (COM SAT). The COM SAT(s) provide for crosslinking the signal to other COM SAT(s) and for broadcasting the paging information to the ACA(s).

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GEOGRAPHIC-AREA SELECTIVE LOW-EARTH SATELLITE-BASED PAGING BROADCAST SYSTEM AND METHOD

Field of the Invention

The present invention relates generally to communication paging systems, and more particularly to paging systems for selective geographic areas within low-earth satellite-based communication network systems.

Background

Communication paging systems have traditionally broadcast pages to a system's entire coverage area. Such a system has been tolerable, though not efficient, for land-based systems. In addition, such a system does not readily allow for adjustment of selected coverage areas. However, a satellite-based paging system typically provides coverage to a larger geographical area than a land based-paging system. Thus, a satellite-based paging system typically expends a large amount of energy and/or capacity sending paging messages to areas in which a pagee is not located in order to be sure that the pagee receives its message. This is inefficient use of broadcasting resources.

Thus, there is a need for a more efficient paging broadcast system and method for facilitating conservation of energy and/or capacity of the system.

Summary of the Invention

The present invention provides a geographic area-selective low-earth satellite-based paging broadcast system and method that utilize at least: a first origination unit for at least a first originator, a first gateway, at least a first termination unit, and a plurality of communication satellites (COM SATs) having a plurality of addressable coverage areas (ACAs). The first origination unit comprises a unit for transmitting paging information (a paging message and a termination unit identification (ID)) to a gateway for further transmission to a COM SAT, where the paging information is ultimately intended for a preselected termination unit, and wherein a signal, as transmitted by the origination unit, may include information indicating a customized preferred geographic area (CPGA). Each gateway comprises a unit for assigning a pager identification code to the termination unit and for transmitting a signal to a COM SAT, a unit for providing selection of selectable geographic area(s) (SGA(s)) and for converting the SGA(s) to at least a first addressable coverage area (ACA) such that the SGA(s) are included within the ACA(s), and a unit for transmitting said signal from the gateway to a communication satellite in accordance with the selected ACA(s). Each communication satellite (COM SAT) comprises at least: a communication relay transceiver for at least receiving the signal from the gateway and transmitting said signal in accordance with the selected ACA(s), which satellite may utilize further communication satellites in a crosslinking manner for retransmission of the signal in accordance with the selected ACA(s), until the communication satellites have completed transmitting said signal in accordance with the selected ACA(s) such that transmission of the signal to the preselected termination unit is facilitated.

Brief Descriptions of the Drawings

FIG. 1 illustrates a geographic area-selective low-earth satellite-based paging broadcast system in accordance with the present invention.

FIG. 2 is a flow chart for a first embodiment of a geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention.

FIG. 3 is a flow chart of an embodiment of one embodiment of steps in the geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention.

FIG. 4 is a flow chart of an embodiment of one embodiment of steps for a gateway's handling long-term preferred geographic areas and short-term preferred geographic areas in the geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention.

Detailed Description of a Preferred Embodiment

To facilitate conservation of energy and/or capacity of the communication paging system, the present invention employs a broadcast system and method for efficient utilization of selected areas of broadcast coverage. The terms termination unit, a radio communication paging unit (user is a terminator) and origination unit, an information entry device, (user is an originator) will be utilized to describe the present invention.

In particular, a terminator having a pager for receiving paging messages selects a long-term preferred geographic area (LTPGA) and in addition, may select a short-term preferred geographic area (STPGA). Alternatively, an originator (i.e., one sending a paging message) may select a customized preferred geographic area (CPGA) into which to

broadcast paging information (the paging message and a termination unit ID). Thus, an area to which a paging message is to be broadcast is limited.

The present invention provides the advantages of allowing an originator to customize the broadcast coverage area over which the page is sent, and allows the terminator to change the broadcast areas easily (allowing at least two broadcast coverage areas). It minimizes satellite power consumption and maximizes the use of the allocated frequency band by allowing for small geographic broadcast areas.

Thus, the present invention, unlike current regional paging systems, readily allows a terminator to change his preferred geographic area. If a terminator is temporarily leaving his normally preferred geographic area, the terminator may call a gateway and provide a short-term preferred geographic area (STPGA). Thus, when a terminator embarks on temporary or unusual travel, the terminator may readily adjust his paging area. Where the terminator travels to an area where he plans to remain for an extended period of time (i.e., relocation), he informs the gateway, and the gateway updates his long-term preferred geographic area.

The provision of two preferred areas, a long-term and a short-term, minimizes the amount of information that a terminator is expected to provide the gateway upon returning from temporary or unusual travel.

When the originator contacts the gateway, typically via the public switched telephone network (PSTN), to attempt a page, he provides the ID of the termination unit. Then, he may choose to send a paging message to the area of record for the termination unit (i.e., to the short- or long-term preferred geographic area presently in effect for the termination unit) or

may send a paging message to an originator customized geographic area.

Thus, if the originator chooses to send a paging message to the area of record, then the gateway determines whether a the short-term preferred geographic area has been stored for the selected termination unit in the memory unit. Where the STPGA has been stored for the selected termination unit in the memory unit, the gateway utilizes the STPGA to determine an addressable coverage area to receive the paging message. Where no STPGA has been stored for the selected termination unit, the gateway utilizes the long-term preferred geographic area that the terminator has previously provided to the gateway. Where the originator has sent previous paging messages to the termination unit, and the messages have been unanswered, or the originator has reason to believe that the terminator is located in a different location than that indicated by the short-term or long-term preferred geographical area, the originator typically selects a customized geographic area.

Once a geographical area is selected, the gateway generates a list of a minimum addressable coverage areas (ACA(s)). Each ACA may be viewed as a cell that is either fixed in position relative to a bottom (surface of the satellite facing the earth) of a communication satellite or is fixed in position on the earth.

Where the cell is viewed as fixed in position relative to the bottom of low-earth orbit satellites, the ACA moves across the surface of the earth at the speed of the satellite. In this embodiment, the selected geographic area for transmission relationship to the list of stored ACA(s) is frequently updated, e.g., every few seconds, by the gateway. In an implementation where the cells are fixed in position on the

earth, for low-earth orbit satellites, for example, the rapidly moving satellites may continually modify the pointing of satellite antenna beams.

