



(12) **United States Patent**
Camp

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(54) **LOCATION SYSTEM COMBINING RANGING MEASUREMENTS FROM GPS AND CELLULAR NETWORKS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/315,002**

(22) Filed: **May 19, 1999**

Related U.S. Application Data

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(51) **Int. Cl.**⁷ **G01S 5/02**; H04B 7/185

(52) **U.S. Cl.** **342/357.06**; 342/357.01; 342/450; 342/463; 701/213; 455/422; 455/426; 455/427; 455/456; 455/457; 327/291

(58) **Field of Search** 342/357.01-357.17, 342/450-465; 455/403, 422, 426, 427, 432, 433, 456, 457; 380/247-250, 255, 270-273, 31-34, 274; 701/200, 207, 213-216; 331/46-56; 327/291, 293, 298; 377/106

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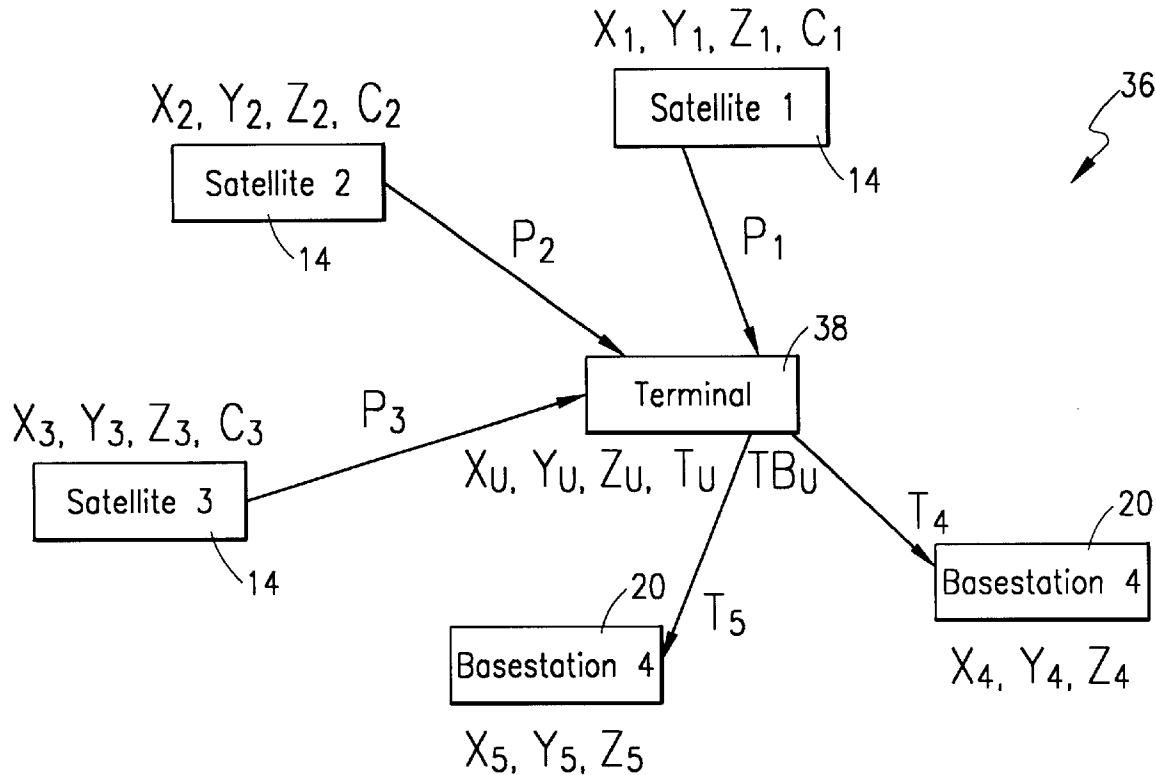
Primary Examiner—Bernarr E. Gregory

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(57) **ABSTRACT**

Methods and arrangements are provided for locating a mobile terminal within a mobile telecommunications system. In certain embodiments, GPS ranging signals and cellular base station transmitted downlink signals are received by a mobile terminal, which is configured to determine its current location using a combination of these two types of ranging signals. In certain other embodiments, GPS ranging signals are received by the mobile terminal, which is also configured to transmit uplink signals to cellular base stations. The current location of the mobile station is determined by fusing measured data from each of these different ranging signal transmissions. By combining the available resources of satellite and terrestrial locating processes, the potential for locating a mobile terminal is significantly increased.

