EUROPEAN PATENT SPECIFICATION

SYSTEM AND METHOD FOR INCREMENTAL BROADCAST OF GPS NAVIGATION DATA IN A CELLULAR NETWORK

VORRICHTEUNG UND VERFAHREN ZUR INKREMENTALEN FUNKÜBERTRAGUNG VON GPS NAVIGATIONSDATEN IN EINEM MOBILFUNKNETZ

SYSTEME ET PROCEDE DE RADIODIFFUSION INCREMENTIELLE DE DONNEES DE NAVIGATION GPS DANS UN RESEAU CELLULAIRE

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Description

FIELD OF THE INVENTION

[0001] This invention relates to Global Positioning System (GPS) receivers and, more particularly, to a system and method for incremental broadcast of GPS navigation data in a wireless cellular network.

BACKGROUND OF THE INVENTION

[0002] Determining the geographical position of a mobile station within a wireless cellular network or other Public Land Mobile Network (PLMN) has recently become important for a wide range of applications. For example, positioning services may be desired by transport and taxi companies to determine the location of their vehicles and to improve the efficiency of dispatch procedures. In addition, for emergency calls, e.g., 911 calls, knowing the exact location of a mobile terminal may be vital in ensuring a positive outcome in emergency situations.

[0003] Furthermore, positioning services can be used to determine the location of a stolen car, to identify home zone calls which may be charged at a lower rate, to detect hot spots in a micro cell, or to provide premium subscriber services, e.g., the Where Am I Service. The Where Am I Service facilitates the determination of, for example, the location of the nearest gas station, restaurant, or hospital to a mobile station.

[0004] One technique for determining the geographic position of a mobile station is to use the satellite-based Global Positioning System (GPS). GPS is a satellite navigation system that provides specially coded satellite signals that can be processed in a GPS receiver to yield the position, velocity and time of a receiving unit. Four or more GPS satellite signals are needed to compute the three-dimensional locational coordinates and the time offset of a receiver clock relative to a fixed coordinate system.

[0005] The GPS system comprises twenty-four satellites (not counting spares) that orbit the Earth in approximately twelve hours. The orbital altitude of the GPS satellites (20,200 km) is such that the satellites repeat the same ground track and configuration over any point approximately once every twenty-four hours. There are six orbital planes each nominally with at least four satellites in each, that are equally spaced (i.e., 60° apart) and inclined at about 55° relative to the equatorial plane of the Earth. This constellation arrangement ensures that between four and twelve satellites are visible to users from any point on Earth.

[0006] The satellites of the GPS system offer two levels of precision in determining the position, velocity and time coordinates at a GPS receiver. The bulk of the civilian users of the GPS system use the Standard Positioning Service (SPS) which has a 2σ accuracy of 100 meters horizontally, +156 meters vertically and ±340 ns time. The Precise Positioning Service (PPS) is available only to authorized users having cryptographic equipment and keys and specially equipped receivers.

[0007] Each of the GPS satellites transmits two L-band carrier signals. The L1 frequency (centered at 1575.42 MHz) carries the navigation message as well as the SPS and PPS code signals. The L2 frequency (centered at 1227.60 MHz) also carries the PPS code and is used to measure the ionospheric delay by receivers compatible with the PPS system.

[0008] The L1 and L2 carrier signals are modulated by three binary codes: a 1.023 MHz Coarse Acquisition (C/A) code, a 10.23 MHz Precise Code (P-Code) and a 50 Hz Navigational System Data Code (NAV Code). The C/A code is a pseudorandom number (PRN) code that uniquely characterizes a GPS satellite. All of the GPS satellites transmit their binary codes over the same L1 and L2 carriers. The multiple simultaneously-received signals are recovered by a Code Division Multiple Access (CDMA) correlator. The correlator in a civilian GPS receiver first recovers the C/A Code as modulated by the NAV Code. A Phase Locked Loop (PLL) circuit then separates out the C/A Code from the NAV Code. It should be emphasized that a GPS receiver first needs to determine its approximate location in order to determine which of the GPS satellites are actually visible. Conversely, a GPS receiver that knows its approximate position can acquire more quickly the signals transmitted by the appropriate GPS satellites.

[0009] The startup of a GPS receiver typically requires the acquisition of a set of navigational parameters from the navigational data signals offour or more GPS satellites. This process of initializing a GPS receiver may often take several minutes.