The originator provides identification (ID) of the termination unit and a paging message. The gateway may assign a message number to the message.

The gateway transmits an information signal, e.g., a packetized data signal, that includes the list of ACA(s) that include the selected geographical areas, the termination unit ID, the paging message, and, optionally, the message number. Typically, the gateway uplinks the information signal to a nearest communication satellite. Then the satellite determines whether the information signal includes any of the ACA(s) which are ACA(s) for that satellite. Where ACA(s) for the satellite are included, the satellite broadcasts the paging information, and optionally, the message number, into the specified ACA(s). Where ACA(s) also include ACA(s) for at least one other satellite, the satellite removes its ACA(s), if any, and broadcasts the signal (REM SIGNAL) containing the remaining information utilizing crosslinks. A crosslink is a communication link between satellites. Alternatively, the signal may be repacketized and transmitted using crosslinks. Repacketizing is duplicating the paging information and, optionally, the message number, dividing the ACA(s) into disjoint lists, and creating multiple crosslink packets for transmission. This sequence of events is repeated by each communication satellite until the paging information (and optionally, the message number) has been transmitted to all selected ACA(s). Clearly, crosslink routing may be modified to accommodate satellite transmission failures.

Also, clearly, the termination unit may be customized to compare a paging message number to recently received paging

message numbers, and to discard paging messages having matching numbers. In addition, the termination unit includes a means to indicate a paging message to the terminator.

FIG. 1, numeral 100, illustrates a geographic area-selective low-earth satellite-based paging broadcast system in accordance with the present invention. A low-earth orbit is defined as an orbit that, while providing service, has a minimum orbital altitude that is less than an altitude of a geostationary satellite.

The said system comprises at least at least a first origination unit (ORIGINATION UNIT 1, ORIGINATION UNIT 2, ...)(102, 104, ...), at least a first paging-supporting gateway (GATEWAY 1,...) (118, ...) , a plurality of communication satellites (COM SATs) (120, 122, 124, 126, ...) having a plurality of addressable coverage areas (ACA1-1, ACA1-2, ACA1-3, ACA2-1, ACA2-2, ACA2-3, ...)(106, 108, 110, 112, 114, 116, ...), and at least a first termination unit (128, 130, ...). Though only two termination units (128, 130) are illustrated in FIG. 1, it is clear that a plurality of termination units that is greater than two may be served by the system. Also, although two COM SATs (120, 124) are illustrated sending pages to only three ACAs per satellite, it is clear that each COM SAT may be arranged to provide pages to a predetermined plurality of ACAs. Clearly, the size and shape of the ACA(s) are system design parameters. For example, a relatively circular area having a radius of a hundred and fifty miles is a workable ACA. The ACAs are typically arranged such that some overlap of ACAs is present, thereby providing paging coverage for the entire earth surface as is clear from FIG. 1. As the COM SATs approach polar regions of the earth and COM SAT orbits are closer together, the degree of such ACA overlap may become so large that preselected ACA(s) may be inactivated as an energy-saving measure (since other overlapping ACA(s) will provide

coverage for the inactivated ACA(s)) and to prevent interference.

The first origination unit (102) is operably coupled to the first gateway (118), for providing information to the first gateway (118). For example, a first origination unit (102) may be a telephone that is connected to the first gateway by a public switched telephone network (PSTN). The information provided indicates at least selected paging information, and where selected, a CPGA, for a selected termination unit.

Each origination unit (102, 104, ...) comprises a unit for transmitting a signal to a gateway for further transmission to a COM SAT, where the signal is ultimately intended for a preselected termination unit (the paging unit to receive the page), wherein the signal, as transmitted by the origination unit, includes at least paging information and may include information indicating a customized preferred geographic area (CPGA). Typically, paging information includes a pager ID for the selected termination unit (pager) and the message being sent by the origination unit.

Each gateway (118,...) includes a unit for assigning a pager identification code to the termination unit (i.e., termination unit IDs/pager IDs). The gateway includes a unit for terminator selection of LTPGA(s), and optionally, STPGA(s). In addition, the gateway includes a unit for optional originator selection of CPGA(s). The gateway provides for memory unit storage of at least termination unit identification numbers , LTPGA(s) or corresponding ACA(s), STPGA(s) or corresponding ACA(s), and selectable paging services information for a pager. Storage is typically accomplished utilizing disk storage or optical storage. The gateway processes the selected geographic area(s) (SGA(s)) into a list of one or more addressable coverage areas (ACA(s)) such that the SGA(s) are

included within the ACA(s). Any one or more CPGA(s), LTPGA(s), and STPGA(s) make up the SGA(s). The gateway provides for transmission of originator-generated paging information, ACA(s), and optionally, a paging message number, to at least a first COM SAT (120, 122, 124, 126, ...) in accordance with preselected paging services for the pager.

Each communication satellite (COM SAT) (120, 122, 124, 126, ...) comprises at least: a communication relay transceiver for at least receiving the signal from the gateway and transmitting said signal in accordance with the selected ACA(s) (ACA1-1, ACA1-2, ACA1-3, ACA2-1, ACA2-2, ACA2-3, ...)(106, 108, 110, 112, 114, 116, ...), which satellite may utilize further communication satellites in a crosslinking manner for retransmission of the signal in accordance with the selected ACA(s), a last such utilized communication satellite completing transmitting said signal in accordance with the selected ACA(s) such that transmission of the signal to the preselected termination unit is facilitated.

The long-term preferred geographic area (LTPGA) is typically provided to the first gateway (118) by a terminator at a time, for example, when the terminator obtains his termination unit (128, 130,...), typically a page-receiving device (i.e., pager). Generally, the terminator selects a LTPGA, an area where he expects to be available for paging, at a time when he rents, leases or purchases the first termination unit (128, 130, ...). The terminator, of course, may change the LTPGA by providing an updated LTPGA to the first gateway (118). In addition, the terminator may select at least a first short-term preferred geographic area (STPGA) to provide flexibility at any time by providing the STPGA to the first gateway (118). The origination unit (102, 104, ...) may be used to enter LTPGA(s) and/or STPGA(s). For example, where the terminator knows that he will be in a location different from

his LTPGA for a short period of time (i.e., a STPGA), he may utilize an origination unit (102, 104, ...) to communicate the STPGA to the gateway (118).

