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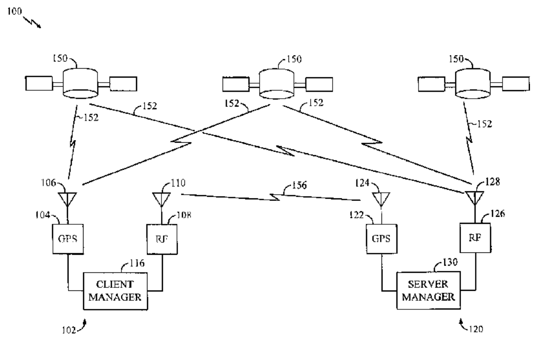
(54)【発明の名称】無線ネットワークにおけるサーバ支援された位置決定システムと方法この出願は、２００１年３月９日に提出され、引用によりこの中に組込まれる、未決定の仮出願番号第６０／２７４，４９

(57)【要約】
この発明の原理に従って、クライアント・ユニット（１０２）は、双方向無線トランシーバ（１０８）および特に位置または状況が非支援の固定を不可能または非実用的にする、サーバ支援されたグローバル・ポジション固定を実行するためのマネージャ（１１６）と統合されるクライアントＧＰＳ受信器（１０４）を具備する。サーバ・ユニット（１２０）もまた、第２の双方向無線トランシーバ（１２６）およびサーバ・マネージャ（１３０）と関連して供給される。第１および第２のマネージャ（１１６および１３０）は通信マネージャとして機能し、それぞれＲＦチャネル・トラフィックを検出するためのモジュールを備えて、トランシーバ（１０８および１２６）の送信器部をイネーブルにする。システムはまたクライアント・ユニットを識別するためにクライアント・ユニットから基地局に送られたデータを添える識別符号を供給することができる。
【選択図】図１



【特許請求の範囲】
【請求項１】
下記を具備するサーバ支援された位置検出システム：
グローバル・ポジショニング・システム（ＧＰＳ）衛星から第１セットの衛星ポジショニング信号データを受信するための、クライアントＧＰＳ受信器回路、該第１セットのデータは該クライアントＧＰＳ受信器の位置を独立して確立するには不十分である；
該第１セットのデータを送信するためのクライアント送信器；
無線周波数（ＲＦ）チャネル上の無線トラフィックを検出するためのクライアント・キャリヤ検出モジュール；
無線トラフィックが該ＲＦチャネル上で検出されない時に該クライアント送信器をイネーブルにするためのクライアント送信イネーブル・モジュール；
該クライアント送信器から該第１セットのデータを受信するためのサーバ受信器；および
該サーバ受信器に連結され、該サーバ受信器により受信された該衛星データを分析するように構成されたサーバ、該サーバは該クライアントＧＰＳ受信器の該位置に関する位置情報を生成するために該第１セットのデータおよび付加的な衛星ポジショニング信号データを使用する。
【請求項２】
該付加的な衛星ポジショニング信号データを生成するために該サーバに関連する付加的なＧＰＳ受信器回路をさらに具備する、請求項１のシステム。
【請求項３】
該クライアント送信器を識別する独特の符号を生成するためにクライアント識別子モジュールをさらに具備する、請求項１のシステム。
【請求項４】
該クライアント・キャリヤ検出モジュールおよび該クライアント送信イネーブル・モジュールがクライアント・プロセッサにより実行される一連のプログラム命令を備える該クライアント・プロセッサをさらに具備する、請求項１の装置。
【請求項５】
該位置情報を表示するための表示スクリーンおよびキーボードを備える、サーバ・ユーザ・インターフェイス・モジュールをさらに具備する、請求項１の装置。
【請求項６】
該サーバ・ユーザ・インターフェイス・モジュールは該位置情報を指示するためのローカル・マップの表記を備える請求項５の装置。
【請求項７】
下記をさらに具備する、請求項１の装置；
該位置情報を受信するためのクライアント受信器；
該クライアント受信器に該位置情報を送信するためのサーバ送信器；
ＲＦチャネル上の無線トラフィックを検出するためのサーバ・キャリヤ検出モジュール；および
無線トラフィックが該ＲＦチャネル上で検出されない時に該サーバ送信器をイネーブルにし、それにより該クライアント受信器に該位置情報を送信するためのサーバ送信イネーブル・モジュール。
【請求項８】
該位置情報を表示するためのディスプレイを備える、クライアント・ユーザ・インターフェイスをさらに具備する、請求項７の装置。
【請求項９】
該クライアント・ユーザ・インターフェイスが該位置情報を指示するためのローカル・マップの表記をさらに具備する請求項８の装置。
【請求項１０】
該ベース・キャリヤ検出モジュールおよびベース送信イネーブル・モジュールはベース・プロセッサにより実行される一連のプログラム命令を備える該ベース・プロセッサをさら

に具備する、請求項７の装置。
【請求項１１】
下記を具備する、サーバ支援された位置検出の方法：
クライアント・ユニットの位置を要求する；
該位置要求に応じて該クライアント・ユニットで複数の衛星グローバル・ポジション信号を検出する；
該複数の衛星信号のセグメントを獲得する；
双方向無線を介してサーバ・ユニットに該獲得された衛星信号を表示するデータパケットを送信する；
該衛星信号セグメントの分析により該クライアント・ユニットの該位置を決定する；
ユーザ・インターフェイスで該クライアント・ユニットの該位置を表示する。
【請求項１２】
下記を備える該局に該データ・パケットを送信する請求項１０の方法：
選択された無線周波数（ＲＦ）チャネル上に現存する無線トラフィックを検出するために該選択されたＲＦチャネルを監視する；および
現存無線トラフィックが無い時は、該クライアント・ユニットから該選択されたＲＦチャネル上の該サーバ・ユニットに該データパケットを送信する。
【請求項１３】
該送信されたデータ・パケットに識別データを付加することをさらに具備する請求項１２の方法、該識別データは該クライアント・ユニットの独特の識別を提供する。
【請求項１４】
下記をさらに具備する、請求項１１の方法：
選択された無線周波数（ＲＦ）チャネル上に現存する無線トラフィックを検出するために該選択されたＲＦチャネルを監視する；および
現存無線トラフィックが無い時は、該サーバ・ユニットから該選択されたＲＦチャネル上の該クライアント・ユニットに該位置情報を送信する。
【請求項１５】
該位置要求が該クライアント・ユニットで生起する請求項１１の方法、該方法は該双方向無線を介して該クライアント・ユニットに該位置を指示するデータを送信することをさらに具備する。
【請求項１６】
下記を備える、該クライアント・ユニットに該位置データを送信する請求項１５の方法：
該位置データを位置情報パケット中に組み込む；
選択された無線周波数（ＲＦ）チャネル上に現存する無線トラフィックを検出するために該選択されたＲＦチャネルを監視する；および
現存無線トラフィックが無い時は、該サーバ・ユニットから該選択されたＲＦチャネル上の該クライアント・ユニットに該位置情報パケットを送信する。
【請求項１７】
該位置情報パケットに識別データを付加することをさらに具備する請求項１６の方法、該識別データは該クライアント・ユニットの独特の識別を提供する。
【請求項１８】
該クライアント・ユニットで複数の衛星グローバル・ポジション信号を検出することおよび該位置要求の受信に先立ってセグメントが獲得される、請求項１１の方法。
【請求項１９】
該複数の衛星グローバル・ポジション信号を該クライアント・ユニットで検出することおよびセグメントの獲得が周期的に実行されること、および要求を受信するステップに続いて該サーバにデータ・パケットを送信することは直近のデータ・パケットを送信することを備える、請求項１８の方法。
【請求項２０】
該ユーザ・インターフェイスは該クライアント・ユニットの一部であることおよび該クラ

イアント・ユニットの該位置を表示することは該位置をディスプレイ上に表示することを備える請求項１１の方法。
【請求項２１】
ローカル・マップを表示することおよび該クライアント・ユニットの該位置を該ローカル・マップ上に表示することをさらに具備する、請求項２０の方法。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は一般に位置決定に関し、特に、無線ネットワークにおけるサーバ支援された(sever-assisted)位置決定技術に関する。
【背景技術】
【０００２】
グローバル・ポジショニング・システム（ＧＰＳ）受信器は様々なＧＰＳ（またはＮＡＶＳＴＡＲ）衛星から同時に送信された信号の相対到着時間を計算することにより、それらの位置を正常に決定する。これらの衛星は、それらのメッセージの部分として、“天体暦”データと呼ばれる、クロックタイミング上のデータと同様に両衛星ポジショニング・データを送信する。ＧＰＳ信号を探索して取得すること、様々な衛星に関する天体暦データを読み取ることおよびこのデータから受信器の位置を計算することの処理は時間を消費しており、しばしば数分を必要としている。多くの場合、この長い処理時間は受入れられず、さらに、超小型化携帯用における電池寿命を大いに限定する。
【０００３】
最近のＧＰＳ受信器の他の限界は、複数の衛星が障害物無しの明瞭な視界内にあり、そして良好な品質のアンテナがそのような信号を受信するために正確に配置されている状態に、好結果の動作が限定されることである。そのように、それらは携帯用、ボディ装着用の用途において、有意な群葉や建物妨害のある地域（例えば、都会の谷間）内、および建物内の適用においては正常に使用できない。
【０００４】
この問題への１つの既知の解答は、ＧＰＳ受信器と統合された、セルラ電話機の使用を含んでいる。セルラ・リンクは、移動ＧＰＳユニット、またはクライアントと、第２のセルラ・ユニットおよびコンピュータ・プロセッサ、またはサーバと関連するところの第２の、固定式の、ＧＰＳ受信器との間に確立される。移動ＧＰＳ受信器は使用可能な衛星信号のスナップショット(anapshot)と呼ばれるものを得る。すなわち、移動ＧＰＳ受信器は視界のその線内で使用できるほど多くの衛星からの短期間の信号を記録する。上述されたように、これらの信号は、建物または群葉等に極めて接近している可能性がある移動ＧＰＳ受信器の位置によって、減衰されて断片的にされ得る。
【０００５】
特許文献１（米国特許番号第６，１３１，０６７号）に記述された１つの既知の方法により、これらの断片的な信号はディジタル化されて、セルラ・リンクを介して、クライアントから第２のＧＰＳ受信器およびサーバに送信される。その間に、第２のＧＰＳ受信器はそれ自身のアンテナの視界線内のＧＰＳ衛星からの信号を記録しており、そのアンテナは固定搭載式のアンテナであり、それは使用可能な衛星からの送信を妨害無しで受信する位置に置かれる。第２のＧＰＳ受信器に関連するサーバはその後２つの受信器の信号を比較する仕事をする。第２のＧＰＳ受信器により受信された完全な信号に対して移動ＧＰＳ受信器からの断片的な信号を分析することによって、サーバは本質的に“空白を埋め”て、移動ＧＰＳ受信器で受信された信号を完成することができる。サーバはその後これらの復元された信号を得ることができ、そして既知の方法を使用して、移動ＧＰＳ受信器の位置を正確に決定することができる。
【特許文献１】
米国特許番号第６，１３１，０６７号
【発明の開示】