[0010] The duration of the GPS positioning process is directly dependent upon how much information a GPS receiver has. Most GPS receivers are programmed with almanac data, which coarsely describes the expected satellite positions for up to one year ahead. However, if the GPS receiver does not have some knowledge of its own approximate location, then the GPS receiver cannot correlate signals from the visible satellites fast enough, and therefore, cannot calculate its position quickly. Furthermore, it should be noted that a higher signal strength is needed for capturing the C/A Code and the NAV Code at start-up than is needed for continued monitoring of an already-acquired signal. It should also be noted that the process of monitoring the GPS signal is significantly affected by environmental factors. Thus, a GPS signal which may be easily acquired in the open becomes progressively harder to acquire when a receiver is under foliage, in a vehicle, or worst of all, in a building.

[0011] Recent governmental mandates, e.g., the response time requirements of the FCC Phase II E-911 service, make it imperative that the position of a mobile handset be determined accurately and in an expedited manner. Thus, in order to implement a GPS receiver ef-
fectively within a mobile terminal while also meeting the demands for fast and accurate positioning, it has become necessary to be able to quickly provide mobile terminals with accurate assistance data, e.g., local time and position estimates, satellite ephemeris and clock information (which may vary with the location of the mobile station). The use of such assistance data can permit a GPS receiver that is integrated with or connected to a mobile station to expedite the completion of its start-up procedures. It is therefore desirable to be able to send the necessary assistance GPS information over an existing wireless cellular network to a GPS receiver that is integrated with or connected to a mobile terminal.

[0012] It is presently known to provide satellite ephemeris and clock correction information to a remote GPS receiver over a radio link. Likewise, it is common in land surveying to provide Differential GPS (DGPS) corrections over a radio link to remote GPS receivers. However, none of these prior systems address the specific operation requirements of a cellular mobile station and the wireless cellular network with which it interacts.

[0013] With a GPS-equipped Mobile Station (GPS-MS), standby time and talk time are limited by battery capacity. The additional battery drain resulting from operation of the integrated GPS receiver can be substantially greater than for the basic cell phone requirements. This can undesirably limit both standby time and talk time.

[0014] Providing GPS assistance information to the GPS-MS improves the sensitivity, Time-To-First-Fix (TTFF), and power consumption of the GPS-MS compared to a stand-alone GPS receiver. However, typical GPS-MS usage scenarios pose problems related to obtaining and updating GPS assistance information from the wireless cellular network. For example, the DGPS correction data is very time sensitive and requires frequent updates, which places a burden on the facilities of the wireless cellular network. Also, once new ephemeris and clock correction data is available for a satellite, all GPS-MS for which the satellite is visible require the new assistance as soon as possible in order to maintain a high degree of position accuracy. Timely delivery of these updates can place significant burden on the facilities of the wireless cellular network.

[0015] The patent application WO-A-9825157 discloses a method to improve the acquisition time of a GPS receiver. The method includes transmitting the satellite ephemeris data from a wireless cellular transmitter to a GPS receiver equipped with a mobile terminal, and broadcasting a plurality of approximate Doppler data of such receivers in a cell serviced by the wireless site. However, it is desirable to increase the accuracy of the GPS receiver whilst at the same time assisting the receiver during the start-up procedure.

[0016] The present invention is directed to overcoming one or more of the problems discussed above in a novel and simple manner.
GPS assistance data in a wireless communication network to mobile stations. Each mobile station operates in the wireless communication network and includes an integrated GPS receiver to make GPS positioning measurements. The system includes a GPS receiver for obtaining orbital modeling information for visible GPS satellites and GPS correction data. A transceiver communicates with mobile stations in the wireless communication network. A broadcast controller is operatively associated with the GPS receiver and the transceiver for selectively establishing a direct point-to-point channel with select mobile stations for transferring the orbital modeling information and for periodically broadcasting the GPS correction data on the wireless communication network to all mobile stations communicating in the wireless communication network.

It is a feature of the invention that the orbital modeling information comprises GPS satellite ephemeris and clock correction information.

It is another feature of the invention that the broadcast controller parses the deviations for currently visible satellites. The broadcast controller parses the deviations for currently visible satellites.

The broadcast controller parses the deviations for currently visible satellites.

Further features and advantages of the invention will be readily apparent from the specification and from the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a system for broadcasting GPS assistance data in a wireless communication network in accordance with the invention; Fig. 2 is a block diagram of a GPS assistance broadcast controller for the system of Fig. 1; and Fig. 3 is a timing diagram illustrating parsing of updated GPS navigation information implemented by the controlled of Fig. 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, a block diagram of a wireless communication network system 10 utilizing assisted-GPS positioning is illustrated. The system and method according to the invention are described relative to the GSM cellular standard. Nevertheless, those skilled in the art will recognize that the invention can be applied to other cellular systems such as, for example, TDMA (ANSI-136) and CDMA (cdmaOne), and also to non-cellular wireless communication systems, such as satellite telephones or land mobile radios.