The gateway (118) assigns a termination unit identification number (termination unit ID) to the termination unit (128), and stores the termination unit ID, typically in a table in a memory unit that is organized and arranged to provide the LTPGA or corresponding ACA(s), and, where selected, the STPGA or corresponding ACA(s), associated with the termination unit ID. Of course, the table may also include a listing of paging services predetermined by the terminator. In other words, upon acquiring a pager, the terminator may elect desired paging services such as message prioritization paging, duplicate paging recognition and elimination, and so forth. The gateway (118) assigns each selected preferred geographic area (LTPGA, STPGA, CPGA) to at least a first addressable coverage area (ACA1-1, ACA1-2, ACA1-3, ACA2-1, ACA2-2, ACA2-3, ...)(106, 108, 110, 112, 114, 116, ...), such that at least a first targeted ACA is provided for receiving transmission of the originator's paging message. The gateway (118) transmits an information signal consisting of at least the originator's paging message, a list of the selected ACA(s), the termination unit ID. In addition, where selected, the gateway (118) may also include an indication of a message number.

At least a first paging-supporting gateway (118,...) is typically provided. Twenty such gateways are a workable number of gateways, where the gateways are arranged to provide distributed coverage across a world-wide receiving area.

Each communication satellite (COM SAT) (120, 122, 124, 126, ...) typically comprises at least a communication relay

transceiver for at least receiving the signal from the gateway or another COM SAT and transmitting said signal in accordance with the selected ACA(s). The COM SAT receiving the signal from the gateway may utilize further COM SAT(s) in a crosslinking manner for retransmission of the signal in accordance with the selected ACA(s). Where ACA(s) are in the COM SAT's broadcasting coverage area, the COM SAT broadcasts the paging information into those ACA(s), such that transmission of the signal by said COM SAT to the preselected termination unit (128, 130,..) is facilitated. Where the COM SAT transmits the signal in a crosslink relay fashion to ACA(s) indicated by the signal, the information identifying the ACA(s) to which the signal has already been transmitted is first removed from the signal, and, where further ACA(s) are represented in the remaining signal, the signal containing the remaining information is transmitted to other COM SAT(s) in accordance with the remaining ACA(s) contained in the signal.

The termination unit (128, 130, ...) is typically a radio communication unit such as a pager, which is operably coupled to a COM SAT by a radio communication link and includes means for indicating a paging message (such as visual display or voice).

The signal transmitted by the gateway to the COM SAT comprises a signal representing at least an ID of the preselected terminator unit, at least a first targeted addressable coverage area (ACA), and the selected paging message. The signal may, of course, be selected to include further information such as a message number.

Thus, for example, an originator may telephone a selected gateway, and, where selected, may register a CPGA. The originator provides selected paging information to be communicated to a first termination unit via a COM SAT, and

where necessary, via crosslinking to further COM SAT(s), such that at least a first COM SAT transmits a signal that represents the paging information to at least a first ACA in accordance with preselected paging service for the preferred geographic area(s) selected.

In addition, the paging services may be selected to provide an indication that the paging signal has been received by the preselected terminator unit. In such a case, in response to receiving the signal from a COM SAT, the termination unit includes means for indicating the message to the terminator (such as visual display or voice) and may provide an identifiable audio tone and/or visual display or vibrators to alert the terminator that a paging signal has been received.

FIG. 2, numeral 200, is a flow chart for a first embodiment of a geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention. Said invention provides a broadcast method for a system comprising at least a first termination unit for at least a first terminator, a plurality of addressable coverage areas (ACAs), and a plurality of communication satellites (COM SATs), for facilitating a user's utilizing an origination unit for transmitting a message to a preselected terminator unit utilizing COM SAT(s) to transmit a message to addressable coverage area(s) (ACA(s)). The method includes the following steps: (A) the gateway's assigning an identification code (ID) to the terminator and the terminator's selecting at least a LTPGA, and optionally, a STPGA, to receive messages sent by originators (202, 204), (B) the originator's transmitting a message (206), (C) the gateway's determining addressable coverage area(s) (ACA(s)) in accordance with the SGA(s) (208), (D) the gateway's transmitting information (210), including at least the ACA(s), the terminator ID, and message to a COM SAT having at least a communication relay

transceiver and one of: (E1) where the ACA(s) are in a broadcast range beyond that of the COM SAT, the COM SAT transmitting the information to further COM SAT(s), each having at least a transceiver, in crosslink fashion to COM SAT(s) in a broadcast range containing the ACA(s), and the COM SAT(s) transmitting to the ACA(s) (214) and (E2) where the ACA(s) are in a broadcast range within that of the COM SAT, the COM SAT transmitting the information to the ACA(s) (212), such that the terminator unit receives the message.

Further details of the system used by the geographic area-selective low-earth satellite-based paging broadcast method, such as the SGA(s), are as described above.

FIG. 3, numeral 300, is a flow chart of an embodiment of one embodiment of steps in the geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention. Said paging broadcast method, as described above, utilizes at least a first origination unit for at least a first originator, a first gateway, a first termination unit, and a plurality of communication satellites (COM SATs), wherein a system implementing the method has a plurality of addressable coverage areas (ACAs) for facilitating a user's utilizing an origination unit for transmitting a message to a preselected termination unit utilizing addressable coverage areas (ACA(s)). Said paging broadcast method includes the following steps: (1) the gateway's determining whether transmission of a paging message has been requested, and, where transmission of a paging message is unrequested, recycling to determining whether transmission of a paging message has been requested (302); (2) where transmission of a paging message is requested, the originator providing a termination unit ID to the gateway for a selected terminator (304); the gateway's determining whether the originator has selected a customized preferred geographic area (CPGA) into