【発明が解決しようとする課題】

【０００６】

第２のＧＰＳ受信器または基地局により供給される支援の量は有意に変更できる。それはマッチング処理および前述されたような信号分析を実行するまで、特定の衛星に関する蓄積された情報を同様に少量送信している可能性がある。しかしながらすべての場合に、サーバ支援された位置付け技術はセルラ・リンクか、双方向通信リンクがクライアントとサーバとの間に連続的に確立されるような何か他の専用の送信メディアの使用を必要とする。

【０００７】

他の環境では、セルラ電話網は使用できず、そして無線通信が当事者間に提供される。当分野の技術者が認めることができるように、無線通信は選択された周波数で送信する単一の送信器および送信された信号を検出することができる選択された周波数に同調されたいずれかの受信器と断続する。送信器が送信を完了した時には、選択された周波数はいずれか他の送信器により利用可能である。このように、特定の周波数またはチャネルはいずれかの送信器も利用できる。上述されたサーバ支援された位置付け技術は無線通信のための従前の双方向無線において実施されることはできず、指定された双方向通信リンクを許可しない。したがって、双方向無線システムにおいてサーバ支援された位置技術(location technology)についての重要な要求が認められ得る。本発明はこの、そして下記の詳細説明と添付の図とから明白になるであろうように、他の利点を提供する。

【課題を解決するための手段】

【０００８】

サーバ支援された位置検出装置はグローバル・ポジショニング・システム（ＧＰＳ）衛星から衛星ポジショニング信号データを受信するためのクライアントＧＰＳ受信器回路を具備する。クライアントＧＰＳ受信器により受信された衛星位置データはクライアントＧＰＳ受信器の位置を独立して(independently)確立するには不十分である。クライアントは衛星データを送信するための送信器をさらに備える。クライアント・キャリヤ検出モジュールは選択された無線周波数（ＲＦ）チャネル上の無線トラフィックを検出するために使用される。クライアント送信イネーブル・モジュールはＲＦチャネル上に無線トラフィックが検出されない時にクライアント送信器をイネーブルにする。

【０００９】

サーバ受信器はクライアント送信器からデータを受信する。サーバ受信器に連結されたサーバはサーバ受信器により受信された衛星データを分析するように構成される。サーバはクライアントＧＰＳ受信器の位置に関する位置情報を生成するために、受信された衛星データおよび付加的な衛星データを使用する。

【００１０】

位置情報は遠隔的に使用されるかクライアント・ユニットに戻されてもよい。位置情報をクライアント・ユニットに戻すために、システムは位置情報を受信するためのクライアント受信器と、クライアント受信器に位置情報を送信するためのサーバ送信器とをさらに具備する。サーバ・ユニットはＲＦチャネル上の無線トラフィックを検出するためのサーバ・キャリヤ検出モジュールと、無線トラフィックをＲＦチャネル上で検出しない時にサーバ送信器をイネーブルにし、それによってクライアント受信器に位置情報を送信するためのサーバ送信イネーブル・モジュールとをさらに具備する。代替の実施形態では、クライアントは位置情報を表示するためのクライアント・ユーザ・インターフェイスをさらに具備してもよい。クライアント・ユーザ・インターフェイスは位置情報を指示するためのローカル・マップの表記をさらに具備してもよい。

【発明を実施するための最良の形態】

【００１１】

この発明はクライアント双方向無線使用のグローバル・ポジションを確立するための方法および装置に関する。便宜上、この発明はクライアント－サーバ構造の形式で記述され、ここでは術語“クライアント”は、双方向無線に統合されるかまたはそれと関連するシス

テムの一部を指し、そしてそのために正確な位置情報が要求される。術語“サーバ”はサーバ双方向無線と関連するシステムの一部を指し、それはそれによってクライアントの位置が正確に決定されることができるデータを供給する。

【００１２】

一般に、双方向無線周波数通信は、いずれか与えられた無線周波数（ＲＦ）チャネル上のトラフィックを管理するための非公式のプロトコルを開発した。術語“チャネル”はこの中で使用されるように、いずれかの無線周波数を指す。ＲＦスペクトルのある部分は所定の周波数を有するチャネルに割り当てられる。しかしながら、本発明の原理は所定の周波数を有するスペクトルの部分に限定されない。このように、チャネルは単純にユーザにより選択されたいずれかの周波数を指している。

【００１３】

与えられたチャネル上で放送したいと思うユーザは、そのチャネル上の他の通信トラフィックの存在を検出するために、まず最初にそのチャネルに同調した受信器を聞く。そのチャネル上に他の通信トラフィックが無ければ、ユーザは同じ周波数で送信器を活性化するボタン、時にはプッシュ・トゥ・トーク（ＰＴＴ）ボタンと呼ばれる、を押して、マイクロフォンに話す。ユーザは送信を止めるためにボタンを放して、そのチャネル上の応答を聞く。応答したいと思う、第２のユーザは、応答する前に同じ手順に従い、まず最初にそのチャネル上の他のトラフィックを聞き、その後ＰＴＴボタンを押して、応答のマイクロフォンに話す。無線トラフィックが重い地域では、２，３の会話がほぼ同時に進行することは稀ではない。そのような事象では、ユーザＣがユーザＤと会話したいと同時に、ユーザＡがユーザＢと会話したいかもしれない。ユーザＡはユーザＢに質問したいが、ユーザＢが応答する前に、ユーザＣがユーザＤを呼ぶ可能性がある。受け入れられたプロトコルによれば、ユーザＢは、ユーザＡの質問に応答する前のそのチャネル上のトラフィックが途切れるまで待たねばならない。この非公式のプロトコルに従うことの失敗は、その結果、２人のユーザ（例えば、ユーザＢとユーザＣ）に同時に送信することになるかもしれない。結果として生じる混信は、そのチャネル上で通信することをいずれのユーザに対しても不可能にする可能性がある。

【００１４】

セルラ電話機のような移動体装置が、セルラ・リンク、または何か他の専用の伝送メディアを使用してその位置を決定する時には、装置（即ち、クライアントとサーバ）はあたかも互いにケーブルをつけられているように動作することができる。すなわち、セルラ・ネットワークは、それを介してクライアントとサーバとが中断無しに通信できる、専用チャネルを割り当てる。符号分割多重アクセス（ＣＤＭＡ）無線システムのような、他の無線システムでは、各クライアント・ユニットは、各クライアント・ユニットが基地局と連続の専用通信リンクを効果的に持つように、独特の符号を割り当てられる。これと対比して、双方向無線通信を使用して動作する装置は、無線周波数チャネルが私有でも独占的でもない事実と戦わなければならない。

【００１５】

サーバ支援されたＧＰＳポジショニング・システムの場合には、上述された非公式プロトコルは、それがセルラ通信用に開発された方法に従って動作することを不可能にする。サーバがクライアントの正確な位置を計算している期間中は、クライアント装置とサーバ装置との間のリンク上に通信は無い。例えば、その中でクライアントＧＰＳ受信器がローカル衛星からの使用可能な信号を記録するスナップショットを実行するには、ある時間の条件がある。またクライアントの位置を確立するのに必要な種々のステップを実行するために、サーバに対して多くの秒、または同等の分を要するかもしれない。そのような活性化は、他のユーザが混信無しにそのチャネル上に送信することをさせないので、クライアント装置は送信器をアクティブ状態に維持することができない。さらに、もしクライアント装置が絶えず送信状態に維持されれば、クライアント装置は応答データをサーバ装置から受信できないであろう。このように、従前の無線システムは一度に１方向のみに送信し、そして送信装置は受信するために送信を止めることが必要である。送信におけるこれらの

途切れの間、他の無線トラフィックはクライアントとサーバとの間のリンクを中断させることができる。

【００１６】

図１は、機能ブロック図の形式で、本発明の原理に従って構成されたシステム１００の基本動作を図示する。クライアント・ユニット１０２はＧＰＳアンテナ１０６に連結されたＧＰＳ受信器１０４と、無線アンテナ１１０に連結された双方向無線トランシーバ１０８とを備える。

【００１７】

クライアント・ユニット１０２はまたクライアント・マネージャ１１６を備える。術語“クライアント・マネージャ”は便宜のためのみに使用され、そしてここに記述されるように実行されるすべての機能が単一の装置または要素によって実行されることを示唆する意味ではない。むしろ、本発明の原理に従って、機能は単一の装置または複数の装置、ハードウェア，ソフトウェアまたはファームウェアを組み込むこと、あるいはそれの組み合わせにより実行されてもよい。

【００１８】

サーバ・ユニット１２０はＧＰＳアンテナ１２４に連結されたＧＰＳ受信器１２２と、無線アンテナ１２８に連結された双方向無線トランシーバ１２６とを有する。サーバ・ユニット１２０はまたサーバ・マネージャ１３０を備える。術語“サーバ・マネージャ”はまた、本発明の原理に従って、１装置、または複数装置により実行される複数の機能を指示するために非常に広い意味で使用される。

【００１９】

上記したように、術語“クライアント”はそれの正確な位置を独立して決定できないシステム１００の一部を指し、一方、術語“サーバ”はクライアントからデータを受信して、クライアント装置の位置を正確に決定するために独立して得られたデータとともにこのクライアント・データを使用する。