26 Claims, 6 Drawing Sheets



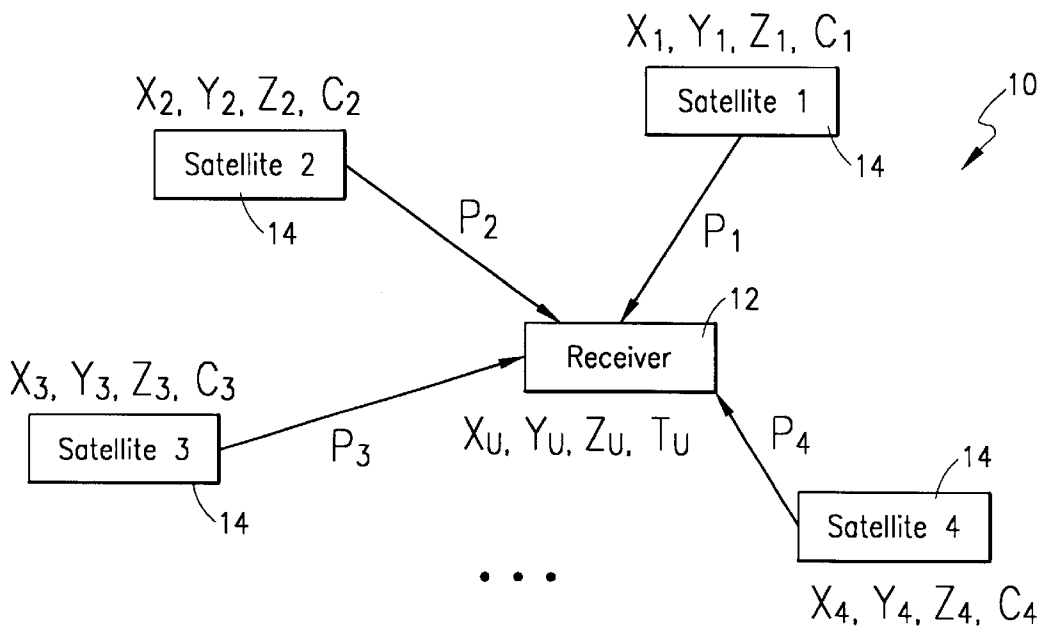


FIG. 1

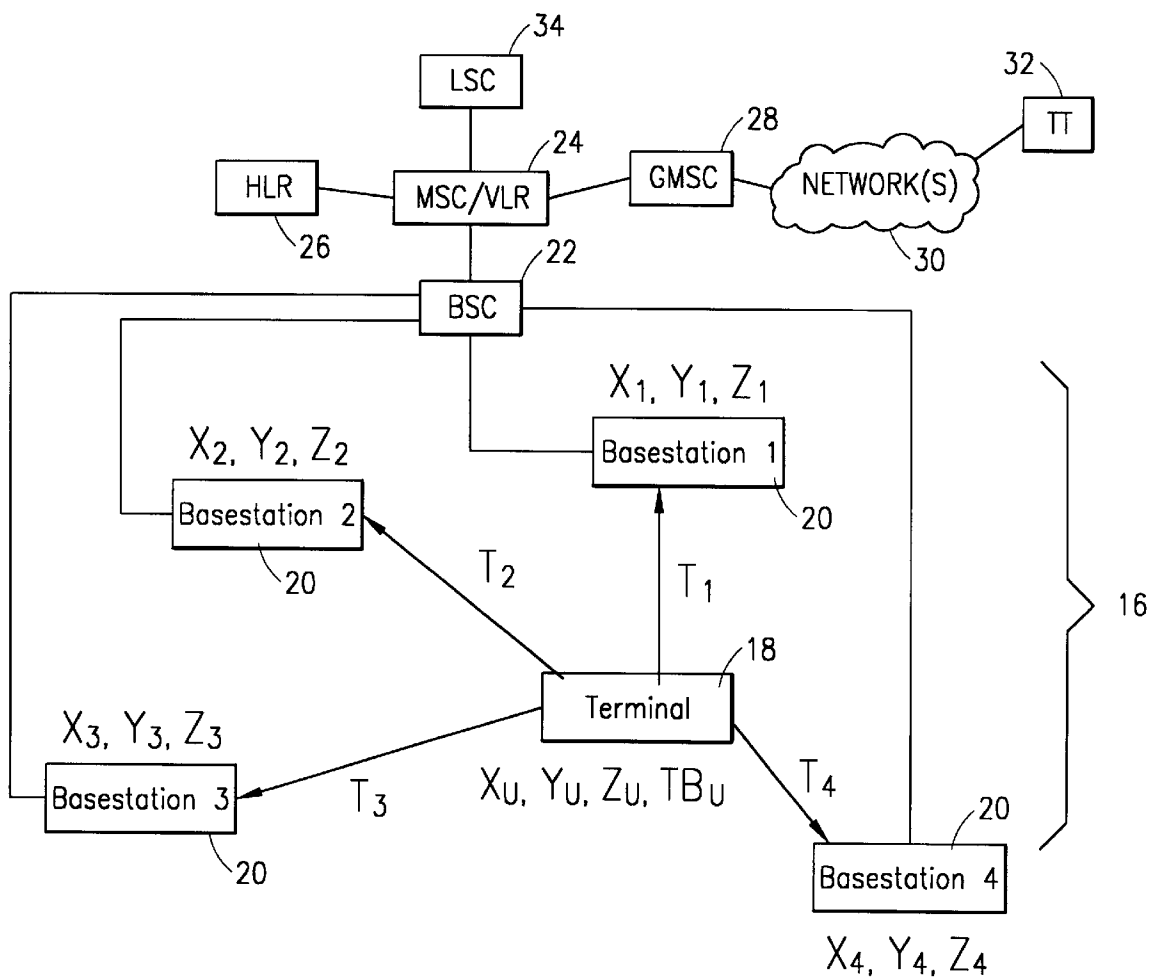


