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Hoffberg

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(54) **MOBILE COMMUNICATION DEVICE**

(76) Inventor: **Steven M. Hoffberg**, 29 Buckout Rd., West Harrison, NY (US) 10604

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(58) **Field of Search** 342/457, 357.06, 342/357.1, 357.13, 357.07; 701/207, 208, 213

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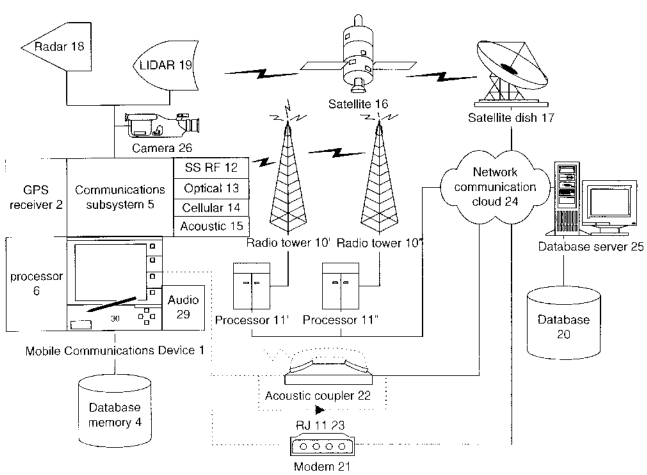
Primary Examiner—Thomas H. Tarcza
Assistant Examiner—Dao L. Phan
(74) *Attorney, Agent, or Firm*—Milde, Hoffberg & Macklin, LLP

(57) **ABSTRACT**

A mobile communications device comprising a location sensing system, producing a location output; a memory, storing a set of locations and associated events; a telecommunications device, communicating event and location information between a remote system and said memory; and a processor, processing said location output in conjunction with said stored locations and associated events in said memory, to determine a priority thereof.

43 Claims, 2 Drawing Sheets



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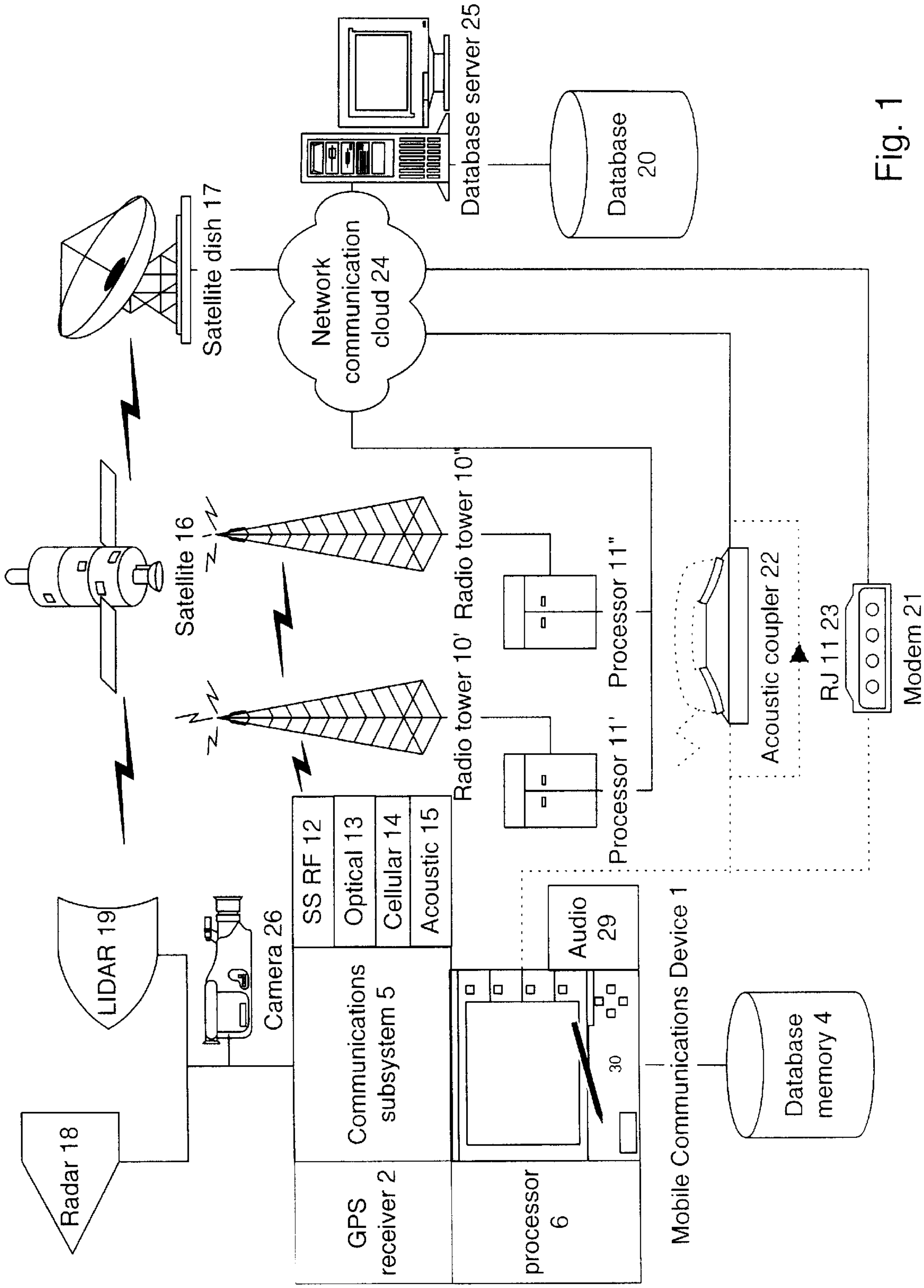
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Mobile Communications Device 1
Database memory 4