【００２０】

典型的な実施形態では、クライアント・ユニット１０２は、警察官や消防士によって使用され得るような、移動双方向無線内で実施されることができる。サーバ・ユニット１２０は、警察や消防部門のための中央派遣センタのような、基地局内で実施されることができる。しかしながら、当分野の技術者は、サーバ・ユニット１２０が移動体ユニットであってもよい一方で、クライアント・ユニット１０２は固定位置にあってもよいことを認めることができる。本発明は単純に、それ自身の位置を独立して計算できないが、サーバ・ユニットによるクライアント・ユニットの位置の計算を可能とするために断片的なまたは不完全な位置データを第２の構成部分（すなわち、サーバ・ユニット１２０）に送信できる１構成部分（すなわち、クライアント・ユニット１０２）を有する。

【００２１】

クライアント・ユニット１０２の位置が必要な時には、その位置はセルラ電話システムに関して記述されたものと同様の方法で決定される。すなわち、クライアントＧＰＳ受信器１０４は使用可能なＧＰＳ衛星送信を１つまたはそれ以上のＧＰＳ衛星１５０から衛星リンク１５２を介して獲得する。もしクライアント・ユニット１０２が十分な数の衛星１５０と共に衛星リンク１５２を確立できたならば、クライアント・ユニットは従前のＧＰＳ技術を使用してそれ自身の位置を決定できる。しかしながら、本発明は、クライアント・ユニット１０２が十分な数の衛星１５０との衛星リンク１５２を確立できないか、または十分な長さの時間の間に衛星リンクを確立できない環境での動作を予定する。完全なセットのＧＰＳデータの代わりに、クライアント・ユニット１０２はＧＰＳデータの“スナップショット”と呼ばれることができる、断片的なあるいは不完全なＧＰＳデータのみを獲得する。術語“スナップショット”は、ＧＰＳ受信器１０４を用いて視界の線内の衛星１５０から、衛星信号を探索し、そして位置決定をさせるには不十分である断片的なまたは不完全なＧＰＳ信号を記録する仕事を指すために使用される。

【００２２】

双方向無線インターフェイスを管理するクライアント・マネージャ１１６とサーバ・マネージャ１３０とを用いて、スナップショットから収集されたデータは無線伝送１５６を介してクライアント・ユニット１０２からサーバ・ユニット１２０に送信される。サーバ・ユニット１２０はクライアント・ユニット１０２により収集されたデータをサーバＧＰＳ受信器１２２により同時に収集されたデータと比較し、それにより要求されるように断片的なデータの復元を可能とする。結果としての情報はクライアント・ユニット１０２の位置を正確に決定するためにサーバ・ユニット１２０により分析される。

【００２３】

クライアント・マネージャ１１６とサーバ・マネージャ１３０とは、クライアント・ユニット１０２とサーバ・ユニット１２０との間のデータの流れを制御する。図２はクライアント・ユニット１０２の機能モジュールを、より詳細に、示し、一方図３は同様にサーバ・ユニット１２０を図示する。

【００２４】

図２に図示された、この発明の１実施形態では、トランシーバ１０８は送信器２００および受信器２０２として機能的に図示される。１実施形態では、トランシーバ１０８はＧＰＳ受信器１０４と１つの単一ユニットに統合される。図２に示されるように、トランシーバ１０８は1アンテナ１１０を、そしてＧＰＳ受信器は第２のアンテナ１０６を有してもよく、またはそれらは単一のアンテナ（図示せず）を共有してもよい。

【００２５】

同じユニットに統合されてもクライアント・マネージャ１１６は、プロセッサ２０４とメモリ２０６とを有している。プロセッサ２０４は、マイクロプロセッサ、マイクロコントローラ、特殊用途向け集積回路、ディジタル信号プロセッサ、または同種類のもののような、いずれか従前の処理装置により実施されることができる。クライアント・メモリ２０６はランダム・アクセス・メモリ（ＲＡＭ）および読出し専用メモリ（ＲＯＭ）を有してもよく、そしてまた不揮発性ＲＡＭを有してもよい。クライアント・メモリ２０６は、クライアント・ユニット１０２の多くの機能を実施するためにＣＰＵ２０４により実行される命令とデータとを備える。例えば、クライアント・メモリ２０６はキャリヤ検出モジュール２０８、送信器イネーブル・モジュール２１０、およびユニット識別子モジュール２１２を具備するソフトウェアまたはファームウェアで供給されてもよい。

【００２６】

アプリケーションの特定の要求条件に従って構成されたユーザ・インターフェイス・モジュール２１６がさらに含まれる。典型的なユーザ・インターフェイス２１６は、手持ち式またはボディ装着式の装置の場合には、キーパッド付きの小ディスプレイを具備し、あるいは車載ユニットにおいて使用されてもよいような、キーボード付きのより大型のコンピュータ・スクリーンを具備してもよい。もしクライアント・ユーザ・インターフェイス２１６が液晶ディスプレイ（ＬＣＤ）のような小ディスプレイを備えるならば、クライアント・ユーザ・インターフェイスは、実例によって、緯度および経度座標を使用しているクライアント・ユニット１０２の位置を指示することができる。もしクライアント・ユーザ・インターフェイス２１６がコンピュータ・ディスプレイを備えるならば、他のオプションのデータがユーザに提供されることができる。例えば、隣接した環境に関してクライアント・ユニット１０２の位置を指示するための手段と共に局部地域の地図の地理的な表記は、もう１つの可能性のあるユーザ・インターフェイスである。

【００２７】

上述された種々の構成部分はバス・システム２２０により一緒に連結され、これはデータ・バス、コントロール・バス、パワー・バス、および同種類のものを含んでもよい。しかしながら、明確にするために、種々のバスは図２ではバス・システム２２０として図示される。当分野の技術者は、種々のモジュール間の実際の通信リンクは、形状によって変化するであろうこと、およびモジュールが単一の装置に統合される実施の形態における集積回路内の導電性の通路と同様に単純であってもよいこと、またはプリント回路ボード・トレース、電子ケーブル、コネクタ、光ケーブル、またはクライアント・ユニット１０２の

モジュール間に確実な通信を提供するために役立つであろういずれか他のメディアであってもよいことを認めるであろう。

【００２８】

図３はサーバ・ユニット１２０の典型的な構成である。基地局の種々の構成部分は単一のユニットに統合されても、されなくてもよい。例えば、サーバ・ユニット１２０は、その中でサーバ・トランシーバ１２６がＧＰＳ受信器１２２と統合される統合システムであってもよい。サーバ・トランシーバ１２６は１アンテナ１２８を、そしてＧＰＳ受信器１２２は第２のアンテナ１２４を有してもよく（図３に示されるように）、またはそれらは単一のアンテナ（図示せず）を共有してもよい。サーバ・マネージャ１３０はサーバ・ユニット１２０に統合されてもよく、またはサーバ・トランシーバ１２６およびＧＰＳ受信器１２２からある距離に配置されてもよい。さらに他の代替の実施形態では、リモート・プロセッサ（図示せず）は断片的なデータをサーバ・トランシーバ１２６を介してクライアント・ユニット１０２から受信し、そして完全なＧＰＳデータをＧＰＳ受信器１２２から受信することができ、そして計算を実行する。結果としての位置情報はサーバ・トランシーバ１２６を介してクライアント・ユニット１０２に中継し返されてもよい。しかしながら、上述された計算はサーバ・ユニット１２０により実行される必要はない。サーバ・トランシーバ１２６はＲＦ送信器３００およびＲＦ受信器３０２として図３に機能的に図示される。

【００２９】

サーバ・マネージャ１３０は、クライアント・ユニット１０２内のクライアント・マネージャ１１６と同様な機能を実行し、そしてサーバ・プロセッサ３０４およびサーバ・メモリ３０６のような、同様の構成部分を備える。プロセッサ３０４は、マイクロプロセッサ、マイクロコントローラ、特殊用途向け集積回路、ディジタル信号プロセッサ、または同種類のもののような、いずれか従前の処理装置により実施されてもよい。サーバ・メモリ３０６はランダム・アクセス・メモリ（ＲＡＭ）および読出し専用メモリ（ＲＯＭ）を含んでもよく、そしてまた不揮発性ＲＡＭを含んでもよい。サーバ・メモリ３０６は、サーバ・ユニット１２０の多くの機能を実施するためにプロセッサにより実行される命令とデータとを備える。例えば、サーバ・メモリ３０６はキャリヤ検出モジュール３０８、送信器イネーブル・モジュール３１０、およびベース識別子モジュール３１２を具備するファームウェアまたはソフトウェア・プログラムで供給されてもよい。

【００３０】

ユーザ・インターフェイス・モジュール３１６はこの出願の特定の要求条件に従って構成される。クライアント・ユーザ・インターフェイス２１６（図２参照）に関して上記したようにサーバ・ユーザ・インターフェイス３１６は、ディスプレイと、キーパッドまたはキーボードのような、ユーザ入力装置とを含んでもよい。簡潔にするために、これらの要素は図３には図示されない。しかしながら、上記したように、サーバ・ユーザ・インターフェイス３１６のディスプレイ部（図示せず）はクライアント・ユニット１０２の位置を指示するデータを供給するための簡単な英数字によるディスプレイであってもよく、あるいは隣接した環境に関してクライアント・ユニットの位置を指示するためのマップ・オーバレイ(overlay)のような、付加的なデータを供給するためのコンピュータ・ディスプレイであってもよい。

【００３１】

上述された種々の構成部分はバス・システム３２０により一緒に連結され、これはデータ・バス、コントロール・バス、パワー・バス、および同種類のものを含んでもよい。しかしながら、明確にするために、種々のバスは図３ではバス・システム３２０として図示される。さらに、構造的によりはむしろ機能的に図示されているバス・システム３２０は、実際に数タイプの接続の少なくとも１つであってもよい。従ってサーバ・ユニット１２０の構成部分は互いに物理的に別種であってもよく、コネクタは特定の要求条件に従って選択されるであろうが、電子ケーブル、光ケーブル、ネットワーク接続、インターネット・リンク、または構成部分の間に必要な通信を確立するための他の手段を含んでもよい。