FIG. 2

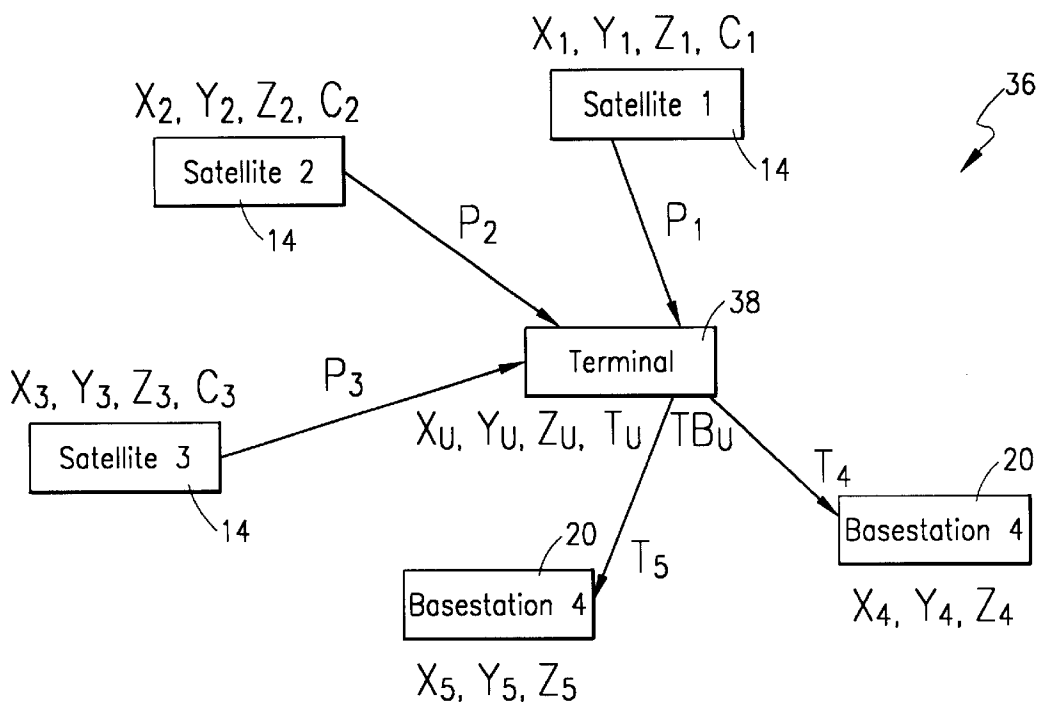


FIG. 3

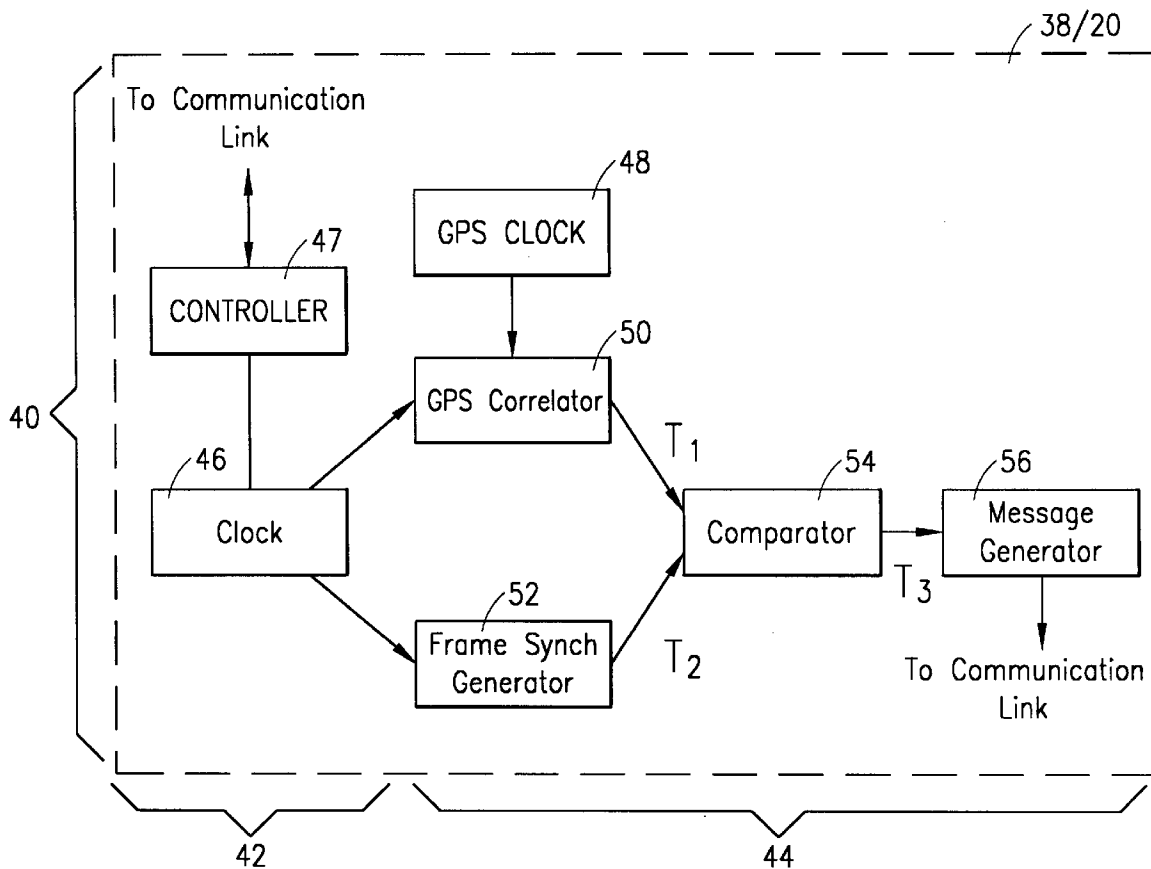