The wireless communication network system 10 includes a Base Transceiver Station (BTS) 12 connected to a Base Station Controller (BSC) 14. The BSC communicates with a Mobile Location Center (MLC) 16 via signaling through the cellular system network, represented by a cloud 34. The BTS 12 is the radio portion of the system 10 and is responsible for transmitting and receiving radio signals used in a particular cell 18. The BSC 14 controls the resources of one or more BTSs, such as the BTS 12, including the broadcast capabilities as described below. The MLC 16 is responsible for determining Global Positioning System (GPS) assistance information for delivery to any GPS-equipped Mobile Stations (GPS-MS) in the area that it serves, such as a GPS-MS 20 shown in the cell 18. This can be done through a local Differential GPS (DGPS) receiver 22 that is co-located with the MLC 16. The DGPS receiver 22 provides corrections as well as navigation messages from the satellites that are visible to it, such as a satellite 24. The satellite 24 could be any Satellite Based Augmentation System (SBAS) satellite that provides a GPS-like ranging signal. For purposes of this application, the satellite 24 is described as a GPS satellite. The DGPS receiver 22 also can use information from other SBAS satellites, such as WAAS or EGNOS geostationary satellites 26 as a redundant source for DGPS corrections.

The GPS-MS 20 comprises a typical mobile station (also called a wireless telephone, cellular telephone, or cell phone) having a cellular transceiver for sending and receiving radio signals between itself and the wireless communication network system 10. The GPS-MS 20 is also equipped with an integrated GPS receiver for receiving composite signals from visible GPS satellites, such as the satellite 24. The GPS-MS 20 is programmed to make GPS positioning measurements using the composite signals and navigation assistance data received from the wireless communication network system 10.

As is apparent, the network system 10 typically includes numerous BTSs, one for each cell, and likewise numerous BSCs. The number of GPS-MSs depends on the number of users utilizing the network system at any given time. However, for simplicity the features of the system and method according to the invention are described relative to the illustrated BTS 12, BSC 14 and GPS-MS 20.
The DGPS corrections improve the horizontal position accuracy of the GPS-MS 20 from 50m (RMS) to 5-10m (RMS), which is important for applications such as personal navigation.

The broadcast capacity of each cell or BTS is relatively limited. The capacity must be used for information other than GPS assistance. For example, the BCCCH must provide information to aid handoff to neighbor cells. Therefore, it is not practical to deliver the larger navigation assistance over a broadcast bearer.

In order to satisfy the above requirements, the wireless communication network system 10 in accordance with the invention utilizes several procedures for providing GPS assistance information to the GPS-MS 20. The first procedure is that when the GPS-MS 20 powers on, it uses a dedicated point-to-point channel 28 to request and receive both orbital modeling information and DGPS correction assistance from the network 10. This dedicated channel may be established specifically for this purpose, or a logical channel established for another purpose may be used for this communication between the GPS-MS 20 and the network system 10. The use of the point-to-point channel 28 provides fast delivery which enables the GPS-MS 20 to quickly compute its position.

Meanwhile, the DGPS correction data is broadcast on each cell's BCCH or another broadcast bearer. The DGPS broadcast data for each cell, such as the cell 18, is updated every thirty seconds or less by the BSC 14. Broadcast is advantageous, since it allows fast delivery of the DGPS corrections to all GPS-MS at once. This is especially important due to the short duration of validity for the correction data.

The above two procedures address the primary operational scenarios. However, a problem occurs when the orbital modeling information, particularly the navigation information, must be updated for all GPS-MS in a geographic region, for example, a cell. One example of this is when a new satellite becomes visible. Point-to-point delivery to all GPS-MS in the cell is not practical, nor is using additional broadcast capacity.

This problem is solved in accordance with the invention by parsing the updated information and adding it to unused portions of broadcast messages. Particularly, most network signaling protocols have a so-called Protocol Data Unit (PDU) in which all messages must be multiples of a certain size. For example, the PDUs for the GSM Short Message Service Cell Broadcast (SMS-CB) are 82 bytes, or 656 bits. If the actual message content is less than this length, then the protocol adds filler data to bring it up to the PDU size. In accordance with the invention, if the broadcast DGPS correction data, discussed above, is less than 1 PDU, then the unused capacity is filled with updated navigation data. In this manner, all GPS-MS in the cell 18 can receive the updated navigation data without having to occupy dedicated point-to-point channels 28 and other network resources, such as an MSC or BSC.