【００３２】
図１乃至３を参照して、システム１００の動作が今記述される。クライアント・ユニット１０２の位置が望まれる時に、ユーザは位置要求をクライアント・インターフェイス２１６（図２参照）で開始する。位置要求に応じて、ＧＰＳ受信器１０４はスナップショットを得て、ＧＰＳ受信器１０４が獲得処理を実行するためにイネーブルである時に視界の線内にあるだけ多くのＧＰＳ衛星１５０（図１参照）からの送信セグメント(segment)を獲得する。ＧＰＳ受信器１０４はその後送信セグメントをディジタル化してそれらをデータ・パケットに収集し、それはクライアント・マネージャ１１６に渡される。
【００３３】
ユニット識別子モジュール２１２は特定のクライアント・ユニット１０２を識別する独特のＩＤ符号を発生し、そしてこのＩＤ符号をデータ・パケットに付加し、それは符号とＧＰＳ受信器１０４からのディジタル化された情報を備える。ＩＤ符号は多くの異なるクライアント・ユニット１０２が１つの地理的地域内で動作している可能性がある時に特に有用である。例えば、システム１００は市内でタクシー団を追跡するために使用されることができる。独特のＩＤ符号は各タクシー間で区別することができる。もし単一のクライアント・ユニット１０２のみがシステム内にあれば、そのときは独特なＩＤ符号は不要である。
【００３４】
キャリヤ検出モジュール２０８（図２参照）は無線周波数チャネル上の無線トラフィックを検出する。キャリヤ検出モジュール２０８は、所定のしきい値以上のエネルギー・レベルを有する送信信号用のＲＦチャネルをモニタするような、既知の技術を使用する。もし無線トラフィックがＲＦチャネル上にあれば、送信器イネーブル・モジュール２１０は送信器２００の活性化を防ぐ。これはＲＦ衝突および結果としての混信を避ける。無線トラフィックがＲＦチャネル上に無ければ、送信器イネーブル・モジュール２１０は少なくとも１つのデータ・パケットを無線伝送１５６（図１参照）を介してサーバ・ユニット１２０に送信するために、送信器２００をイネーブルにする。
【００３５】
図３を参照して、サーバ・ユニット１２０の受信器３０２は伝送されたデータ・パケットを受信する。サーバ・ユニット識別子３１２はクライアント・ユニット１０４の独特の符号を承認し、そしてサーバ・マネージャ１３０はこの伝送を受け入れる。サーバ・プロセッサ３０４はデータを抽出して、前述したように位置分析を実行し、そしてクライアント・ユニット１０４の正確な位置を確立する。サーバＧＰＳ受信器１２２からのＧＰＳデータとともにスナップショット・データを使用してクライアント・ユニット１０４を位置付けする手順は当分野で周知であり、そしてこの中に詳細に記述される必要はない。
【００３６】
サーバ・プロセッサ３０４は無線伝送１５６（図１参照）上で伝送されたデータを使用してクライアント・ユニット１０４の位置を正確に確立することができる。サーバ・プロセッサ３０４はクライアント・ユニット１０２に関する位置情報を発生する。この位置情報は位置情報パケットにディジタル的に組み立てられる。サーバ識別子モジュール３１２はその後クライアント・ユニット１０２を識別する独特の符号を発生して付加する。
【００３７】
サーバ・キャリヤ検出モジュール３０８は無線周波数チャネル上の無線トラフィックを検出する。もし無線トラフィックがＲＦチャネル上にあれば、送信器イネーブル・モジュール３１０は送信器３００の活性化を防ぐ。これはＲＦ衝突と、結果としての混信とを避ける。無線トラフィックがＲＦチャネル上に無ければ、送信器イネーブル・モジュール３１０は位置情報を無線伝送１５６（図１参照）を介してクライアント・ユニット１０２に送信するために、送信器３００をイネーブルにする。このように、システム１００は無線伝送１５６を介してクライアント・ユニット１０２とサーバ・ユニット１２０との間の情報の交換を可能とする。同時に、システム１００は、他のＲＦトラフィックが選択されたＲＦチャネル上に既にある時に送信により混信を引き起こす可能性のあるクライアント・ユ

ニット１０２かまたはサーバ・ユニット１２０による偶然の送信を防ぐ。

【００３８】

再び図２に戻って、クライアント・ユニット１０２のＲＦ受信器２０２は送信された位置情報パケットを受信する。クライアント・ユニット識別子モジュール２１２は独特のＩＤ符号を検出し、この符号は位置情報パケットをクライアント・ユニット１０２のために適切なものとして識別し、そして位置情報を抽出して、位置情報パケットを復号する。クライアント・ユニット１０２の位置はユーザ・インタフェイス２１６で表示される。

【００３９】

システム１００の動作は図４のフローチャートに図示され、そこではスタート４００で、少なくとも１つのクライアント・ユニット１０２（図１参照）と１つのサーバ・ユニット１２０とが使用可能である。ステップ４０２では、クライアント・ユニット１０２の位置を決定するために１つの要求がある。上で検討した、１実施例では、クライアント・ユニット１０２のユーザはその位置をユーザ・インターフェイス２１６（図２参照）を介して手動で要求する。しかしながら、当分野の技術者は多数の異なる技術がクライアント位置を要求するために使用されてもよいことを認識するであろう。例えば、クライアント１０２はクライアント位置要求を所定の時間間隔で自動的に発生してもよい。さらに他の代替の実施形態では、もしユーザが最近、ユーザ・インターフェイス２１６を介して手動要求を発生しなかったならば、クライアント・ユニット１０２はクライアント位置についての要求を周期的に発生してもよい。

【００４０】

さらに他の代替の実施形態では、サーバ・ユニット１２０がステップ４０２でクライアント位置を要求してもよい。この実施形態では、サーバ・ユニット１２０は無線伝送１５６（図１参照）を介して位置要求を送信してもよい。この実施形態では、クライアント・ユニット１０２はサーバ・ユニット１２０により送信された要求に自動的に応答してもよく、あるいはユーザ・インターフェイス２１６を介してクライアント位置についての要求を活性化するようにユーザを促してもよい。もしクライアント・ユニット１０２が自動的に応答すれば、クライアント・ユニット１０２の位置は、ユーザに明白な方法で決定されてもよい。

【００４１】

ステップ４０２におけるクライアント位置を要求する特定のエンティティ(entity)にかかわらず、ステップ４０４ではクライアント・ユニット１０２は断片的なＧＰＳデータを獲得することによりその要求に応ずる。上記で検討したように、断片的なＧＰＳデータは、クライアント・ユニット１０２がそれ自身の位置を独立して決定できないようなある方法において不十分であるかまたは不完全であるＧＰＳデータを単純に参照する。

【００４２】

ステップ４０６では、クライアント・キャリヤ検出モジュール２０８（図２参照）は選択されたＲＦチャネル上のＲＦトラフィックをモニタする。決定４１０では、クライアント・ユニット１０２はＲＦチャネルが使用可能かどうかを決定する。もしＲＦチャネルが使用できなければ（即ち、無線トラフィックが既にそのＲＦチャネル上にある）、決定結果４１０はＮＯである。この事態では、クライアント・ユニット１０２はステップ４０６に戻って、ＲＦチャネルが使用可能になるまでＲＦトラフィックをモニタし続ける。もしＲＦチャネルが使用可能であれば、決定結果４１０はＹＥＳである。この事態では、ステップ４１２において、送信器イネーブル・モジュール２１０は、双方向無線伝送１５６を介してディジタル化された断片的なＧＰＳデータの伝送を可能とするために、送信器２００をイネーブルにする。

【００４３】

ステップ４１４では、サーバ・プロセッサ３０４はクライアント・ユニット１０２の位置を正確に決定するためにサーバＧＰＳ受信器１２２により供給されたデータと一緒に伝送されたデータを使用する。

【００４４】

一度クライアント１０２の位置が正確に決定されると、サーバ・ユニット１２０は無線伝送１５６を介して位置情報をクライアント・ユニット１０２に返送することができる。ステップ４１６では、サーバ・キャリヤ検出モジュール３０８（図３参照）は選択されたＲＦチャネル上のＲＦトラフィックをチェックする。決定４２０では、システムはＲＦチャネルが使用可能かどうかを決定する。もしＲＦチャネルが使用できなければ（即ち、他の無線トラフィックがそのＲＦチャネル上に既に送信されている）、そのとき決定結果４２０はＮＯである。この事態では、サーバ・ユニット１２０はステップ４１６に戻って、ＲＦチャネルが使用可能になるまでＲＦトラフィックをモニタし続ける。ＲＦチャネルが使用可能である時は、決定結果４２０はＹＥＳである。この事態では、ステップ４２２において、サーバ送信器イネーブル・モジュール３１０は、無線伝送１５６を介してサーバ・ユニット１２０からクライアント・ユニット１０２への位置情報の送信を可能とするために、サーバ送信器３００をイネーブルにする。一度位置情報が送信されると、処理は４２４で終了する。

【００４５】

この方法では、システム１００はクライアント・ユニット１０２とサーバ・ユニット１２０との間の無線周波数リンクを使用してクライアント・ユニットの位置を正確に決定するためのサーバ支援された技術を提供する。

【００４６】

上述されたシナリオに他の変種があることは、当分野の技術者には明白であろう。クライアント・ユニット１０２の位置についての要求はクライアント・ユニット１０２またはサーバ・ユニット１２０で生起し、いずれの場合にも、サーバ・ユニット１２０は付けられた独特の識別符号と共に位置要求を送信する。類似のＩＤ符号を有するクライアント・ユニット１０２はスナップショットを得ることにより応答し、そして位置情報がサーバ・ユーザ・インターフェイス３１６で表示されることを除いては、処理が記述されたように続くであろう。もしサーバ・ユニット１２０が位置要求を始めれば、クライアント・ユニット１０２に位置を提供する必要はなくなる可能性がある。この例では、図４に図示された手順４１６乃至４２２を実行する必要はなくなる。

【００４７】

本発明の原理に従って、そしてそれの種々の実施形態では、記述された装置は多くのアプリケーションにおいて有用であり得る。例えば、タクシーやメッセンジャーにより運ばれるクライアント・ユニットは、スナップショットを自動的に得、そして配車係に正確な位置情報を実時間で供給して、調節された間隔でデータ・パケットを送信するようにプログラムされることができる。