which to broadcast the paging message (306); where the originator has selected CPGA(s), the gateway's utilizing the selected CPGA(s) (314); where a customized preferred geographic area (CPGA) for receiving the paging message is unselected, the gateway's determining whether a short term preferred geographic area (STPGA) has been selected (308); where a short term preferred geographic area is unselected, the gateway's utilizing the predetermined long term preferred geographic area (LTPGA) (310); where a short term preferred geographic area (STPGA) is selected, the gateway's utilizing the predetermined short term preferred geographic area (STPGA) (312); the gateway's converting the selected geographical area(s) (SGA(s) to corresponding addressable coverage area(s) (target ACA(s)) (316); the originator's transmitting the paging message to the gateway (318); the gateway's formulating a signal including at least the ACA(s), the termination unit ID, and the paging message in an information signal (320); the gateway's transmitting the information signal to a COM SAT (322); the COM SAT determining whether the information signal includes ACA(s) in the COM SAT's broadcasting range (324); where the signal includes ACA(s) in the COM SAT's broadcasting range, the COM SAT's removing ACA(s) of its broadcasting range from the information signal (326) and transmitting a signal having the paging information to the target ACA(s), i.e., broadcasting paging information to own ACA(s))(328); where all of the ACA(s) in the signal are outside of the COM SAT's broadcasting range, crosslinking to COM SAT(s) based on remaining ACA(s) (332); after the COM SAT's broadcasting the paging information to its own ACA(s), the COM SAT's determining whether further target ACA(s) remain in the information signal (330); where further target ACA(s) remain, and only one crosslink is required, crosslinking the remaining signal and where more than one crosslinking COM SAT is required repacketizing and transmitting using crosslinks (Repacketizing is duplicating the

paging information, dividing the ACA(s) into disjoint lists, and creating multiple crosslink packets for transmission) based on remaining target ACA(s) (332); where all target ACA(s) have been removed from the information signal, the steps of the method have been completed (330).

The information transmitted by the gateway to the communication satellite comprises a signal including at least an ID of the preselected termination unit, at least a first targeted addressable coverage area (ACA), and the selected paging message. In addition, a message number may also be included in the transmitted information.

FIG. 4, numeral 400, is a flow chart of an embodiment of one embodiment of steps for a gateway's handling long-term preferred geographic areas and short-term preferred geographic areas in the geographic area-selective low-earth satellite-based paging broadcast method in accordance with the present invention. In accordance with the embodiment of the present invention in correspondence with the page originator's steps set forth above, steps as viewed by the page terminator, typically comprise the steps of: (A) the gateway's assigning and storing an identification code (ID) for the termination unit (paging customer/user) (402); (B) the gateway's storing customer-selected services in a memory unit in correspondence with the termination unit ID (404); (C) the gateway's storing a customer-selected long term preferred geographic area (LTPGA) in a memory unit in correspondence with the termination unit ID (406); (D) determining whether the customer has selected a short term preferred geographic area (STPGA) (408) and where the short term preferred geographic area is unselected, proceeding to (H) determining whether an updated LTPGA has been selected (416); where an updated LTPGA has been selected, recycling to the gateway's storing the LTPGA (406); and where the LTPGA is unchanged,

recycling to determining whether the customer has selected a short term preferred geographic area (STPGA) (408); (E) where the customer has selected a short term preferred geographic area, the gateway's storing the STPGA in a memory unit in correspondence with the termination unit ID (410); (F) determining whether to revert to the LTPGA (412) and, where no reversion to a LTPGA is selected, proceeding to (H) determining whether an updated LTPGA has been selected (416); where an updated LTPGA has been selected, recycling to the gateway's storing the LTPGA (406); and where the LTPGA is unchanged, recycling to determining whether the customer has selected a short term preferred geographic area (STPGA) (408);(G) where reversion to a LTPGA is selected, clearing the existing STPGA (414) and proceeding to (H), determining whether whether an updated LTPGA has been selected (416); where an updated LTPGA has been selected (416), recycling to the gateway's storing the LTPGA (406); and where the LTPGA is unchanged (416), recycling to determining whether the customer has selected a short term preferred geographic area (STPGA) (408). A single memory unit or multiple memory units may be used to store termination unit ID(s), customer selected service(s), LTPGA(s), and STPGA(s).

Also, the origination unit and the preselected termination unit may be selected to include features described in more detail above.

In addition, at least some of the gateways may be operably coupled to a public telephone network for further facilitating transmission of the origination unit paging information to the preselected termination unit.

Although certain embodiments are described above, it will be obvious to those skilled in the art that many alterations and modifications may be made without departing

from the invention. Accordingly, it is intended that all such alterations and modifications be included within the spirit and scope of the invention as defined in the appended claims.

We claim:

Claims:

1. A geographic area-selective low-earth satellite-based paging broadcast system comprising at least:

at least a first origination unit for at least a first originator,

a first gateway,

at least a first termination unit, and

a plurality of communication satellites (COM SATs) having a plurality of addressable coverage areas (ACAs), wherein

the first origination unit comprises:

means for transmitting paging information to a gateway for further transmission to a COM SAT, where the paging information (a paging message and a termination unit identification (ID)) is ultimately intended for a preselected termination unit, and wherein a signal, as transmitted by the origination unit, may include information indicating a customized preferred geographic area (CPGA),

each gateway comprises:

means for assigning a pager identification code to the termination unit and for transmitting a signal to a COM SAT,

means for providing selection of at least a first addressable coverage area (ACA) such that selected geographic area(s) (SGA(s)) are included within the ACA(s), and

means for at least transmitting said signal from the gateway to a communication satellite in accordance with the selected ACA(s),

and each communication satellite (COM SAT) comprises at least:

a communication relay transceiver for at least receiving the signal from the gateway and transmitting said signal in accordance with the selected ACA(s), which satellite may utilize further communication satellites in a crosslinking

manner for retransmission of the signal in accordance with the selected ACA(s) such that transmission of the signal to the preselected termination unit is facilitated.

2. The system of claim 1 wherein the SGA(s) comprise at least one of:

(A) at least a first selected long-term preferred geographic area (LTPGA),

(B) at least a first selected short-term preferred geographic area (STPGA), and

(C) a customized preferred geographic area (CPGA), and

each selected geographic area is converted to at least a first ACA such that the SGA(s) are included within the ACA(s).

3. The system of claim 2 wherein the signal transmitted by the gateway to the communication satellite comprises a signal including at least:

(A) an ID of the preselected termination unit,

(B) at least a first targeted addressable coverage area (ACA), and

(C) the selected paging message.

