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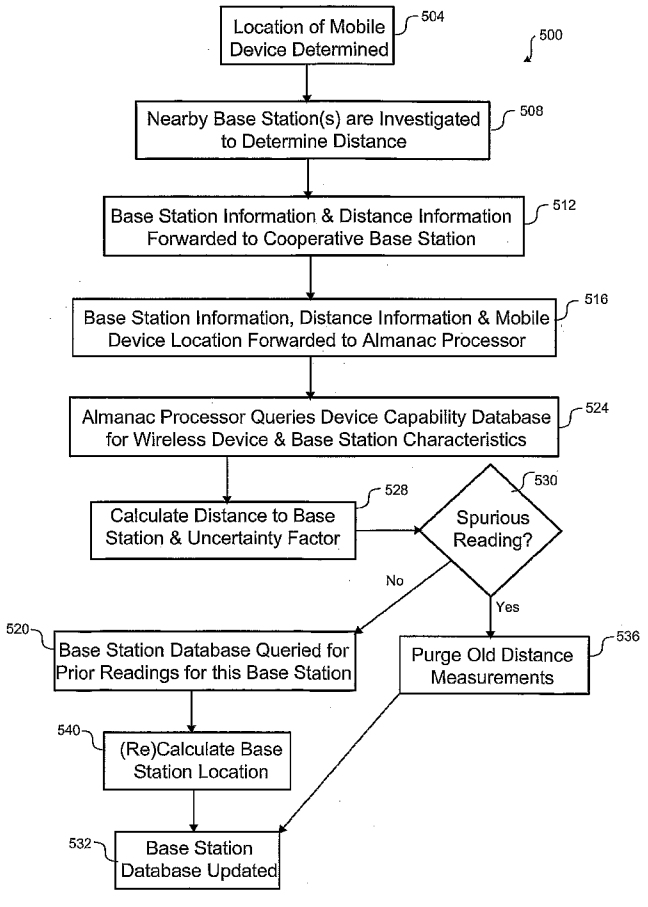
(54) Title: DYNAMIC LOCATION ALMANAC FOR WIRELESS BASE STATIONS



(57) Abstract: A system and method of dynamically updating an almanac of base stations with wireless phones that are controlled by end users. First, second, and third location information are received respectfully from a first, second, and third wireless phones. A position of each wireless device is known. The distance between each wireless device an uncooperative base station is determined while accounting for an uncertainty factor. A location of the uncooperative base station is calculated using the first, second, and third location information and the distances. The almanac is updated with the location.

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AMENDED CLAIMS
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1. A dynamic almanac system comprising:

machine-readable media including:

first location information indicative of a position of an uncooperative base station, the first location information based on information from a user-controlled wireless device in a first position, wherein the user-controlled wireless device in the first position is not authorized to freely transmit data or voice information using the uncooperative base station;

second location information indicative of the position of the uncooperative base station, the second location information based on information from a wireless device in a second position;

third location information indicative of the position of the uncooperative base station, the third location information based on information from a wireless device in a third position; and

an almanac processor configured to:

calculate measured location information of the uncooperative base station using the first, second, and third location information and information indicative of the first, second, and third positions,

assign a location uncertainty factor to the measured location information, and

update an almanac using the measured location information.

2. The dynamic almanac system of claim 1 wherein at least two of the wireless device in the first location, the wireless device in the second location, and the wireless device in the third location is the same wireless device in two different locations.

3. The dynamic almanac system of claim 1 wherein the almanac processor is further configured to determine that the uncooperative base station has moved.

4. The dynamic almanac system of claim 1 wherein at least two of the wireless device in the first location, the wireless device in the second location, and the wireless device in the third location is the same wireless device at two different times.

5. The dynamic almanac system of claim 1 wherein the almanac processor is co-located with a cooperative base station, wherein the user-controlled wireless device in the first position is authorized to freely transmit data or voice information or both using the cooperative base station.

6. The dynamic almanac system of claim 1 further comprising:

the wireless device in the first position;

the wireless device in the second position;

the wireless device in the third position; and

a cooperative base station in communication with at least two of the almanac processor and the wireless device in the first position, the wireless device in the second position, and the wireless device in the third position.

7. The dynamic almanac system of claim 1 wherein at least one of the wireless device in the first position, the wireless device in the second position, and the wireless device in the third position comprises at least one device type included in the group consisting of a tracking device, a child or parolee monitor, a navigational device, a wireless pager, and a wireless computer.

8. The dynamic almanac system of claim 1 wherein the first, second, and third positions are geographically separate.

9. A method for dynamically updating an almanac of base stations using a plurality of wireless devices that are controlled by end users, comprising:

receiving first location information from a wireless device of the plurality of wireless devices located at a first position, the first location information indicative of a position of an uncooperative base station with respect to the first location;

obtaining information indicative of the the first position;

receiving second location information from a wireless device of the plurality of wireless devices located at a second position, the second location information indicative of the position of the uncooperative base station with respect to the second location;

obtaining information indicative of the second position;

receiving third location information from a wireless device of the plurality of wireless devices located at a third position, the third location information indicative of the position of the uncooperative base station with respect to the third location;

obtaining information indicative of the third position;

assigning an associated uncertainty factor to at least one of the first, second, and third location information;

calculating a measured location of the uncooperative base station using the first, second, and third location information and the first, second, and third positions; and

updating the almanac using the measured location.

10. The method of claim 9 wherein said calculating comprises weighting at least one of the first, second, and third location information with the associated uncertainty factor.

11. The method of claim 9 wherein an uncertainty factor associated with the first distance is aged with time to indicate greater uncertainty.