【００４８】

警察や救急隊員により運ばれるクライアント・ユニットは、周期的な間隔でスナップショットを得て、そのデータを蓄積するようにプログラムされることができる。緊急の事態では、ユーザは直近のスナップショット・データを送信するであろう。これはスナップショット手順に関連する遅れを削除し、そしてまたユニットが建物内などで、ＧＰＳ衛星送信から完全に陰になる状況においても概略の位置を供給するであろう。

【００４９】

この発明について多くの他のアプリケーションがあることは当分野の技術者には明白であろう、その各々はこの中に記述された実施形態に変化を必要とするであろう、そしてそれはこの発明の範囲内に含まれるべきと考えられる。

【図面の簡単な説明】

【００５０】

【図１】本発明の１実施例の機能ブロック図を図示する。

【図２】図１のクライアント・ユニットの構成部分を図示する機能ブロック図である。

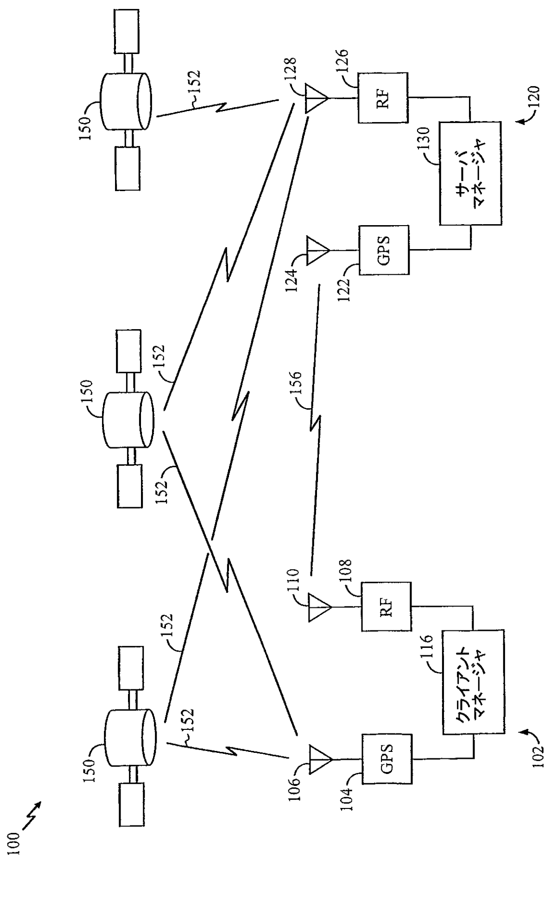
【図３】図１の基地局の構成部分を図示する機能ブロック図である。

【図４】本発明の動作を図示するフローチャートである。

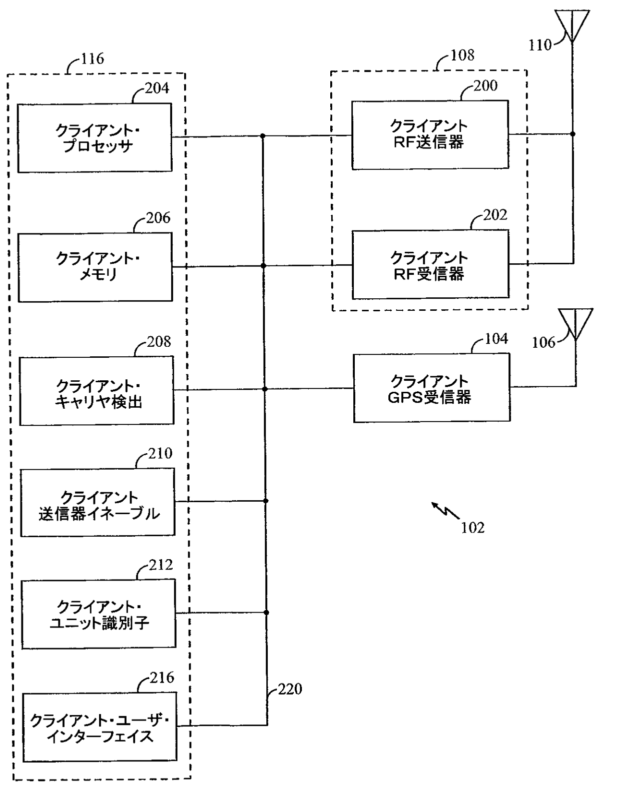
【符号の説明】

【００５１】
１００‥システム，１０８‥トランシーバ，１１６‥クライアント・マネージャ，１２０‥サーバ・ユニット，１３０‥サーバ・１５０‥ＧＰＳ衛星，１５２‥衛星リンク，１５６‥無線伝送，２２０‥バスシステム，マネージャ，３２０‥バスシステム

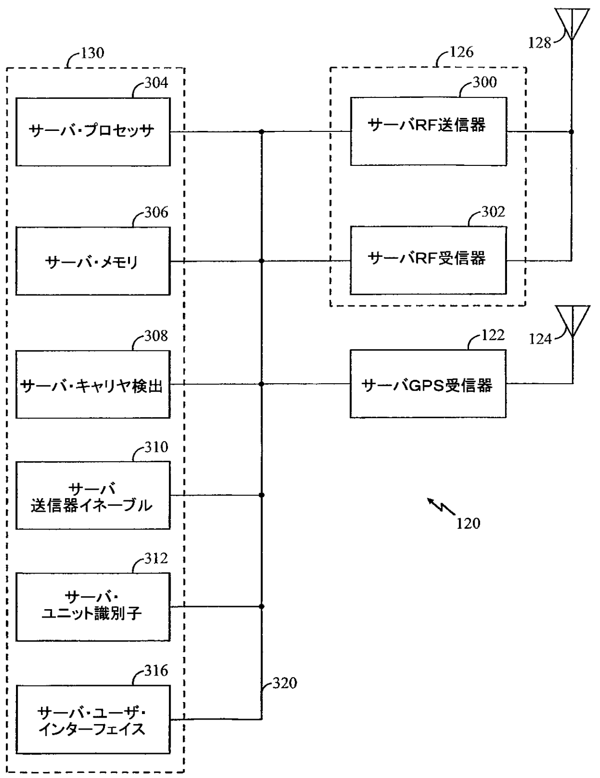
【図１】



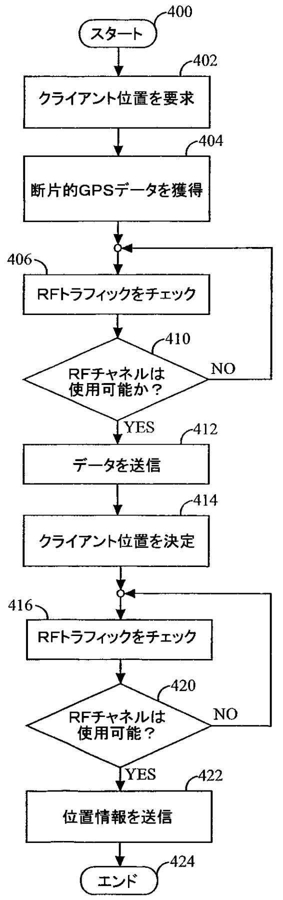
【図２】



【図３】


130
304
サーバ・プロセッサ
306
サーバ・メモリ
308
サーバ・キャリヤ検出
310
サーバ
送信器イネーブル
312
サーバ・
ユニット識別子
316
サーバ・ユーザ・
インターフェイス
320
126
300
サーバRF送信器
302
サーバRF受信器
128
122
サーバGPS受信器
124
120

【図４】


スタート
400
クライアント位置を要求
402
断片的GPSデータを獲得
404
406
RFトラフィックをチェック
RFチャネルは
使用可能か？
410
NO
YES
データを送信
412
クライアント位置を決定
414
416
RFトラフィックをチェック
RFチャネルは
使用可能？
420
NO
YES
位置情報を送信
422
エンド
424

【国際公開パンフレット】

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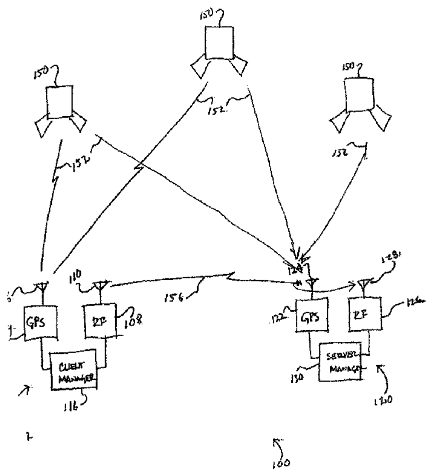
[Continued on next page]

(54) Title: SERVER-ASSISTED POSITION DETERMINATION IN A RADIO NETWORK



(57) Abstract: According to the principles of the invention, a client unit (102) comprises a client GPS receiver (104) is integrated with a two-way-radio transceiver (108) and a manager (116) for the purpose of performing server-assisted global position fixes, especially in cases where the location or situation makes unassisted fixes impossible or impractical. A server unit (120) is also provided, associated with a second two-way-radio transceiver (126) and a server manager (130). The first and second managers (116 and 130) function as communication managers, each comprising modules for detecting RF channel traffic, enabling transmitter portions of the transceivers (108 and 126). The system may also provide identification codes that accompany data sent from the client unit to the base station to identify the client unit.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SERVER-ASSISTED POSITION DETERMINATION IN A RADIO NETWORK

RELATED APPLICATIONS

[0000] This application claims priority to pending Provisional application number 60/274,494, filed on March 9, 2001, incorporated herein by reference.

FIELD OF THE INVENTION

[1001] The present invention relates generally to position determination and, in particular, concerns to server-assisted position determination technology in a radio network.

BACKGROUND OF THE INVENTION

[1002] Global Positioning System (GPS) receivers normally determine their position by computing relative times of arrival of signals transmitted simultaneously from a multiplicity of GPS (or NAVSTAR) satellites. These satellites transmit, as part of their message, both satellite positioning data as well as data on clock timing, so-called "ephemeris" data. The process of searching for and acquiring GPS signals, reading the ephemeris data for a multiplicity of satellites and computing the location of the receiver from this data is time consuming, often requiring several minutes. In many cases, this lengthy processing time is unacceptable and, furthermore, greatly limits battery life in micro-miniaturized portable applications.