In accordance with the invention, there are two
options for sending the navigation data updates in the broadcast DGPS message. The first is to directly send the ephemeris, clock corrections, etc. for each of the satellite(s) affected by the update by parsing the data to fill the unused broadcast capacity. The second option is to directly send information for one or more newly visible satellites, but only to send the expected navigation parameter deviations for currently visible satellites. With past broadcast updates stored, the GPS-MS 20 is then able to apply the deviations to existing information and determine the most recent navigation data updates. This allows the data to be more quickly distributed to the GPS-MS 20.

[0047] Once the MLC 16 has captured the DGPS correction data from the DGPS receiver 22, or another external source, it sends this data to the BSC 14 via the network 34. Alternatively, the MLC 16 may be co-located with the BSC 14. Preferably, the MLC 16 updates the DGPS correction data periodically, such as every thirty seconds or less. After it receives each update, the BSC 14 sends this data to its internal GPS assistance broadcast controller 36, see Fig. 2.

[0048] Referring to Fig. 2, the broadcast controller 36 includes a multiplexer 38 that receives the DGPS correction data from the MLC 16. The BSC 14 also receives the GPS navigation data from the MLC 16. This data comes from the DGPS receiver 22 or perhaps from an external source (not shown). Updates to the navigation data occur when the GPS satellites change their respective navigation messages or possibly when a new satellite comes into view. After receiving this navigation data, the BSC 14 sends it to the internal broadcast controller 36, where it is stored in a buffer 40 for current data. The buffer 40 is compared to a buffer 42 which stores past data using a change detect block 44. If there are no navigation data differences for a currently visible satellite, then no additional broadcast message content need be generated for this satellite. If there are changes for a currently visible satellite, then the broadcast controller 36 calculates deviation terms that relate the preceding set of navigation parameters to the new set of navigation parameters. These deviation terms are transferred to a block 46 that encodes and buffers the changed data and parses it into the unused portions of the point-to-multipoint broadcast messages using a parser 48. The parser 48 is also connected to a size detect block 50 that receives the DGPS correction data. The size detect block determines if the broadcast DGPS correction data is less than one PDU. The size detect block 50 then instructs the parser 48 as to the unused capacity that can be filled with updated navigation data. The parser 48 then supplies the parsed navigation data to the multiplexer 38 for filling the unused capacity of the broadcast DGPS correction data, which is output as broadcast message content. This allows the navigation data to be distributed more quickly to all of the GPS-MS communicating in the wireless communication network 10.

[0049] As is apparent, if a satellite is newly visible and no past data is buffered at the block 42, then the navigation data is simply passed along and parsed in its standard form.

[0050] Fig. 3 shows a time line of how the updated navigation information, illustrated at a block 52, is parsed and added to broadcast messages labeled N, N+1, N+2, N+3 and N+4, along with respective DGPS correction data at times t0, t1, t2, t3 and t4.

[0051] One benefit of transferring only deviation terms for currently visible satellites is message compression. As the size of individual navigation updates is reduced, the effective delivery rate of a sequence of navigation updates can be increased. Alternatively, the effective delivery rate can be maintained while the conserved bits are utilized for other purposes. For instance, bits that indicate the precise relationship between the respective time references of the wireless cellular network system and the GPS can be broadcast periodically using these conserved bits. It is known to those skilled in the art that knowledge of this relationship is a core component of any effective GPS assistance scheme. These timing relationships are described in Bloebaum et al. application No. 09/264,120, filed March 8, 1999, and assigned to the assignee of the present application.

[0052] It is anticipated that a two- to threefold compression factor between sequential 2-hour navigation fit span intervals are feasible. For instance, the Issue-Of-Data terms for Clock and Ephemeris (IODC & IODE) can be reduced from a combined 18 bits to just 1-2 bits, which is enough to indicate occurrence of a change. Likewise, the time-of-clock and time-of-ephemeris (tOC and tOE) can be reduced from 16 bits each to less than 8 bits each.

[0053] Furthermore, other orbital parameters lend themselves to compression because the navigation data stored in the GPS-MS 20 from the preceding update contain their corresponding higher order derivatives. The conventional set of terms \( \{a_{f0}, a_{1}, I_0, \Omega_0, M_0, \omega \} \) can be projected precisely two hours forward by employing the higher order derivatives contained in the set \( \{a_1, a_2, dI/dt, d\Omega/dt, \Delta \} \). The differences between the precisely projected estimates and their associated terms from a new update are minimal. This is especially true since it is well known that pseudorange pairs produced by successive fit-span updates (two-hour lag) differ by less than one meter. Since this set of six terms accounts for a total of 166 clock/ephemeris bits, a four-fold compression of this subset could yield a reduction of approximately 120 bits.