FIG. 4

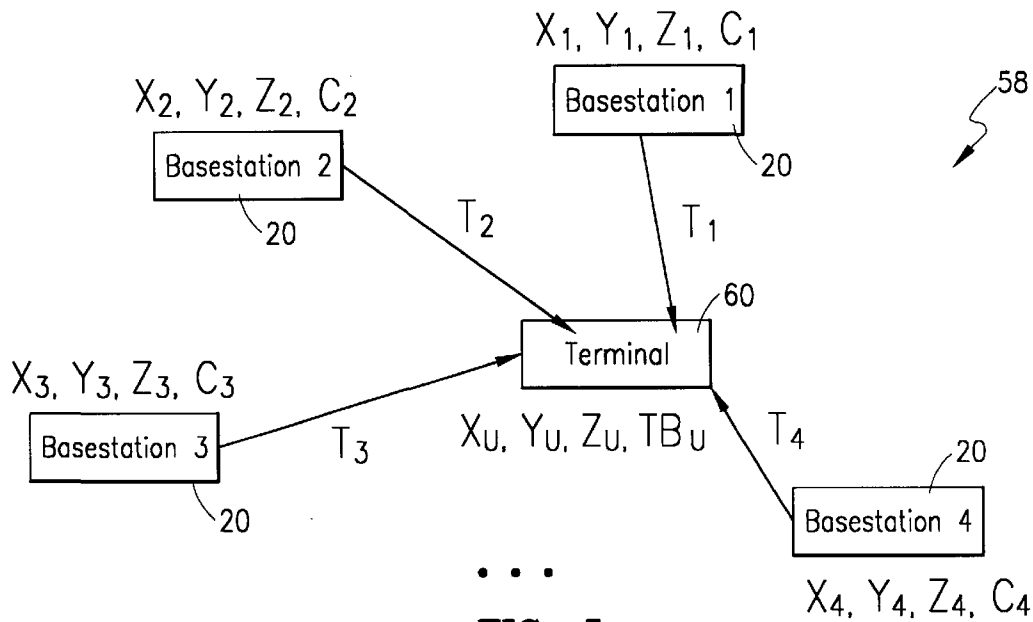


FIG. 5

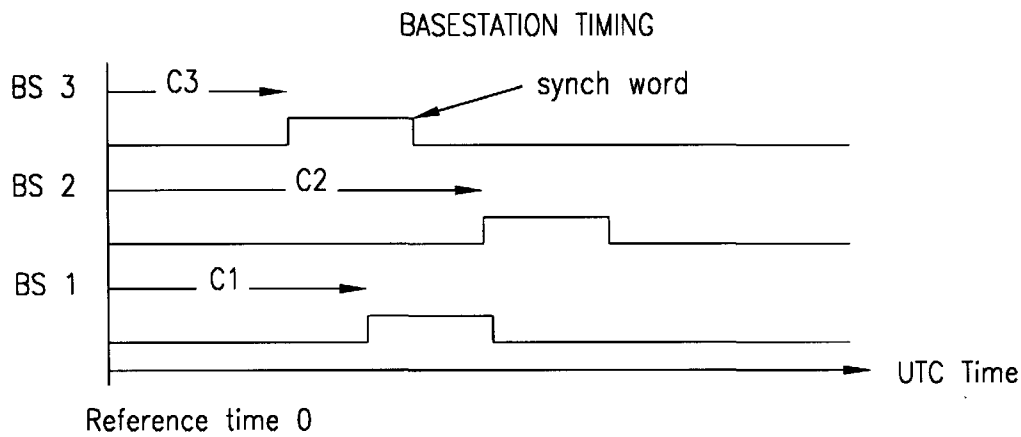