[1003] Another limitation of current GPS receivers is that successful operation is limited to situations in which multiple satellites are clearly in view, without obstructions, and where a good quality antenna is properly positioned to receive such signals. As such, they normally are unusable in portable, body-mounted applications, in areas where there is significant foliage or building blockage (*e.g.*, urban canyons), and in in-building applications.

[1004] One known solution to this problem involves the use of a cellular telephone, integrated with a GPS receiver. A cellular link is established between the mobile GPS unit, or client, and a second, stationary, GPS receiver, which is associated with a second cellular unit and a computer processor, or server. The mobile GPS receiver takes what is referred to as a snapshot of the available satellite signals. That is to say, the mobile GPS receiver records a short duration of signals from as many satellites as are available in its line of sight. As described above, these signals are likely to be attenuated and fragmented, due to the location of the mobile GPS receiver, which may be in close proximity to buildings or foliage, etc.

[1005] According to one known method, described in U.S. Patent No. 6,131,067, these fragmented signals are digitized, and transmitted, via a cellular link, from the client to the second GPS receiver and server. The second GPS receiver, meanwhile, is recording signals from GPS satellites within line of sight of its own antenna, which is a stationary mounted antenna, situated in a location where it receives unobstructed transmissions from the available satellites. The server associated with the second GPS receiver is then tasked with comparing the signals of the two receivers. By analyzing the fragmented signals from the mobile GPS receiver to the complete signals received by the second GPS receiver, the server can essentially "fill in the blanks" and complete the signals as received at the mobile GPS receiver. The server can then take those reconstructed signals and, using known methods, accurately determine the location of the mobile GPS receiver.

[1006] The amount of assistance afforded by the second GPS receiver or base station, can vary significantly. It may be as little as transmitting stored information regarding specific satellites, up to performing the matching process and signal analysis as previously described. In all cases however, the server-assisted location technology requires the use of a cellular link, or some other dedicated transmission medium such that a two-way communication link is continuously established between the client and server.

[1007] In other circumstances, a cellular telephone network is not available and radio communication is provided between parties. As those skilled in the art can appreciate, radio communication is intermittent with a single transmitter transmitting at a selected frequency and any receiver tuned to the selected frequency being capable of detecting the transmitted signals. When the transmitter completes transmitting, the selected frequency is available for use by any other transmitter. Thus, a particular frequency or channel is available for use by any transmitter. The server-assisted location technology described above cannot be implemented in a conventional two-way radio because radio communication, does not permit a dedicated two-way communication link. Therefore, it can be appreciated that there is a significant need for server-assisted location technology in a two-way radio system. The present invention provides this, and other advantages, as will be apparent from the following detailed description and accompanying figures.

SUMMARY OF THE INVENTION

[1008] A server-assisted position detection device comprises a client global positioning system (GPS) receiver circuit to receive satellite positioning signal data from GPS satellites. The satellite position data received by the client GPS receiver is insufficient to independently establish the location of the client GPS receiver. The client further includes a transmitter to transmit satellite data. A client carrier detection module is used to detect radio traffic on a selected radio frequency (RF) channel. A client transmit enable module enables the client transmitter when no radio traffic is detected on the RF channel.

[1009] A server receiver receives data from the client transmitter. A server coupled to the server receiver is configured to analyze the satellite data received by the server receiver. The server uses the received satellite data and additional satellite data to generate location information regarding the location of the client GPS receiver.

[1010] The location information may be used remotely or returned to the client unit. To return the location information to the client unit, the system may further comprise a client receiver to receive the location information and a server transmitter to transmit the location information to the client receiver. The server unit further comprises a server carrier detection module to detect radio traffic on an RF channel and a server transmit enable module to enable the server transmitter when no radio traffic is detected on the RF channel to thereby transmit the location information to the client receiver. In alternative embodiments, the client may further comprise a client user interface for displaying the location information. The client user interface may further comprise representation of a local map to indicate the location information.

BRIEF DESCRIPTION OF THE DRAWINGS

[1011] FIG. 1 illustrates a functional block diagram of an exemplary embodiment of the present invention.

[1012] FIG. 2 is a functional block diagram illustrating the components of a client unit of FIG. 1.

[1013] FIG. 3 is a functional block diagram illustrating the components of a base station of FIG. 1.

[1014] FIG. 4 is a flowchart illustrating the operation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[1015] This invention concerns the method and apparatus for establishing a global position using a client two-way radio. For the sake of convenience, the invention is described in the form of a client-server architecture where the term "client" refers to a portion of the system integrated into or associated with a two-way radio and for which accurate location information is desired. The term "server" refers to a portion of the system associated with a server two-way radio and which provides data by which the location of the client may be accurately determined.

[1016] Two-way radio frequency communication, in general, has developed an informal protocol to manage traffic on any given radio frequency (RF) channel. The term "channel" as used herein refers to any radio frequency. Some portions of the RF spectrum are allocated into channels having predetermined frequencies. However, the principles of the present invention are not limited to portions of the spectrum having predetermined frequencies. Thus, channel simply refers to any frequency selected by the user.

[1017] A user, wishing to broadcast on a given channel, first listens to a receiver tuned to that channel, to detect the existence of other communication traffic on the channel. In the absence of other traffic on the channel, the user presses a button, sometimes referred to as a push-to-talk (PTT) button, which activates a transmitter on the same frequency, and speaks into the microphone. The user releases the button to cease transmitting and listens for a response on the channel. A second user, wishing to respond, follows the same procedure before responding, first listening for other traffic on the channel, then pressing the PTT button, and speaking into a microphone in response. In regions where radio traffic is heavy, it is not uncommon for two or three conversations to proceed more or less simultaneously. In such an event, user A might wish to converse with user B, while user C wishes to converse with user D. User A might ask a question of user B, but before user B responds, user C might address user D. According to the accepted protocol, user B must wait until there is a break in the traffic on the channel before responding to the question of user A. Failure to follow this informal protocol may result in two users (*e.g.*, user B and user C) transmitting at the same time. The resultant interference may make it impossible for any users to communicate on that channel.

[1018] When a mobile device, such as a cellular telephone, determines its position using a cellular link, or some other dedicated transmission medium, the devices (*i.e.*, the client and the server) can operate as though they are cabled together. That is, the cellular network assigns dedicated channels over which the client and server may communicate without disruption. In other wireless systems, such as a code division multiple access (CDMA) wireless system, each client unit is assigned a unique code such that each client unit effectively has a continuous dedicated communication link with a base station. In contrast, devices operating using two-way radio communication must contend with the fact that the radio frequency channel is neither private nor exclusive.

[1019] In the case of a server-assisted GPS positioning system, the informal protocol described above would make it impossible to function according to the methods developed for cellular communication. During the period of time that the server is calculating the accurate position of the client, there is no communication on the link between the client device and the server device. For example, there is a certain time requirement in performing the snapshot, in which the client GPS receiver records available signals from the local satellites. It may also take many seconds, or even minutes, for the server to perform the various steps required in establishing the position of the client. The client device cannot maintain the transmitter in an active state since such activation prevents other users from transmitting on that channel without interference. Furthermore, the client device would be incapable of receiving response data from the server device if the client device were constantly maintained in a transmit mode. Thus, a conventional radio system transmits in only one direction at a time and requires that the transmitting device cease transmission in order to receive. During these breaks in transmission other radio traffic can disrupt the link between the client and the server.

[1020] FIG. 1 illustrates, in a functional block diagram format, the basic operation of a system **100** constructed according to the principles of the invention. A client unit **102** comprises a GPS receiver **104** coupled to a GPS antenna **106** and a two-way radio transceiver **108** coupled to a radio antenna **110**.

[1021] The client unit **102** also includes a client manager **116**. The term "client manager" is used for convenience only, and is not intended to suggest that all the functions performed as described herein are performed by a single device or component. Rather, according to the principles of the invention, the functions may be performed by a single device or a plurality of devices, incorporating hardware, software or firmware, or a combination thereof.

[1022] A server unit **120** comprises a GPS receiver **122** coupled to GPS antenna **124** and a two-way radio transceiver **126** coupled to a radio antenna **128**. The server unit **120** also includes a server manager **130**. The term "server manager" is also used in a very broad sense to indicate a plurality of functions which are performed by a device, or devices, according to the principles of the invention.

[1023] As noted above, the term "client" refers to a portion of the system **100** which cannot independently determine its precise location while the term "server" refers to a portion of the system that receives data from the client and uses the client data in conjunction with independently derived data to precisely determine the location of the client device.

[1024] In a typical embodiment, the client unit **102** may be implemented in a mobile two-way radio, such as may be used by a police officer or firefighter. The server unit **120** may be implemented in a base-station, such as a central dispatch center for a police or fire department. However, those skilled in the art can appreciate that the client unit **102** may be in a fixed location while the server unit **120** may be a mobile unit. The present invention simply has one component (*i.e.*, the client unit **102**) that is incapable of independently calculating its own location, but which can transmit fragmentary or incomplete location data to a second component (*i.e.*, the server unit **120**) to permit the calculation of the client unit location by the server unit.

[1025] When the location of the client unit **102** is required, the position is determined in a manner that is similar to that described with respect to the cellular telephone system. That is, the client GPS receiver **104** captures the available GPS satellite transmissions from one or more GPS satellites **150** via a satellite link **152**. If the client unit **102** were capable of establishing satellite links **152** with a sufficient number of satellites **150**, the client unit could determine its own location using conventional GPS techniques. However, the present invention is intended for operation in circumstances where the client unit **102** cannot establish satellite links **152** with a sufficient number of satellites **150** or cannot establish the satellite links for a sufficient length of time. Instead of a complete set of GPS data, the client unit **102** captures only fragmentary or incomplete GPS data in what may be referred to as a "snapshot" of GPS data. The term "snapshot" is used to refer to the task of seeking the satellite signals, from satellites **150** in line of sight with the GPS receiver **104**, and recording fragmentary or incomplete GPS signals that are insufficient to permit location determination.