[0054] For the remaining terms, \( \{a_2, dI/dt, d\Omega/dt, \Delta \} \) and the six harmonic correction amplitudes, determining the range of expected span-to-span parameter deviations is not so straightforward. Such determinations require some empirical investigation of the span-to-span deviations exhibited in archived navigation messages. However, one must consider that the respective parameters for two successive fit-span inter-
vals are derived essentially from the same continuous 4-week set of control segment observation data. Thus, junctions between successive fit-span parameter sets are inherently smooth due to the excessively long observation window utilized. If the 222 bits required by these remaining terms can be cut in half and the aforementioned reductions are made, a three-fold compression is possible.

[0055] As shown in Fig. 1, the GPS-MS 20 receives both the point-to-point and point-to-multipoint channels that are transmitted by the serving BTS 12. When the GPS-MS 20 powers on and has no valid navigation data, it may request the data directly from the MLC 16 on a point-to-point channel. However, if the GPS-MS 20 already has valid navigation data then it may listen to the point-to-multipoint channel for new data while using its existing data.

[0056] Thus, in accordance with the invention, there is illustrated a system and method for incremental broadcast of GPS assistance data in a wireless communication system, such as a cellular network system, to provide frequent updates of time sensitive information while minimizing burden on the wireless communication network.

Claims

1. The method of broadcasting Global Positioning System (GPS) assistance data in a wireless communication network (10) to mobile stations, each mobile station including a transceiver operating in the wireless communication network (10) and an integrated GPS receiver to make GPS positioning measurements, the method is characterised by the steps of:

- establishing a direct point-to-point channel (28) with a select mobile station (20);
- transferring initial orbital modelling information on the point-to-point channel (28) to the select mobile station (20) for visible GPS satellites (24);
- broadcasting orbital modelling information updates and GPS correction data on the wireless communication network (10) to all mobile stations communicating in the wireless communication network (10).

2. The method of claim 1 wherein the orbital modelling information includes GPS satellite ephemeris and clock correction information.

3. The method of claim 1 wherein the orbital modelling information includes GPS satellite almanac data.

4. The method of claim 1 wherein the GPS correction data comprises DGPS correction data.

5. The method of claim 1 wherein broadcasting orbital modelling information updates comprises parsing the data representing updated orbital modelling information and selectively adding the parsed data to unused portions of broadcast messages.

6. The method of claim 5 further comprising the step of comparing updated orbital modelling information to existing orbital modelling information to determine deviations for currently visible satellites.

7. The method of claim 6 wherein the parsing step comprises parsing the deviations for currently visible satellites.

8. The method of claim 5 wherein the orbital modelling information updates comprise compressed data representing updated orbital modelling information.

9. The method of claim 8 wherein the data is compressed by determining deviations for currently visible satellites.

10. The method according to any of the claims 1-9, wherein, the Global Positioning System (GPS) assistance data being updated and incrementally broadcasted, and the mobile stations having past orbital modelling information for recently visible GPS satellites, the method comprising the further steps of:

- periodically receiving current orbital modelling information for currently visible satellites;
- comparing the received current orbital modelling information to the past orbital modelling information and responsive to any deviations developing updated orbital modelling information; and
- broadcasting updated orbital modelling information on the wireless communication network (10) to all mobile stations communicating in the wireless communication network (10).

11. The method of claim 10 wherein the broadcasting step comprises parsing data representing the updated orbital modelling information and selectively adding the parsed data to unused portions of broadcast messages.

12. The method of claim 11 wherein the parsing step comprises parsing the deviations for currently visible satellites.

13. The method of claim 10 wherein the broadcasting step comprises compressing data representing the updated orbital modelling information.

14. The method of claim 13 wherein the broadcasting
step compresses the data by determining the deviations for currently visible satellites.

15. The method of claim 10 further comprising the step of adding data describing a relationship between respective time references of the wireless communication network (10) and the GPS to unused portions of broadcast messages.