FIG. 6

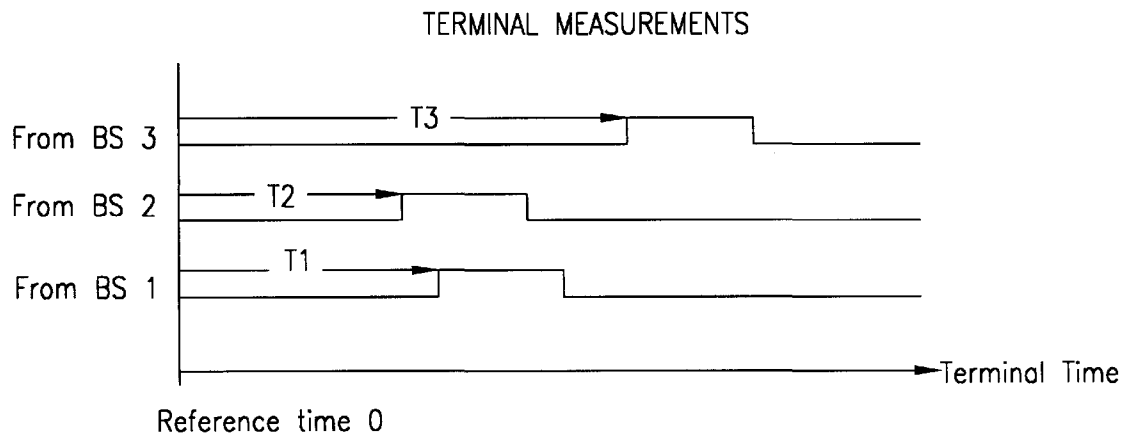


FIG. 7

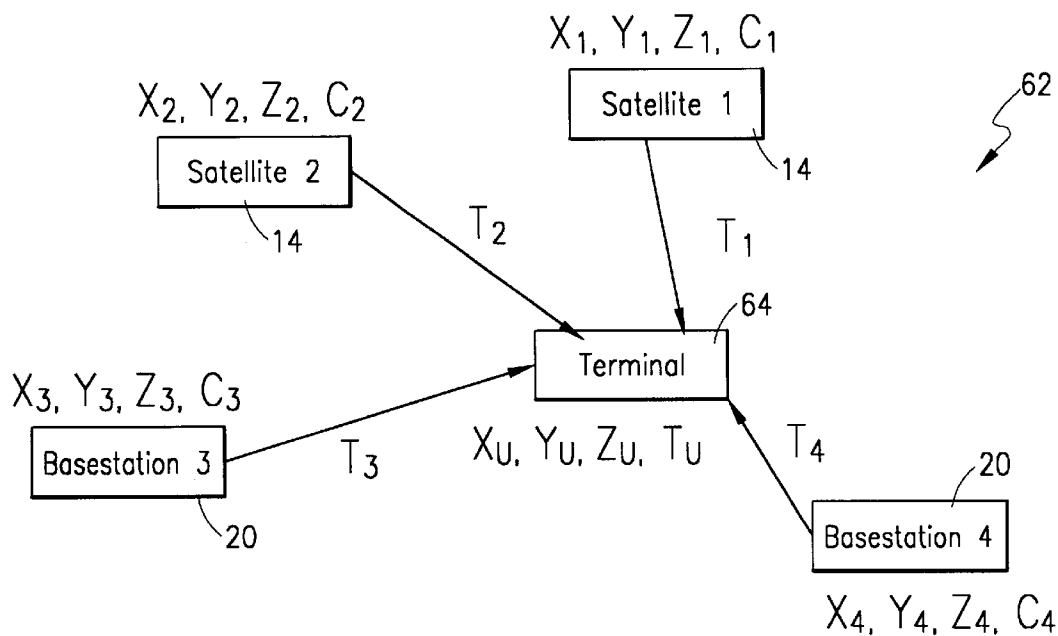