4. The system of claim 1 wherein the origination unit further comprises:

(A) means for providing an indication that the signal has been received by the preselected termination unit, and

(B) means for transmitting paging information, and, where selected, customized preferred geographic area selection to the gateway.

5. The system of claim 1 wherein the preselected termination unit further comprises means for providing at least one of:

(A) means for indicating the message to the terminator, and

(B) a distinctive audio tone, visual display, and vibrator,

to advise the preselected termination unit that it has a signal.

6. In a paging broadcast communication system comprising a first origination unit for at least a first originator, a plurality of gateways, at least a first termination unit, and a plurality of geographic area-selective low-earth communication satellites (COM SATs), a paging system comprising:

(A) first origination unit means for transmitting paging information to a gateway for further transmission to a COM SAT, where the paging information (a paging message and a termination unit identification (ID)) is ultimately intended for a preselected termination unit, and

(B) gateway means for assigning a pager identification code to the termination unit, providing for selection of at least a first addressable coverage area (ACA) such that the selected geographic area(s) (SGA(s)) are included within the ACA(s), transmitting said signal from the origination unit to a communication satellite (COM SAT) in accordance with the selected ACA(s) which satellite may utilize further communication satellites in a crosslinking manner for retransmission of the signal in accordance with the selected ACA(s), until communication satellites complete transmitting said signal in accordance with the selected ACA(s) such that transmission of the signal to the preselected termination unit is facilitated.

7. The system of claim 6 wherein the first origination unit means further comprises at least one of:

(A) means for providing a customized preferred geographic area (CPGA) to the gateway means, and

(B) means for providing an indication to the originator that a signal has been received by the preselected termination unit.

8. The system of claim 6 wherein the preselected termination unit further comprises means for providing one of:

(A) means for indicating the message to the terminator,

(B) a distinctive audio tone, visual display, and a vibrator,

to advise the preselected termination unit that it has a message.

9. A geographic area-selective low-earth satellite-based paging broadcast method for a system comprising at least:

a first origination unit for at least a first originator,

a first termination unit for at least a first terminator,

a first gateway, and

a plurality of communication satellites (COM SATs) having a plurality of addressable coverage areas (ACAs),

for facilitating an originator's utilizing an origination unit for transmitting a message to a preselected termination unit utilizing a gateway and at least a first communication satellite (COM SAT),

said method comprising the steps of:

(A) the gateway's assigning an identification code (ID) to the termination unit and the termination unit's selecting at least a first long-term preferred geographic area (LTPGA), and optionally selecting a short-term preferred geographical area (STPGA) to receive messages sent by originators,

(B) the originator's transmitting a message, and optionally, a customized preferred geographical area (CPGA),

(C) the gateway's determining addressable coverage area(s) (ACA(s)) in accordance with SGA(s),

(D) the gateway's transmitting information including at least the ACA(s), the termination unit ID, and message to a COM SAT having at least a transceiver, and

(E) one of:

(E1) where the ACA(s) are in a broadcast range beyond that of the COM SAT, the COM SAT transmitting, the information to further COM SAT(s), each having at least a transceiver, in crosslink fashion to COM SAT(s) that are in a

broadcast range containing the ACA(s), and the COM SAT(s) transmitting to the ACA(s),

(E2) where the ACA(s) are in a broadcast range within that of the COM SAT, the COM SAT transmitting the information to the ACA(s),

such that the message is transmitted to the termination unit.

10. A geographic area-selective low-earth satellite-based paging broadcast method for a system comprising at least:

a first origination unit for at least a first originator,

a first termination unit for at least a first terminator,

a first gateway, and

a plurality of communication satellites (COM SATs) having a plurality of addressable coverage areas (ACAs),

for facilitating an originator's utilizing an originator unit for transmitting a message to a preselected termination unit addressable coverage area(s) (ACA(s)) and at least a first communication satellite (COM SAT),

said method comprising the steps of:

(A) the gateway's assigning an identification code (ID) to the termination unit and the termination unit's selecting at least a long-term preferred geographical area (LTPGA) and, optionally selecting a short-term preferred geographical area (STPGA) to receive messages sent by originators,

(B) the originator's transmitting a message, and optionally, a customized preferred geographical area (CPGA),

(C) the gateway's determining addressable coverage area(s) (ACA(s)) in accordance with SGA(s),

(D) the gateway's transmitting information including at least the ACA(s), the termination unit ID, and message to a COM SAT having at least a transceiver, and

(E) one of:

(E1) where the ACA(s) are in a broadcast range beyond that of the COM SAT, the COM SAT transmitting, the information to further COM SAT(s), each having at least a transceiver, in crosslink fashion to COM SAT(s) that are in a

broadcast range containing the ACA(s), and the COM SAT(s) transmitting to the ACA(s),

(E2) where the ACA(s) are in a broadcast range within that of the COM SAT, the COM SAT transmitting the information to the ACA(s),

such that the message is transmitted to the termination unit;

(F) where selected, the gateway's determining a whether a short-term preferred geographic area (STPGA) has been selected by the termination unit, and where same is selected, utilizing the STPGA in correspondence with the termination unit ID, for use as selected by termination unit, and

simultaneously, the gateway's determining whether a paging message has been sent by the termination unit and continuing said determination at predetermined intervals until a paging message is detected,

(G) where a paging message has been transmitted by the originator, the originator's providing to the gateway a target pager ID for the termination unit to receive the paging message,

(H) customizing selection of a geographic coverage area in correspondence with one of: the LTPGA, the STPGA and the CPGA (where selected by the originator),

(I) the gateway's determining at least a first ACA in correspondence with the geographic area selected in (H),

(J) the gateway's transmitting information including the at least first ACA, target pager ID, and message to a first communication satellite (COM SAT),

(K) the first COM SAT's determining whether the information includes ACA's within said COM SAT's broadcast range, and where beyond said range, crosslink transmitting to further COM SAT(s) until COM SAT(s) within said range receives the information,

(L) where the COM SAT within said range receives the information, said COM SAT's transmitting the information to

ACA(s) in said COM SAT's broadcast range and removing said ACA(s) from the information, and, where further ACA(s) remain, transmitting the information with remaining ACA(s) to a COM SAT for crosslink transmission in accordance with the above scheme until the information has been transmitted to all ACA(s) selected by the originator, thus facilitating transmission of the information to the predetermined termination unit.