12. The method of claim 9, further comprising:

ascertaining if ~~a~~ information received from at least one wireless device of the plurality of wireless devices indicates the uncooperative base station to be outside a predetermined threshold from the location; and wherein updating the almanac using the measured location comprises:

purging old location information from the almanac based upon said ascertaining; and

storing new location information indicative of the measured location.

13. The method of claim 9 further comprising:

ascertaining if information received from at least one ~~a~~ wireless device indicates the uncooperative base station is away from a previous location and within a predetermined threshold of variance from the location;

waiting for confirmation from another wireless device; and

wherein updating the almanac using the measured location comprises storing new location information and purging old location information indicative of the previous location if said ascertaining is confirmed during said waiting.

14. The method of claim 9 wherein at least one of the plurality of wireless devices includes at least one device type selected from the group consisting of a tracking device, a child or parolee monitor, a navigational device, a wireless pager, and a wireless computer.

15. The method of claim 9 wherein the uncooperative base station does not freely allow transport of data or voice or both transmitted by at least one of the wireless device located at the first position, the wireless device located at the second position, and the wireless device located at the third position.

16. A method for dynamically updating an almanac of base stations with wireless phones, comprising:

locating first, second, and third positions respectively of first, second, and third wireless phones;

estimating first, second, and third distances respectively between the first, second, and third wireless phones and an uncooperative base station that does not freely allow data and voice transport of at least one of the first, second, and third wireless phones;

reporting to a point away from the first, second, and third wireless phones first, second, and third location information that is respectively related to the first, second, and third distances;

determining measured location information for the uncooperative base station from the first, second, and third location information and the first, second, and third distances;

updating a location of the uncooperative base station included in the almanac using the measured location information;

wherein at least one of the first second, and third wireless phones is carried by an end user during said locating.

17. The method of claim 16 further comprising assigning an uncertainty factor to each of the first, second, and third distances.

18. The method of claim 16 wherein the first location information comprises information indicative of a unique identifier for the uncooperative base station.

19. The method of claim 16 wherein at least one of said assigning an uncertainty factor to each of the first, second, and third distances comprises assigning an uncertainty factor indicating increased uncertainty over time; and

wherein the reporting to a point away from the first, second, and third wireless phones comprises reporting to a cooperative base station.

20. The method of claim 16 wherein said estimating first, second, and third distances comprises estimating at least one of the first, second, and third distances at a location away from the associated wireless phone.

21. The method of claim 16 wherein said estimating first, second, and third distances comprises estimating at least one of the first, second, and third distances using the associated wireless phone.

22. The method of claim 16 wherein said determining measured location information is performed by a wireless phone.

23. The method of claim 16 wherein each of said estimating first, second, and third distances comprises:

receiving information indicative of a unique identifier for the uncooperative base station; and

presuming a distance to the uncooperative base station based upon at least one parameter selected from the group consisting of a response delay, a signal strength, and a signal range.

24. The method of claim 16 wherein the location of the uncooperative base station included in the almanac is adjusted over time with new measured location information from one or more wireless phones.

25. The method of claim 16 wherein older location information in the almanac is deemphasized over time.

26. The method of claim 16 wherein at least one of the first, second, and third wireless phones is owned by an end user.

27. The method of claim 16 wherein the uncooperative base station is a local area network base station.

28. The method of claim 16 wherein at least one of the first wireless phone, the second wireless phone, and the third wireless phone operates using a particular service provider, and wherein the uncooperative base station is a cellular phone base station for another service provider not under a roaming agreement with the service provider.

29. The method of claim 16 further comprising:

determining a likelihood the uncooperative base station will move from a current location of the uncooperative base station; and

preventing the measured location from being used in the almanac based on the likelihood.

30. A computer readable medium having computer-executable instructions for causing one or more machines to perform operations comprising:

receiving first information indicative of a location of a base station based on information from a wireless device in a first position;

receiving second information indicative of a location of the base station based on information from a wireless device in a second position;

receiving third information indicative of a location of the base station based on information from a wireless device in a third position;

associating an uncertainty factor with at least one of the first information, the second information, and the third information; and

updating a base station position database using the first information, the second information, the third information, and the uncertainty factor.

31. A dynamic almanac system configured to update an almanac of base stations with information from a plurality of wireless phones that are controlled by end users, comprising:

means for receiving first location information from a first wireless phone of the plurality of wireless phones, the first location information indicative of a separation between the first wireless phone and an uncooperative base station;

means for retrieving a first position of the first wireless phone;

means for receiving second location information from a second wireless phone of the plurality of wireless phones, the second location information indicative of a separation between the second wireless phone and the uncooperative base station;

means for retrieving a second position of the second wireless phone;

means for receiving third location information from a third wireless phone of the plurality of wireless phones, the third location information indicative of a separation between the third wireless phone and the uncooperative base station;

means for retrieving a third position of the third wireless phone, wherein at least one of the first, second, and third wireless phones is under control of an end user;

means for calculating a measured location of the uncooperative base station using the first, second, and third location information and the first, second, and third positions;

means for assigning a location uncertainty factor to the measured location; and

means for updating the almanac with the measured location.

32. The dynamic almanac system of claim 31 wherein the first wireless phone cannot freely use the uncooperative base station to transport data or voice.

33. The dynamic almanac system of claim 31, further comprising:

means for determining a first distance between the first position and the uncooperative base station using the first location information;

means for determining a second distance between the second position and the uncooperative base station using the second location information;

means for determining a third distance between the third position and the uncooperative base station using the third location information; and

wherein the means for calculating a measured location of the uncooperative base station using the first, second, and third location information and the first, second, and third positions comprises means for calculating the measured location of the uncooperative base station using the first, second, and third positions and the first, second, and third distances.