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PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Small Entity)

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INVENTOR(S)/APPLICANT(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
James	Fitch	Edmonds, Washington
David	Hose	Boulder, Colorado
Michael	McKnight	Westminster, Colorado

[ ] Additional inventors are being named on page 2 attached hereto

TITLE OF THE INVENTION (280 characters max)

"DATA FUSION FOR WIRELESS LOCATION-BASED APPLICATIONS"

CORRESPONDENCE ADDRESS

Direct all correspondence to:

[ ] Customer Number _____ → *Place Customer Number Bar Code Label here*

OR

[X] Firm *or* Individual Name	Holme Roberts & Owen LLP				
Address	1700 Lincoln Street, Suite 4100				
Address					
City	Denver	State	Colorado	ZIP	80203
Country	U.S.A.	Telephone	(303) 861-7000	Fax	(303) 866-0200

ENCLOSED APPLICATION PARTS (check all that apply)

[X] Specification	*Number of Pages*	34	[ ] Small Entity Statement
[X] Drawing(s)	*Number of Sheets*	7	[ ] Other (specify) _____

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Respectfully submitted

SIGNATURE *Kent A Fisch*   Date   11/03/1998

TYPED or PRINTED NAME   Kent A. Fischmann, Esq.

REGISTRATION NO. (if appropriate)   35,511

TELEPHONE   (303) 861-7000

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DATA FUSION FOR WIRELESS LOCATION-BASED APPLICATIONS

FIELD OF THE INVENTION

The present invention relates in general to wireless location-based applications and, in particular, to a method and apparatus for use in processing multiple location finding

5 equipment inputs and making the resulting location information available to wireless location-based applications.

BACKGROUND OF THE INVENTION

Wireless communications networks generally allow for communication between wireless stations, e.g., wireless telephones (analog, digital cellular and PCS), pagers or data

10 terminals that communicate using RF signals. In recent years, a number of location-based service systems have been implemented or proposed for wireless networks. Such systems generally involve determining location information for a wireless station and processing the location information to provide an output desired for a particular application.

Examples of such existing or proposed applications include emergency or "911"

15 applications, location dependent call billing and vehicle tracking. In 911 applications, the location of a wireless station is determined when the station is used to place an emergency call. The location is then transmitted to a local emergency dispatcher to assist in responding to the call. In typical location dependent call billing applications, the location of a wireless station is determined, for example, upon placing or receiving a call. This location is then

20 transmitted to a billing system that determines an appropriate billing value based on the location of the wireless station. Vehicle tracking applications are used, for example, to track the location of stolen vehicles. In this regard, the location of a car phone or the like in a stolen vehicle can be transmitted to the appropriate authorities to assist in recovering the vehicle.

25 From the foregoing, it will be appreciated that location-based service systems involve location finding equipment (LFE) and location-related applications. To some extent, the LFEs and applications have developed independently. In this regard, a number of types of LFEs exist and/or are in development. These include so-called angle of arrival (AOA) time delay of arrival (TDOA), handset global positioning system (GPS) and cell/sector equipment.

The types of equipment employed and the nature of the information received from such equipment vary in a number of ways. First, some of these equipment types, like GPS, are wireless station-based whereas others are "ground-based", usually infrastructure-based. Some can determine a wireless station's location at any time via a polling process, some

5   require that the station be transmitting on the reverse traffic channel (voice channel), and others can only determine location at call origination, termination, and perhaps registration. Moreover, the accuracy with which location can be determined varies significantly from case to case. Accordingly, the outputs from the various LFE's vary in a number of ways including data format, accuracy and timeliness.

10   The nature of the information desired for particular applications also varies. For example, for certain applications such as 911, accuracy and timeliness are important. For the applications such as vehicle tracking, continuous or frequent monitoring independent of call placement is a significant consideration. For other applications, such as call billing, location determination at call initiation and call termination is generally sufficient.

15   Heretofore, developers have generally attempted to match available LFEs to particular applications in order to obtain the location information required by the application. This has not always resulted in the best use of available LFE resources for particular applications. Moreover, applications designed to work with a particular LFE can be disabled when information from that LFE is unavailable, e.g., due to limited coverage areas,

20   malfunctions or local conditions interfering with a particular LFE modality. In addition, the conventional query and response mode of operation between applications and the associated LFEs has resulted in the use by applications of LFE dependent data formats, LFE limited data contents, and single LFE input location determinations.

SUMMARY OF THE INVENTION

25   The present invention is directed to a method and apparatus for using multiple LFE inputs to enhance the location information made available to wireless location-based applications. The invention allows wireless location-based applications access to information based inputs from LFEs of different types, thereby enhancing the timeliness, accuracy and/or reliability of the requested location information. Moreover, in accordance

30   with the present invention, applications are independent of particular LFEs and can access

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multiple LFEs receiving a location request from a wireless location application seeking LFE independent location data (i.e., location data having a content and format independent of any particular location finding technology) and responding to the location request based on LFE dependent location data. The process implemented by the processing system may further

5   involve generating and storing LFE independent location data based on the LFE dependent data. The processing system may be resident on the location finding controllers associated with each LFE, on a separate platform and/or the processing system functionality may be distributed over multiple platforms.

According to a still further aspect of the present invention, multiple LFE inputs, are

10   utilized to make a location determination regarding a wireless station. The corresponding method involves the steps of receiving a first location input from a first LFE including first location information and first uncertainty information, receiving a second location input from a second LFE including second location information and second uncertainty information and combining the first and second location inputs to provide a combined location input

15   including combined location information and uncertainty information based on the first and second inputs. Preferably, the first and second inputs include raw location and uncertainty information obtained from LFE measurements prior to aggregation and related processing. One or both of the first and second inputs may constitute partial information, insufficient on its own to yield a location and uncertainty regarding the wireless station within the

20   requirements of the wireless location application. For example, in the case of LFEs that determine location based on readings obtained from two or more cell sites, a reading from one of the cell sites may be used in conjunction with, e.g., cell sector information to make a location determination.

According to another aspect of the present invention, multiple LFE inputs, obtained

25   at different times from the same or different LFEs, are utilized to derive tracking information improved location determination accuracy. The associated method includes the steps of receiving a first LFE input including first location information and first corresponding time information for a particular wireless station, receiving a second LFE input including second location information and second time information for the wireless station, and using the first

30   and second inputs to derive tracking information for the wireless station. The tracking information preferably includes information regarding the mobile station's speed of travel

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