16. A system for broadcasting Global Positioning System (GPS) assistance data in a wireless communication network (10) to mobile stations, each mobile station communicating in a wireless communication network (10) and including an integrated GPS receiver to make GPS positioning measurements, the system comprising a transceiver for communicating with mobile stations in the wireless communications network; the system is characterised by comprising:

- a GPS receiver (22) for obtaining orbital modelling information for visible GPS satellites (24) and GPS correction data,
- a broadcast controller operatively associated with the GPS receiver and the transceiver for selectively establishing a direct point-to-point channel (28) with select mobile stations (20) for transferring initial orbital modelling information and for periodically broadcasting orbital modelling information updates and GPS correction data on the wireless communication network (10) to all mobile stations communicating in the wireless communication network (10).

17. The system of claim 16 wherein the orbital modelling information comprises GPS satellite ephemeris and clock correction information.

18. The system of claim 16 wherein the orbital modelling information comprises GPS satellite almanac data.

19. The system of claim 16 wherein the GPS correction data comprises DGPS correction data.

20. The system of claim 16 wherein broadcasting orbital modelling information updates comprises parsing the data representing updated orbital modelling information and selectively adding the parsed data to unused portions of broadcast messages.

21. The system of claim 20 wherein the broadcast controller compares updated orbital modelling information to existing orbital modelling information to determine deviations for currently visible satellites.

22. The system of claim 21 wherein the broadcast controller parses the deviations for currently visible satellites.

23. The system of claim 20 wherein the broadcast controller compresses the data representing updated orbital modelling information.

24. The system of claim 23 wherein the broadcast controller adds data describing the relationship between respective time references of the wireless communication network (10) and the GPS to unused portions of broadcast messages.

Patentansprüche

1. Verfahren zum Rundsenden von Unterstützungsdaten eines globalen Positionierungssystems (GPS) in einem drahtlosen Kommunikationsnetz (10) zu Mobilstationen, wobei jede Mobilstation inkludiert einen Transceiver, der in dem drahtlosen Kommunikationsnetz (10) arbeitet, und einen integrierten GPS-Empfänger, um GPS-Positions Messungen vorzunehmen, wobei das Verfahren durch die Schritte gekennzeichnet ist:

- Herstellen eines direkten Punkt-zu-Punkt-Kanals (28) mit einer ausgewählten Mobilstation (20);
- Transferieren von Anfangsorbitalmodellierungsinformation in dem Punkt-zu-Punkt-Kanal (28) zu der ausgewählten Mobilstation (20) für sichtbare GPS-Satelliten (24); und
- Rundsenden von Orbitalmodellierungsinformationsaktualisierungen und GPS-Korrekturdaten in dem drahtlosen Kommunikationsnetz (10) zu allen Mobilstationen, die in dem drahtlosen Kommunikationsnetz (10) kommunizieren.

2. Verfahren nach Anspruch 1, wobei die Orbitalmodellierungsinformation GPS-Satellitenephemeride und Taktkorrekturinformation inkludiert.

3. Verfahren nach Anspruch 1, wobei die Orbitalmodellierungsinformation GPS-Satellitenalmanachdaten inkludiert.

4. Verfahren nach Anspruch 1, wobei die GPS-Korrekturdaten DGPS-Korrekturdaten umfassen.

5. Verfahren nach Anspruch 1, wobei Rundsenden von Orbitalmodellierungsinformationsaktualisierungen Parsen der Daten, die aktualisierte Orbitalmodellierungsinformation darstellen, und selektives Hinzufügen der geparsenen Daten zu ungenutzten Abschnitten von Rundsendungsnachrichten umfasst.

7. Verfahren nach Anspruch 6, wobei der Schritt zum Parsen Parsen der Abweichungen für gegenwärtig sichtbare Satelliten umfasst.

8. Verfahren nach Anspruch 5, wobei die Orbitalmodellierungsinformationsaktualisierungen komprimierte Daten umfassen, die aktualisierte Orbitalmodellierungsinformation darstellen.

9. Verfahren nach Anspruch 8, wobei die Daten durch Bestimmen von Abweichungen für gegenwärtig sichtbare Satelliten komprimiert werden.

10. Verfahren nach beliebigen der Ansprüche 1-9, wobei die Unterstützungsdaten eines globalen Positionierungssystems (GPS) aktualisiert und inkremental rundgesendet werden, und die Mobilstationen vergangene Orbitalmodellierungsinformation für unlängst sichtbare GPS-Satelliten haben, das Verfahren die weiteren Schritte umfasst:

   periodisches Empfangen aktueller Orbitalmodellierungsinformation für gegenwärtig sichtbare Satelliten;

   Vergleichen der empfangenen aktuellen Orbitalmodellierungsinformation mit der vergangenen Orbitalmodellierungsinformation und reagierend auf beliebige Abweichungen Entwicklung aktualisierter Orbitalmodellierungsinformation; und

   Rundsenden aktualisierter Orbitalmodellierungsinformation in dem drahtlosen Kommunikationsnetz (10) zu allen Mobilstationen, die in dem drahtlosen Kommunikationsnetz (10) kommunizieren.