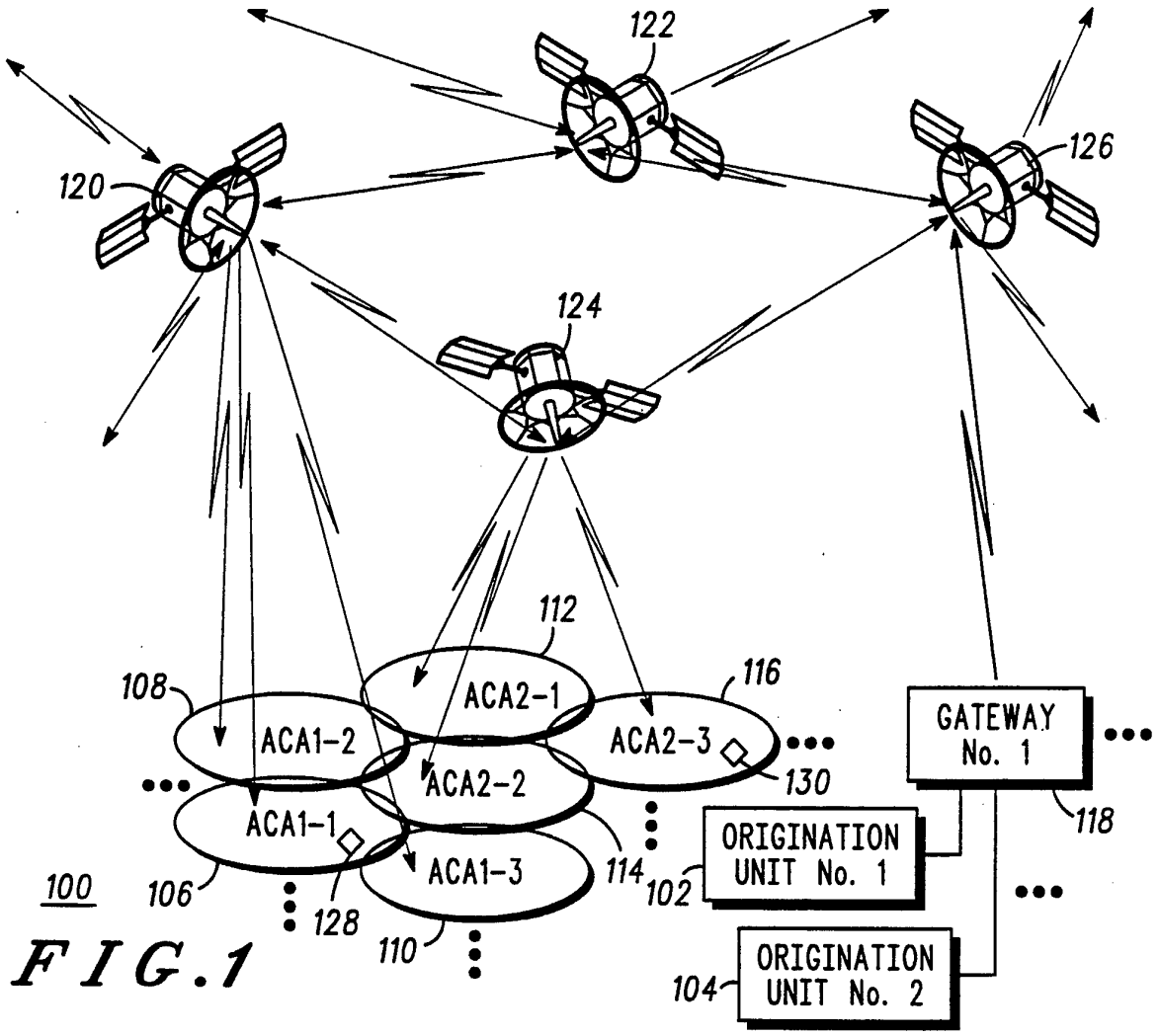

122
120
126
124
112
108
116
ACA2-1
ACA1-2
ACA2-3
ACA2-2
ACA1-1
ACA1-3
130
114
100
106
128
110
102
GATEWAY No. 1
118
ORIGINATION UNIT No. 1
ORIGINATION UNIT No. 2
104