FIG. 8

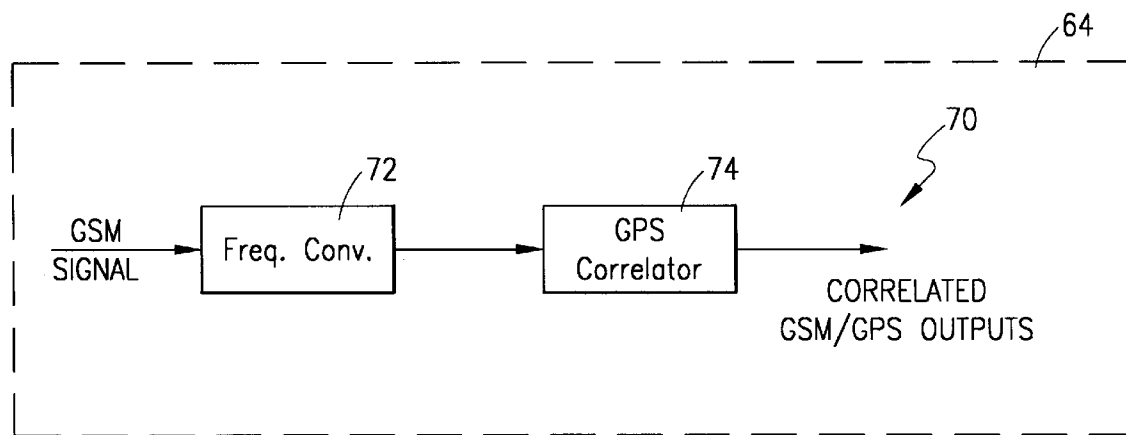


FIG. 9

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