[1026] With the client manager 116 and the server manager **130** managing the two-way-radio interface, the data collected from the snapshot are transmitted via a radio transmission **156** from the client unit **102** to the server unit **120**. The server unit **120** compares the data collected by the client unit **102** with data collected simultaneously by the server GPS receiver **122**, thereby permitting reconstruction of the fragmentary data as required. The resulting information is analyzed by the server unit **120** to accurately determine the location of the client unit **102**.

[1027] The client manager **116** and the server manager **136** control the flow of data between the client unit **102** and the server unit **120**. FIG. 2 shows, in greater detail, the functional modules of the client unit **102**, while FIG. 3 similarly illustrates the server unit **120**.

[1028] In one embodiment of the invention, illustrated in FIG. 2, the transceiver **108** is functionally illustrated as a transmitter **200** and receiver **202**. In one embodiment, the transceiver **108** may be integrated with the GPS receiver **104** into a single unit. The transceiver **108** may have one antenna **110**, and the GPS receiver a second antenna **106**, as shown in FIG. 2, or they may share a single antenna (not shown).

[1029] Also integrated into the same unit is the client manager **116**, having a processor **204** and memory **206**. The processor **204** may be implemented by any conventional processing device, such as a microprocessor, microcontroller, application specific integrated circuit, digital signal processor, or the like. The client memory **206** may comprise random access memory (RAM) and read-only memory (ROM) and may also include nonvolatile RAM. The client memory **206** contains instructions and data executed by the CPU **204** to implement many of the functions of the client unit **102**. For example, the client memory **206** may be supplied with software or firmware comprising a carrier detection module **208**, a transmitter enable module **210**, and a unit identifier module **212**.

[1030] A user interface module **216** configured according to the specific requirements of the application is further included. A typical user interface **216** might comprise a small display with a keypad, in the case of a hand held or body mounted device, or a larger computer screen with keyboard, such as might be used in a vehicle mounted unit. If the client user interface **216** includes a small display, such as a liquid crystal display (LCD), the client user interface can indicate the position of the client unit **102** using, by way of example, latitude and longitude coordinates. If the client user interface **216** includes a computer display, other optional data may be provided to the user. For example, a graphical representation of a map of the local region with means for indicating the position of the client unit **102** in relation to the immediate surroundings is another possible user interface.

[1031] The various components described above are coupled together by a bus system **220**, which may include a data bus, control bus, address bus, power bus, and the like. However, for the sake of clarity, the various buses are illustrated in FIG. 2 as the bus system **220**. A person skilled in the art will recognize that the actual communication links between the various modules will vary according to the configuration, and may be as simple as conductive pathways in an integrated circuit in an implementation where the modules are integrated into a single device, or may be printed circuit board traces, electronic cables, connectors, optical cables or any other medium that will serve to provide reliable communication between the modules of the client unit **102**.

[1032] FIG. 3 shows a typical configuration of a server unit **120**. The various components of the base station may or may not be integrated into a single unit. For example, the server unit **120** may be an integrated system in which the server transceiver **126** is integrated with the GPS receiver **122**. The server transceiver **126** may have one antenna **128** and the GPS receiver **122** a second antenna **124** (as shown in FIG. 3), or they may share a single antenna (not shown). The server manager **130** may be integrated into the server unit **120** or may be located at some distance from the server transceiver **126** and GPS receiver **122**. In yet another alternative embodiment, a remote processor (not shown) may receive the fragmentary data from the client unit **102** via the server transceiver **126** and the complete GPS data from the GPS receiver **122** and perform calculations. The resultant location information may be relayed back to the client unit **102** via the server transceiver **126**. However, the calculations described above need not be performed by the server unit **120**. The server transceiver **126** is functionally illustrated in FIG. 3 as a RF transmitter **300** and a RF receiver **302**.

[1033] The server manager **130**, performs a similar function as the client manager **116** in the client unit **102** and includes similar components, such as a server processor **304** and server memory **306**. The processor **304** may be implemented by any conventional processing device, such as a microprocessor, microcontroller, application specific integrated circuit, digital signal processor, or the like. The client memory **306** may comprise random access memory (RAM) and read-only memory (ROM) and may also include nonvolatile RAM. The client memory **306** contains instructions and data executed by the processor to implement many of the functions of the server unit **120**. For example, the client memory **306** may be supplied with firmware or software programs comprising a carrier detection module **308**, a transmitter enable module **310**, and a base identifier module **312**.

[1034] A user interface module **316** is configured according to the specific requirements of the application. As noted above with respect to the client user interface **216** (see FIG. 2) the server user interface **316**, may comprise a display and user input device, such as a keypad or keyboard. For the sake of brevity, those elements are not illustrated in FIG. 3. However, as noted above, the display (not shown) portion of the server user interface **316** may be a simple alphanumeric display to provide data indicating the position of the client unit **102** or may be a computer display to provide additional data, such as a map overlay to indicate the position of the client unit relative to immediate surroundings.

[1035] The various components described above are coupled together by a bus system **320**, which may include a data bus, control bus, address bus, power bus, and the like. However, for the sake of clarity, the various buses are illustrated in FIG. 3 as the bus system **320**. Furthermore, the bus system **320**, which is illustrated functionally rather than structurally, may actually be one or more of several types of connections. Inasmuch as the components of the server unit **120** may be physically remote from each other, the connectors will be selected according to the specific requirements, but may include electronic cables, optical cables, network connections, internet links, or other means for establishing the required communication between the components.

[1036] With reference to FIGs. 1-3, the operation of the system **100** may now be described. When the location of the client unit **102** is desired, the user initiates the location request at the client user interface **216** (see FIG. 2). In response to the location request, the GPS receiver **104** takes a snapshot, capturing a segment of transmission from as many of the GPS satellites **150** (see FIG. 1) as are in line of sight when the GPS receiver **104** is enabled to perform the capture process. The GPS receiver **104** then digitizes the transmission segments and collects them into data packets, which are passed to the client manager **116**.

[1037] The unit identifier module **212** generates a unique ID code that identifies the particular client unit **102**, and appends the ID code to the data packets, which include the code and the digitized information from the GPS receiver **104**. The ID code is particularly useful when many different client units **102** may be operating in a geographic region. For example, the system **100** may be used to track a fleet of taxi cabs in a city. The unique ID code can differentiate between each of the taxi cabs. If only a single client unit **102** is present in the system, then the unique ID code is not necessary.

[1038] The carrier detection module **212** (see FIG. 2) detects radio traffic on a radio frequency channel. The carrier detection module **212** uses known techniques, such as monitoring an RF channel for transmitted signals having an energy level above a predetermined threshold. If radio traffic is present on the RF channel, the transmitter enable module **210** prevents activation of the transmitter **200**. This avoids RF collision and the resultant interference. In the absence of radio traffic on the RF channel, the transmitter enable module **210** enables the transmitter **200** to transmit one or more data packets to the server unit **120** via the radio transmission **156** (see FIG. 1).

[1039] With reference to FIG. 3, the receiver **302** of the server unit **120** receives the transmitted data packets. The server unit identifier **312** recognizes the unique code of the client unit **104** and the server manager **130** accepts the transmission. The server processor **304** extracts the data and performs the location analysis as previously described, and establishes the precise location of the client unit **104**. The process of locating the client unit **104** using the snapshot data in conjunction with GPS data from the server GPS receiver **122** is well known in the art and need not be described in detail herein.

[1040] The server processor **304** can accurately establish the location of the client unit **104** using data transmitted over the radio transmission **156** (see FIG. 1). The server processor **304** generates location information concerning the client unit **102**. The location information is assembled digitally into a location information packet. The server identifier module **312** then generates and attaches the unique code identifying the client unit **102**.

[1041] The server carrier detection module **308** detects radio traffic on a radio frequency channel. If radio traffic is present on the RF channel, the transmitter enable module **310** prevents activation of the transmitter **300**. This avoids RF collision and the resultant interference. In the absence of radio traffic on the RF channel, the transmitter enable module **310** enables the transmitter **300** to transmit location information to the client unit **102** via the radio transmission **156** (see FIG. 1). Thus, the system **100** permits the exchange of information between the client unit **102** and the server unit **120** via the radio transmission **156**. At the same time, the system **100**

prevents the inadvertent transmission by either the client unit **102** or the server unit **120** that may cause interference by transmitting when other RF traffic is already on the selected RF channel.

[1042] Returning again to FIG. 2, the RF receiver **202** of the client unit **102** receives the transmitted location information packet. The client unit identifier module **212** detects the unique ID code, which identifies the location information packet as being pertinent to the client unit **102**, and decodes the location information packet, extracting the location information. The location of the client unit **102** is presented at the user interface **216**.

[1043] The operation of the system **100** is illustrated in the flowchart of FIG. 4 where at a start **400**, at least one client unit **102** (see FIG. 1) and one server unit **120** are available. In step **402**, there is a request to determine the location of the client unit **102**. In one example embodiment, discussed above, the user of the client unit **102** manually requests the location via the user interface **216** (see FIG. 2). However, those skilled in the art will appreciate that a number of different techniques may be used to request the client location. For example, the client **102** may automatically generate the client location request at predetermined time intervals. In yet another alternative embodiment, the client unit **102** may generate the request for client location periodically unless the user has recently generated a manual request via the user interface **216**.

[1044] In yet another alternative embodiment, the server unit **120** may request the client location in step **402**. In this embodiment, the server unit **120** may transmit a location request via the radio transmission **156** (see FIG. 1). In this embodiment, the client unit **102** may automatically respond to the request transmitted by the server unit **120** or may prompt the user to activate the request for client location via the user interface **216**. If the client unit **102** responds automatically, the location of the client unit **102** may be determined in a manner that is transparent to the user.

[1045] Regardless of the specific entity requesting the client location in step **402**, the client unit **102** responds to the request by capturing fragmentary GPS data in step **404**. As previously discussed, fragmentary GPS data simply refers to GPS data that is insufficient or incomplete in some manner such that the client unit **102** cannot determine its own location independently.

[1046] In step **406**, the client carrier detection module **208** (see FIG. 2) monitors the RF traffic on a selected RF channel. In decision **410**, the client unit **102** determines whether the RF channel is available. If the RF channel is not available (*i.e.*, radio traffic is already present on the RF channel), the result of decision **410** is NO. In that event, the client unit **102** returns to step **406** and continues to monitor RF traffic until an RF channel is available. If the RF channel is available, the result of decision **410** is YES. In that event, in step **412**, the transmitter enable module **210** enables the transmitter **200** to allow the transmission of the digitized fragmentary GPS data via the two-way radio transmission **156**.