FIG. 1

FIG. 2

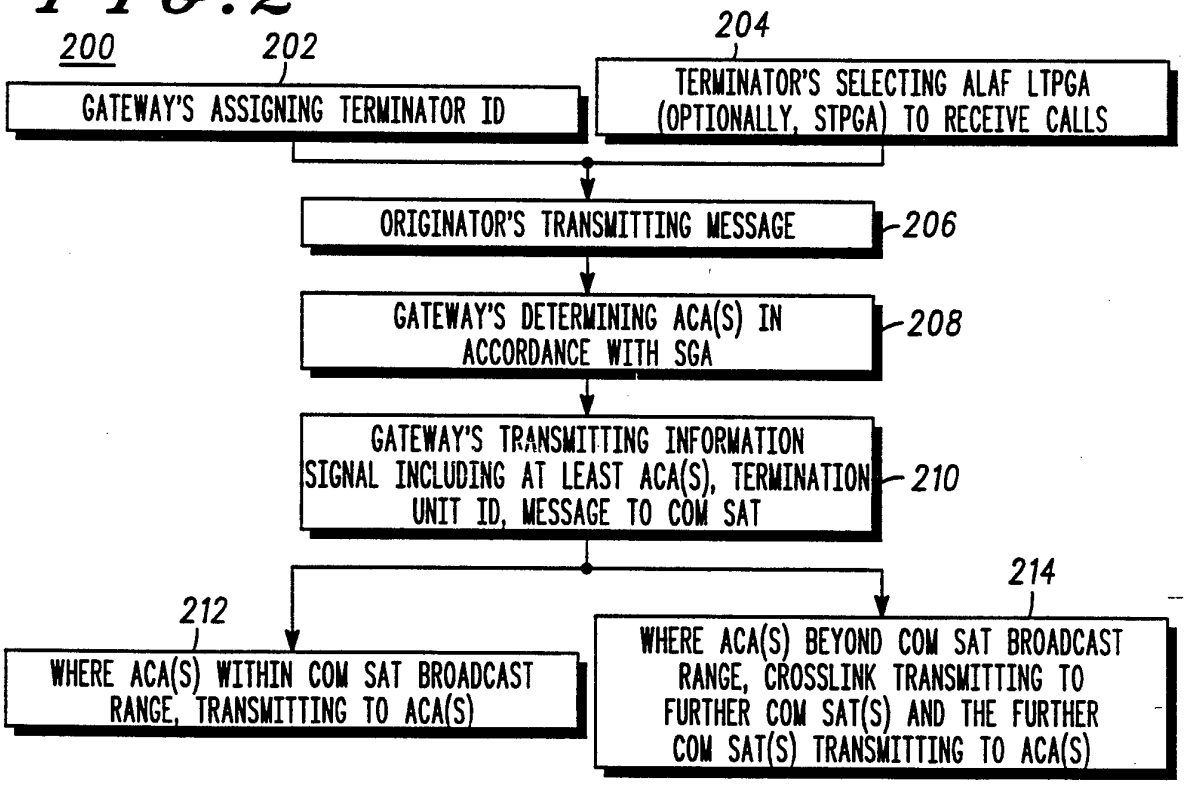

200
202
GATEWAY'S ASSIGNING TERMINATOR ID
204
TERMINATOR'S SELECTING ALAF LTPGA (OPTIONALLY, STPGA) TO RECEIVE CALLS
ORIGINATOR'S TRANSMITTING MESSAGE
206
GATEWAY'S DETERMINING ACA(S) IN ACCORDANCE WITH SGA
208
GATEWAY'S TRANSMITTING INFORMATION SIGNAL INCLUDING AT LEAST ACA(S), TERMINATION UNIT ID, MESSAGE TO COM SAT
210
212
WHERE ACA(S) WITHIN COM SAT BROADCAST RANGE, TRANSMITTING TO ACA(S)
214
WHERE ACA(S) BEYOND COM SAT BROADCAST RANGE, CROSSLINK TRANSMITTING TO FURTHER COM SAT(S) AND THE FURTHER COM SAT(S) TRANSMITTING TO ACA(S)

FIG. 3

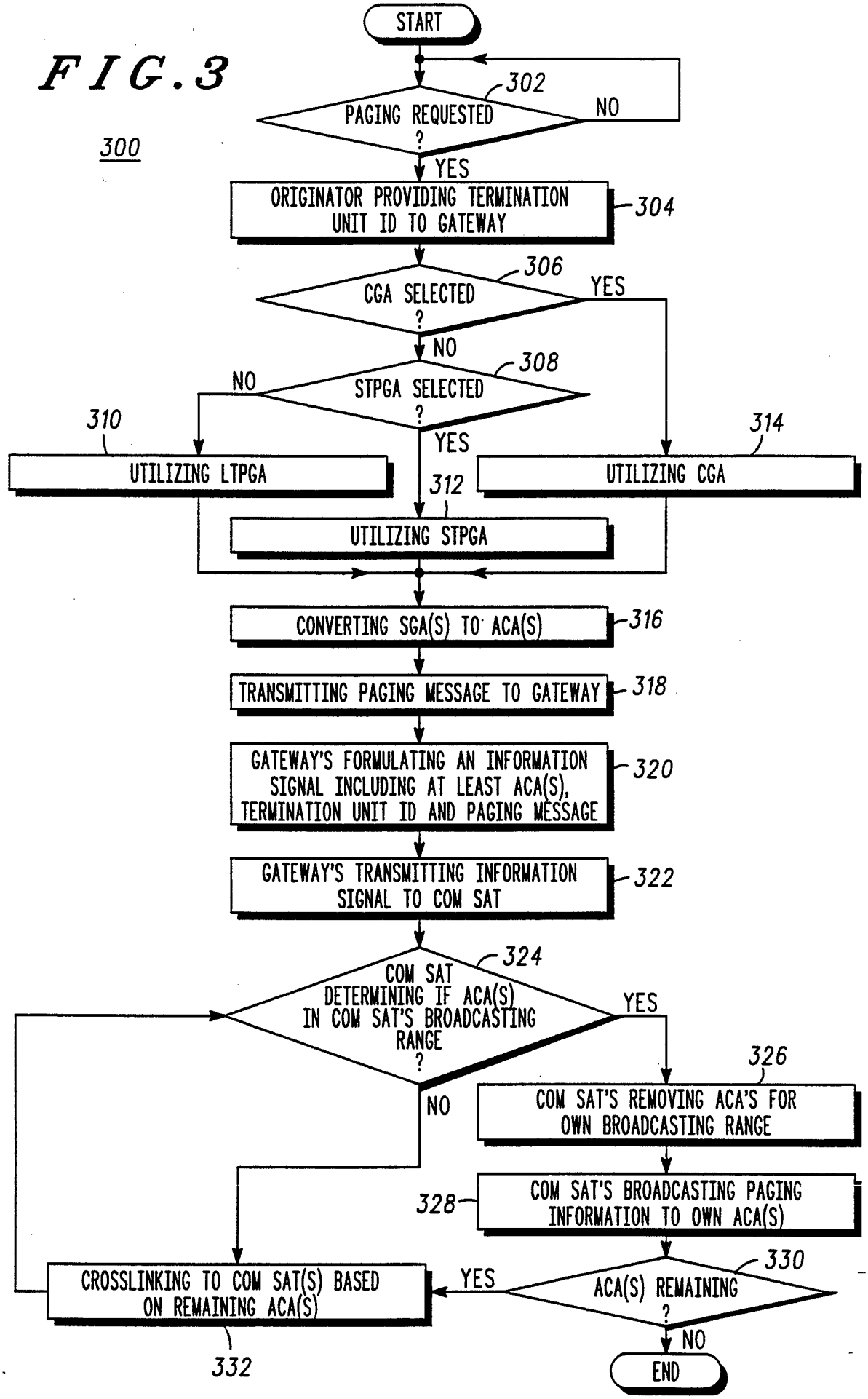
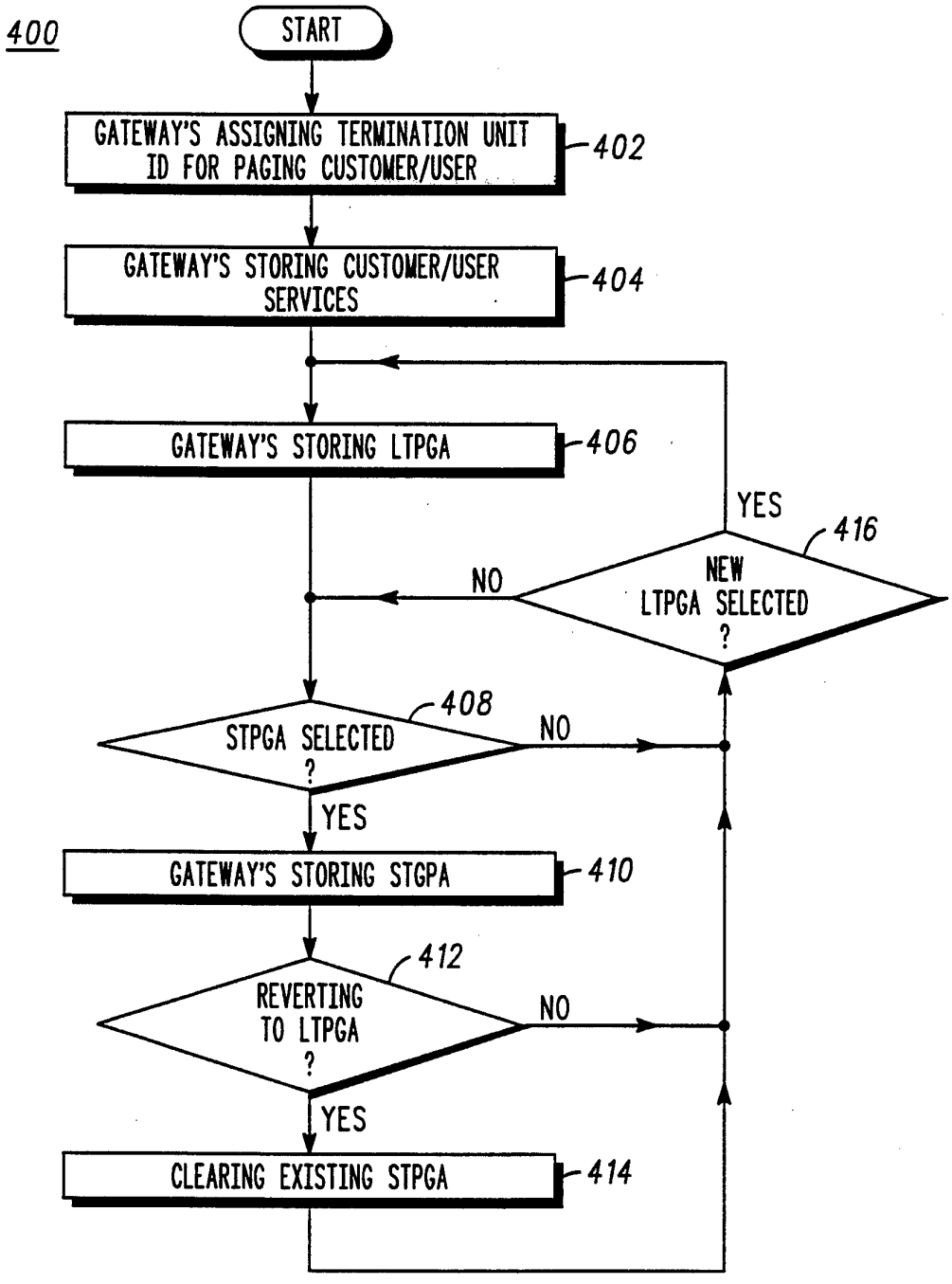