Fig. 1

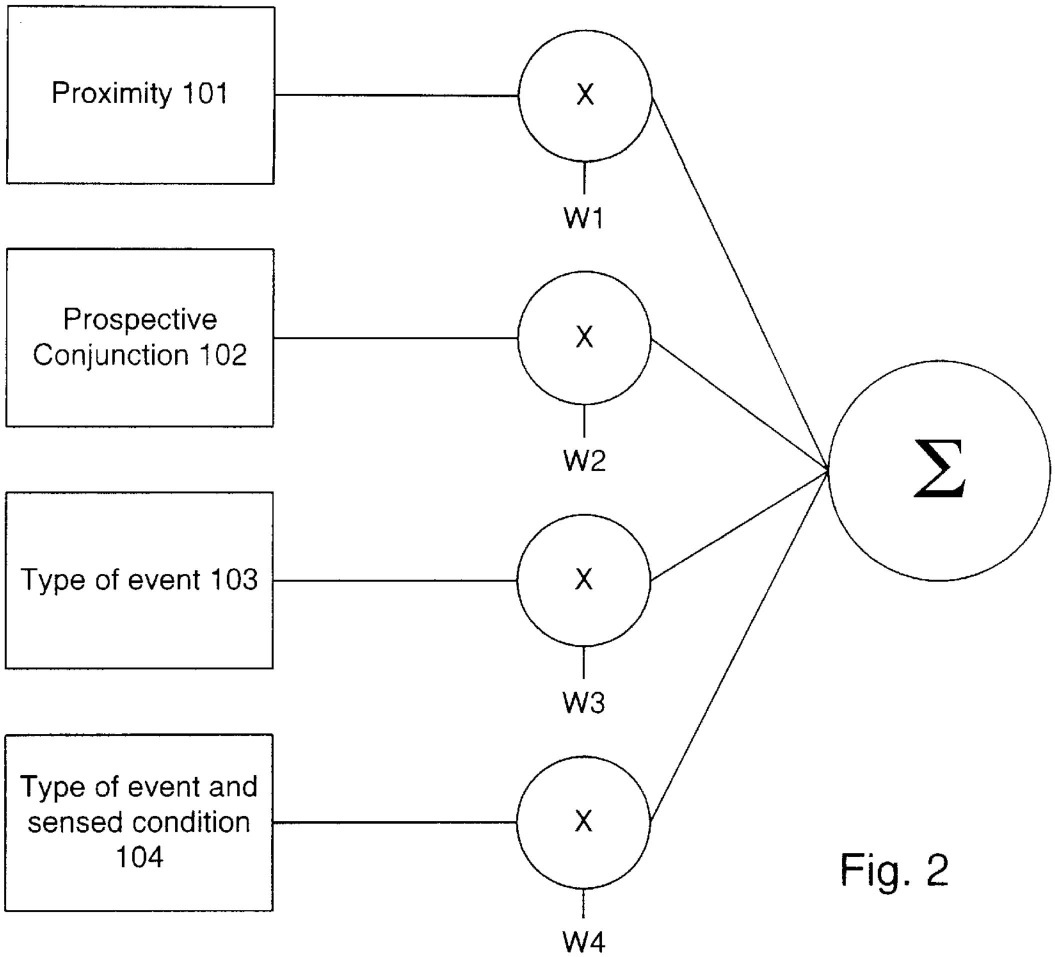
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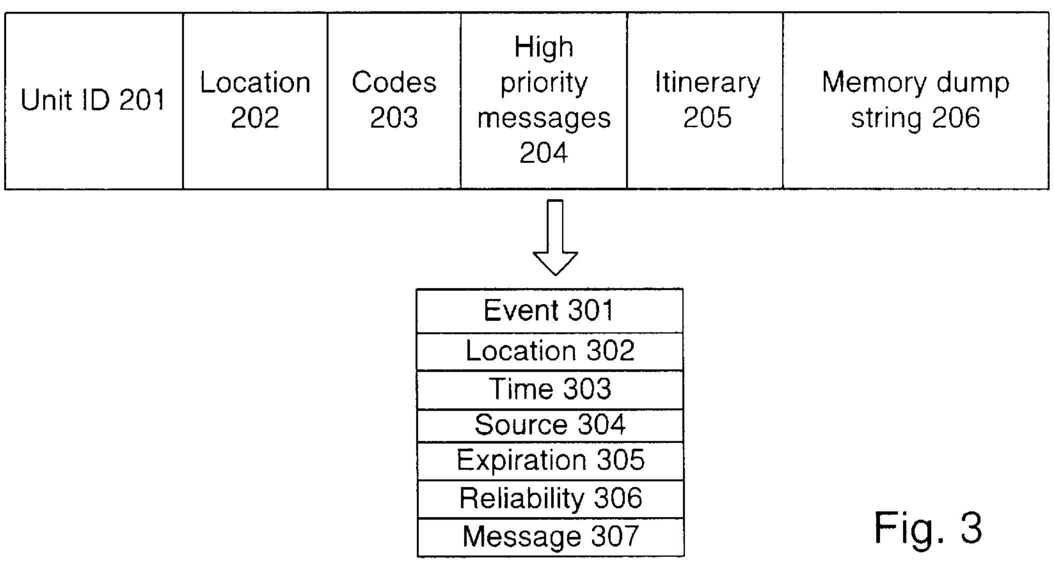
Fig. 2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Reliability 306
Message 307

Fig. 3

MOBILE COMMUNICATION DEVICE

The present application claims the benefit of priority from U.S. Provisional Patent Application Ser. No. 60/072,757, the entirety of which is incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to the field of communications devices, and more particularly to mobile telecommunications devices having position detection and event storage memory.

BACKGROUND OF THE INVENTION

A number of devices are known which provide mobile telecommunication capabilities. Further, known position detection systems employ the known Global Positioning System (GPS), Global Orbiting Navigational System (GLONASS), Loran, RF triangulation, inertial frame reference and Cellular Telephone base site, e.g., time difference of arrival (TDOA) or nearest antenna proximity systems. Known GPS mobile systems include memory to record location, time and event type, and some systems may be integrated with global information systems, to track path, speed, etc. Known Differential GPS (DGPS) systems include mobile telecommunication functionality to communicate between distant units, typically to allow very precise relative position measurements, in the presence of substantial absolute position errors, or to calibrate the position of a mobile transceiver based on a relative position with respect to a fixed transceiver having a known location. These systems do not typically intercommunicate event information between units. Thus, the communications streams relate to position information only. However, known weather balloon transceiver systems, for example, do transmit both position and weather information to a base station.