11. Verfahren nach Anspruch 10, wobei der Rundsendungsschritt Parsen von Daten, die die aktualisierte Orbitalmodellierungsinformation darstellen, und selektives Hinzufügen der geersten Daten zu ungenutzten Abschnitten von Rundsendungsnachrichten umfasst.

12. Verfahren nach Anspruch 11, wobei der Schritt zum Parsen Parsen der Abweichungen für gegenwärtig sichtbare Satelliten umfasst.

13. Verfahren nach Anspruch 10, wobei der Rundsendungsschritt Komprimieren von Daten umfasst, die die aktualierte Orbitalmodellierungsinformation darstellen.

14. Verfahren nach Anspruch 13, wobei der Rundsendungsschritt die Daten durch Bestimmen der Abweichungen für gegenwärtig sichtbare Satelliten komprimiert.


16. System zum Rundsenden von Unterstützungsdaten eines globalen Positionierungssystems (GPS) in einem drahtlosen Kommunikationsnetz (10) zu Mobilstationen, wobei jede Mobilstation in einem drahtlosen Kommunikationsnetz (10) kommuniziert und einen integrierten GPS-Empfänger inkludiert, um GPS-PositionierungsMESSUNGEN vorzunehmen, wobei das System umfasst einen Transceiver zum Kommunizieren mit Mobilstationen in dem drahtlosen Kommunikationsnetz; wobei das System gekennzeichnet ist durch Umfassen:


17. System nach Anspruch 16, wobei die Orbitalmodellierungsinformation GPS-Satellitenephemeride und Taktkorrekturinformation umfasst.

18. System nach Anspruch 16, wobei die Orbitalmodellierungsinformation GPS-Satellitenalmanachdaten umfasst.


20. System nach Anspruch 16, wobei Rundsenden von Orbitalmodellierungsinformationsaktualisierungen Parsen der Daten, die aktualisierte Orbitalmodellie-
runingsinformation darstellen, und selektives Hinzufügen der geparsnten Daten zu ungenutzten Abschnitten von Rundsendungsnachrichten umfasst.

21. System nach Anspruch 20, wobei die Rundsendungssteuervorrichtung aktualisierte Orbitalmodellierungsinformation mit existierender Orbitalmodellierungsinformation vergleicht, um Abweichungen für gegenwärtig sichtbare Satelliten zu bestimmen.

22. System nach Anspruch 21, wobei die Rundsendungssteuervorrichtung die Abweichungen für gegenwärtig sichtbare Satelliten parst.

23. System nach Anspruch 20, wobei die Rundsendungssteuervorrichtung die Daten komprimiert, die aktualisierte Orbitalmodellierungsinformation darstellen.

24. System nach Anspruch 23, wobei die Rundsendungssteuervorrichtung die Daten durch Bestimmen von Abweichungen für gegenwärtig sichtbare Satelliten komprimiert.

25. System nach Anspruch 20, wobei die Rundsendungssteuervorrichtung Daten, die die Beziehung zwischen jeweiligen Zeitbezügen des drahtlosen Kommunikationsnetzes (10) und dem GPS beschreiben, zu ungenutzten Abschnitten von Rundsendungsnachrichten hinzufügt.

Revendications

1. Procédé de radiodiffusion dé données d'assistance du Système de Positionnement Global (GPS pour "Global Positioning System") dans un réseau de communication sans fil (10) vers des stations mobiles, chaque station mobile comportant un émetteur-récepteur fonctionnant dans le réseau de communication sans fil (10) et un récepteur GPS intégré pour effectuer des mesures de positionnement GPS, le procédé étant caractérisé par les étapes consistant à :

   établir un canal direct point-à-point (28) avec une station mobile sélectionnée (20) ;
   transférer des informations de modélisation orbitale initiales sur le canal point-à-point (28) à la station mobile sélectionnée (20) pour des satellites GPS visibles (24) ; et
   radiodiffuser des mises à jour des informations de modélisation orbitale et des données de correction GPS sur le réseau de communication sans fil (10) vers toutes les stations mobiles communiquant dans le réseau de communication sans fil (10).

2. Procédé selon la revendication 1, dans lequel les informations de modélisation orbitale comprennent des éphémérides de satellites GPS et des informations de correction d'horloge.

3. Procédé selon la revendication 1, dans lequel les informations de modélisation orbitale comprennent des données d'almanachs de satellites.