300
START
302
PAGING REQUESTED ?
NO
YES
ORIGINATOR PROVIDING TERMINATION UNIT ID TO GATEWAY
304
306
CGA SELECTED ?
YES
NO
308
STPGA SELECTED ?
NO
YES
310
UTILIZING LTPGA
312
UTILIZING STPGA
314
UTILIZING CGA
CONVERTING SGA(S) TO ACA(S)
316
TRANSMITTING PAGING MESSAGE TO GATEWAY
318
GATEWAY'S FORMULATING AN INFORMATION SIGNAL INCLUDING AT LEAST ACA(S), TERMINATION UNIT ID AND PAGING MESSAGE
320
GATEWAY'S TRANSMITTING INFORMATION SIGNAL TO COM SAT
322
324
COM SAT DETERMINING IF ACA(S) IN COM SAT'S BROADCASTING RANGE ?
YES
NO
326
COM SAT'S REMOVING ACA'S FOR OWN BROADCASTING RANGE
328
COM SAT'S BROADCASTING PAGING INFORMATION TO OWN ACA(S)
330
ACA(S) REMAINING ?
YES
NO
CROSSLINKING TO COM SAT(S) BASED ON REMAINING ACA(S)
332
END

FIG. 4


400
START
GATEWAY'S ASSIGNING TERMINATION UNIT ID FOR PAGING CUSTOMER/USER
402
GATEWAY'S STORING CUSTOMER/USER SERVICES
404
GATEWAY'S STORING LTPGA
406
YES
416
NO
NEW LTPGA SELECTED ?
408
STPGA SELECTED ?
NO
YES
GATEWAY'S STORING STGPA
410
412
REVERTING TO LTPGA ?
NO
YES
CLEARING EXISTING STPGA
414

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/07851

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :HO4B 7/185
US CL : 455/13.1, 13.2, 38.1; 340/825.44
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/12.1, 13.1, 13.2, 13.3, 13.4, 38.1, 51.2; 340/825.44

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

none

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

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91/08621, (Schwendeman) 13 June 1991 see 5-7 and 14-18; also, see figures 1, 3 and 6b	1-3, 5-6 and 8-10
Y	WO 91/08621 (Schwendeman) 13 June 1991	4 and 7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	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 part 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 document 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 search	Date of mailing of the international search report
29 October 1993	13 DEC 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer Andrew Faile
Facsimile No. NOT APPLICABLE	Telephone No. (703) 305-4380

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