Many electronic location determination systems are available, or have been proposed, to provide location information to a user equipped with a location determination receiver. Groundbased location determination systems, such as Loran, Omega, TACAN, Decca, U.S. Airforce Joint Tactical Information Distribution System (JTIDS Relnav), or U.S. Army Position Location and Reporting System (PLRS), use the intersection of hyperbolic surfaces to provide location information. A representative ground system is LORAN-C discussed in LORAN-C User Handbook, Department of Transportation, U.S. Coast Guard, Commandant Instruction M16562.3, May 1990, which is incorporated by reference herein. LORAN-C provides a typical location accuracy of approximately 400 meters. A limitation of a LORAN-C location determination system is that not all locations in the northern hemisphere, and no locations in the southern hemisphere, are covered by LORAN-C. A second limitation of LORAN-C is that the typical accuracy of approximately 400 meters is insufficient for many applications. A third limitation of LORAN-C is that weather, local electronic signal interference, poor crossing angles, closely spaced time difference hyperbolas, and skywaves (multipath interference) frequently cause the accuracy to be significantly worse than 400 meters.

Other ground-based location determination devices use systems that were developed primarily for communications, such as cellular telephone, FM broadcast, and AM broadcast. Some cellular telephone systems provide estimates of location, using comparison of signal strengths from three or more sources. FM broadcast systems having subcarrier

signals can provide estimates of location by measuring the phases of the subcarrier signals. Kelley et al. in U.S. Pat. No. 5,173,710 disclose a system that allows determination of a location of a vehicle. FM subcarrier signals are received from three FM radio stations with known locations but unknown relative phases by signal processors at the vehicle as well as at a fixed station having a known location. The fixed station processor determines the relative phase of the signals transmitted by the three FM radio stations and transmits the relative phase information to the vehicle. The vehicle processor determines its location from the FM subcarrier signal phases and from the relative phase information it receives. A limitation of cellular systems and FM subcarrier systems for location determination is that they are limited to small regions, with diameters of the order of 20–50 km.

Satellite-based location determination systems such as GPS and GLONASS, use the intersection of spherical surface areas to provide location information with a typical (selective availability) accuracy of 100 meters, anywhere on or near the surface of the earth. These systems may also be used to obtain positional accuracies within 1 centimeter. The satellite-based location determination systems include satellites having signal transmitters to broadcast location information and control stations on earth to track and control the satellites. Location determination receivers process the signals transmitted from the satellites and provide location information to the user.

The Global Positioning System (GPS) is part of a satellite navigation system developed by the United States Defense Department under its NAVSTAR satellite program. A fully operational GPS includes up to 24 satellites approximately uniformly dispersed around six circular orbits with four satellites each, the orbits being inclined at an angle of 55°, relative to the equator, and being separated from each other by multiples of 60° longitude. The orbits have radii of 26,560 kilometers and are approximately circular. The orbits are non-geosynchronous, with 0.5 sidereal day (11.967 hours) orbital time intervals, so that the satellites move with time, relative to the Earth below. Theoretically, four or more GPS satellites will have line of sight to most points on the Earth's surface, and line of sight access to three or more such satellites can be used to determine an observer's position anywhere on the Earth's surface, 24 hours per day. Each satellite carries a cesium or rubidium atomic clock to provide timing information for the signals transmitted by the satellites. Internal clock correction is provided for each satellite clock.

A second configuration for global positioning is GLONASS, placed in orbit by the former Soviet Union and now maintained by the Russian Republic. GLONASS also uses 24 satellites, distributed approximately uniformly in three orbital planes of eight satellites each. Each orbital plane has a nominal inclination of 64.8° relative to the equator, and the three orbital planes are separated from each other by multiples of 120° longitude. The GLONASS circular orbits have smaller radii, about 25,510 kilometers, and a satellite period of revolution of $8/17$ of a sidereal day (11.26 hours). A GLONASS satellite and a GPS satellite will thus complete 17 and 16 revolutions, respectively, around the Earth every 8 sidereal days. The signal frequencies of both GPS and GLONASS are in L-band (1 to 2 GHz).

Because the signals from the satellites pass through the troposphere for only a short distance, the accuracy of satellite location determination systems such as GPS or GLONASS is largely unaffected by weather or local anomalies. A limitation of GLONASS is that it is not clear that the

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