4. Procédé selon la revendication 1, dans lequel les données de correction GPS comprennent des données de correction DGPS.

5. Procédé selon la revendication 1, dans lequel la radiodiffusion de mises à jour d'informations de modélisation orbitale consiste à décomposer les données représentant des informations de modélisation orbitale mises à jour et à ajouter sélectivement les données décomposées à des parties inutilisées de messages radiodiffusés.

6. Procédé selon la revendication 5, comprenant en outre l'étape consistant à comparer des informations de modélisation orbitale mises à jour à des informations de modélisation orbitale existantes pour déterminer des écarts pour des satellites visibles à un instant considéré.

7. Procédé selon la revendication 6, dans lequel l'étape de décomposition consiste à décomposer les écarts pour des satellites visibles à un instant considéré.

8. Procédé selon la revendication 5, dans lequel les mises à jour d'informations de modélisation orbitale comprennent des données comprimées représentant des informations de modélisation orbitale mises à jour.

9. Procédé selon la revendication 8, dans lequel les données sont compressées en déterminant des écarts pour des satellites visibles à un instant considéré.

10. Procédé selon l'une quelconque des revendications 1-9, dans lequel les données d'assistance du Système de Positionnement Global (GPS) sont mises à jour et radiodiffusées de façon incrémentielle, et les stations mobiles contiennent des informations de modélisation orbitale antérieures pour des satellites GPS récemment visibles, le procédé comprenant les étapes supplémentaires consistant à :

   recevoir périodiquement des informations de modélisation orbitale courantes pour des satellites visibles à un instant considéré ;
   comparer les informations de modélisation orbitale courantes reçues aux informations de
modélisation orbitale antérieures et, en répon-
se à d'éventuels écarts, élaborer des informa-
tions de modélisation orbitale mises à jour ; et
radiodiffuser des informations de modélisation
orbitale mises à jour sur le réseau de commu-
nication sans fil (10) vers toutes les stations
mobiles communiquant dans le réseau de com-
mutation sans fil (10).

11. Procédé selon la revendication 10, dans lequel
l'étape de radiodiffusion consiste à décomposer
des données représentant les informations de mo-
délisation orbitale mises à jour et à ajouter sélecti-
vement les données décomposées à des parties
inutilisées de messages de radiodiffusion.

12. Procédé selon la revendication 11, dans lequel
l'étape de décomposition consiste à décomposer
les écarts pour des satellites visibles à un instant
considéré.

13. Procédé selon la revendication 10, dans lequel
l'étape de radiodiffusion consiste à comprimer des
données représentant les informations de modéli-
sation orbitale mises à jour.

14. Procédé selon la revendication 13, dans lequel
l'étape de radiodiffusion comprime les données en
déterminant les écarts pour des satellites visibles à
un instant considéré.

15. Procédé selon la revendication 10, comprenant en
outre l'étape consistant à ajouter des données dé-
crivant une relation entre des références temporel-
les respectives du réseau de communication sans
fil (10) et le GPS, à des parties inutilisées de mes-
sages radiodiffusés.

16. Système de radiodiffusion de données d'assistance
du Système de Positionnement Global (GPS) dans
un réseau de communication sans fil (10) vers des
stations mobiles, chaque station mobile communi-
quant dans un réseau de communication sans fil
(10) et comportant un récepteur GPS intégré pour
effectuer des mesures de positionnement GPS, le
système comprenant :

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| un émetteur-récepteur pour communiquer avec des stations mobiles dans le réseau de communication sans fil ; le système étant caractérisé par le fait qu'il comprend : un récepteur GPS (22) pour obtenir des informations de modélisation orbitale pour des satellites GPS visibles (24) et des données de correction GPS, une unité de commande de radiodiffusion fonctionnellement associée au récepteur GPS et à l'émetteur-récepteur pour établir sélectivement un canal direct point-à-point (28) avec des stations mobiles sélectionnées (20) pour transférer des informations de modélisation orbitale initiales et pour radiodiffuser périodiquement des mises à jour d'informations de modélisation orbitale et des données de correction GPS sur le réseau de communication sans fil (10) vers toutes les stations mobiles communiquant dans le réseau de communication sans fil (10).
| 17 | 18 |
| 19 | 20 |
| 21 | 22 |
| 23 | 24 |
| 25 | 26 |
l'unité de commande de radiodiffusion ajoute des données décrivant les relations entre des références temporelles respectives du réseau de communication sans fil (10) et le GPS, à des parties inutilisées de messages radiodiffusés.