[1047] In step **414**, the server processor **304** uses the transmitted data along with data provided by the server GPS receiver **122** to accurately determine the location of the client unit **102**.

[1048] Once the location of the client **102** has been accurately determined, the server unit **120** can transmit location information back to the client unit **102** via the radio transmission **156**. In step **416**, the server carrier detection module **308** (see FIG. 3) checks RF traffic on the selected RF channel. In decision **420**, the system determines whether the RF channel is available. If the RF channel is not available (*i.e.*, other radio traffic is already transmitting on the RF channel), then the result of decision **420** is NO. In that event, the server unit **120** returns to step **416** and continues to monitor the RF traffic until the RF channel is available. When the RF channel is available, the result of decision **420** is YES. In that event, in step **422**, the server transmitter enable module **310** enables the server transmitter **300** to permit the transmission of location information from the server unit **120** to the client unit **102** via the radio transmission **156**. Once the location information has been transmitted, the process ends at **424**.

[1049] In this manner, the system **100** provides server-assisted techniques for accurately determining the location of the client unit using a radio frequency link between the client unit **102** and the server unit **120**.

[1050] It will be apparent to one skilled in the art that there are other variations to the scenario described above. The request for the location of the client unit **102** could originate at the client unit **102** or the server unit **120**, in which case, the server unit **120** transmits a location request with the unique identifying code attached.

The client unit **102** having the corresponding ID code responds by taking the snapshot, and the process would continue as described, except that the location information would be presented at the server user interface **316**. If the server unit **120** initiates the location request, it may not be necessary to provide location to the client unit **102**. In this example, it is not necessary to perform the processes **416-422** illustrated in FIG. 4.

[1051] According to the principles of the invention, and in various embodiments thereof, the device described can be useful in many applications. For example, client units carried by taxis and messengers could be programmed to automatically take a snapshot and transmit the data packets at timed intervals, providing a dispatcher with accurate location information in real time.

[1052] Client units carried by police or other emergency personnel could be programmed to take snapshots at periodic intervals and store the data. In the event of an emergency, the user would transmit the most recent snapshot data. This would eliminate the time lag associated with the snapshot procedure, and would also provide a general location in situations in which the unit is completely shadowed from the GPS satellite transmissions, within buildings etc.

[1053] It will be obvious to those skilled in the art that there are many other applications for the invention, each of which will require variations on the embodiments described herein, and which are considered to be encompassed within the scope of the invention.

CLAIMS

What is claimed is:

1. A server-assisted position detection system, comprising:

a client global positioning system (GPS) receiver circuit, for receiving a first set of satellite positioning signal data from GPS satellites, the first set of data being insufficient to independently establish the location of the client GPS receiver;

a client transmitter to transmit the first set of data;

a client carrier detection module to detect radio traffic on a radio frequency (RF) channel;

a client transmit-enable module to enable the client transmitter when no radio traffic is detected on the RF channel;

a server receiver to receive the first set of data from the client transmitter; and

a server coupled to the server receiver and configured to analyze the satellite data received by the server receiver, the server using the first set of data and additional satellite positioning signal data to generate location information regarding the location of the client GPS receiver.

2. The system of claim 1, further comprising an additional GPS receiver circuit associated with the server to generate the additional satellite positioning signal data.

3. The system of claim 1, further comprising a client identifier module to generate a unique code identifying the client transmitter.

4. The device of claim 1, further comprising a client processor wherein the client carrier detect module and the client transmit enable module comprise a series of program instructions executed by the client processor.

5. The device of claim 1, further comprising a server user interface module, including a display screen and keyboard to display the location information.

6. The device of claim 5 wherein the server user interface module comprises a representation of a local map for indicating the location information.

7. The device of claim 1, further comprising;

a client receiver to receive the location information;

a server transmitter to transmit the location information to the client receiver;

a server carrier detection module for detecting radio traffic on an RF channel; and

a server transmit-enable module to enable the server transmitter when no radio traffic is detected on the RF channel to thereby transmit the location information to the client receiver.

8. The device of claim 7, further comprising a client user interface, including a display to display the location information.

9. The device of claim 8 wherein the client user interface further comprises a representation of a local map for indicating the location information.

10. The device of claim 7, further comprising a base processor wherein the base carrier detect module and the base transmit enable module comprise a series of program instructions executed by the base processor.

11. A method of server-assisted location detection, comprising:

requesting a location of a client unit;

detecting a plurality of satellite global position signals at the client unit in response to the location request;

capturing segments of the plurality of satellite signals;

transmitting data packets indicative of the captured satellite signals to a server unit via two way radio;

determining the location of the client unit by analysis of the satellite signal segments;

presenting the location of the client unit at a user interface.

12. The method of claim 10 wherein transmitting the data packets to the station comprises:

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in the absence of existing radio traffic, transmitting the data packets from the client unit to the server unit on the selected RF channel.

13. The method of claim 12, further comprising appending identification data to the transmitted data packets, the identification data providing a unique identification of the client unit.

14. The method of claim 11, further comprising:

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in absence of existing radio traffic, transmitting the location information from the server unit to the client unit on the selected RF channel.

15. The method of claim 11 wherein the location request originates at the client unit, the method further comprising transmitting data indicating the location to the client unit via the two-way radio.

16. The method of claim 15 wherein transmitting the location data to the client unit comprises:

compiling the location data into a location information packet;

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in the absence of existing radio traffic, transmitting the location information packet from the server unit to the client unit on the selected RF channel.

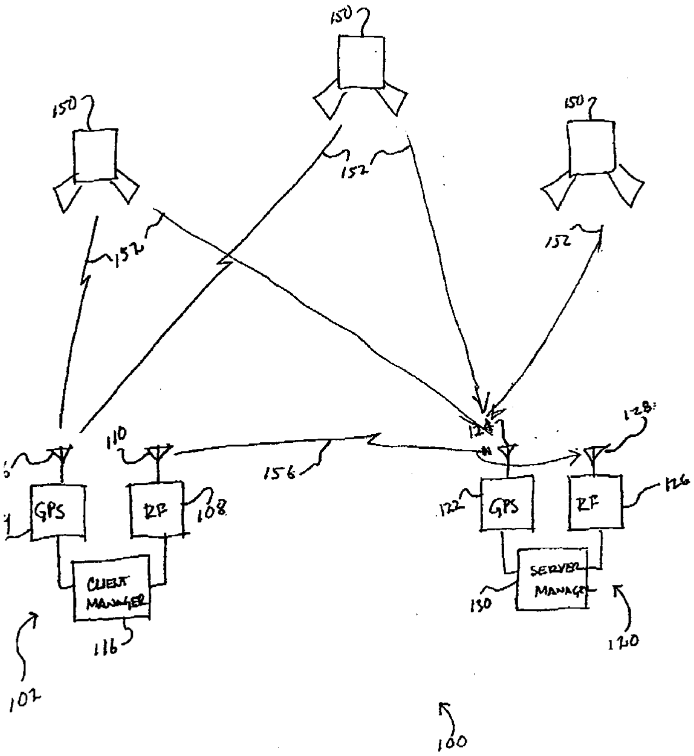
17. The method of claim 16, further comprising appending identification data to the location information packet, the identification data providing a unique identification of the client unit.

18. The method of claim 11 wherein detecting the plurality of satellite global position signals at the client unit and capturing segments occur in advance of receiving the location request.

19. The method of claim 18 wherein detecting the plurality of satellite global position signals at the client unit and capturing segments are performed periodically, and wherein the transmitting data packets to the server following step of receiving a request comprises transmitting the most recent data packets.

20. The method of claim 11 wherein the user interface is a portion of the client unit and presenting the location of the client unit comprises displaying the location on a display.

21. The method of claim 20, further comprising displaying a local map and displaying the location of the client unit on the local map.


150
150
150
152
152
152
152
110
156
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GPS
RF
108
122
GPS
RF
126
CLIENT MANAGER
SERVER MANAGER
130
116
120
102
100

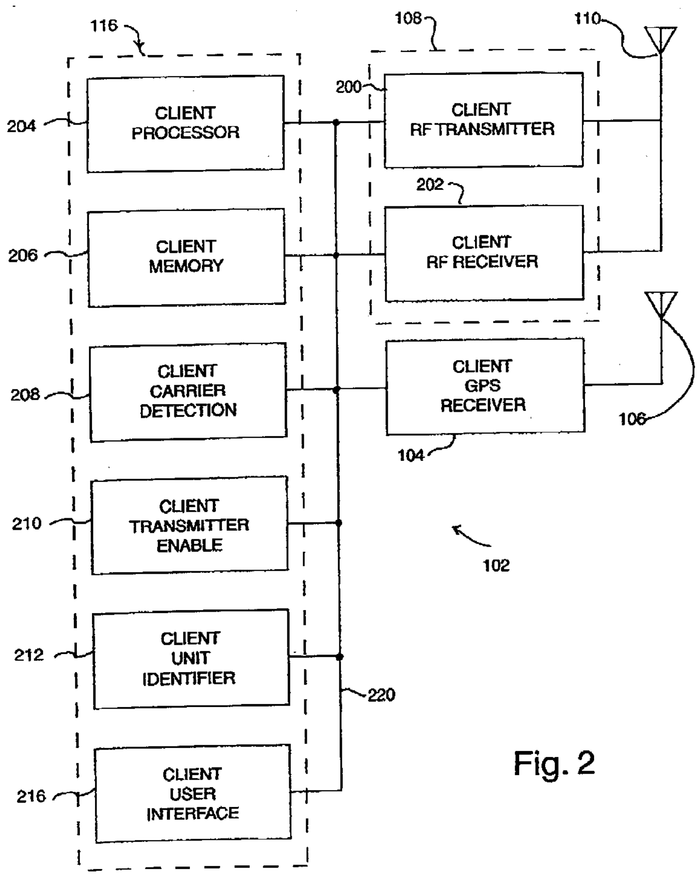
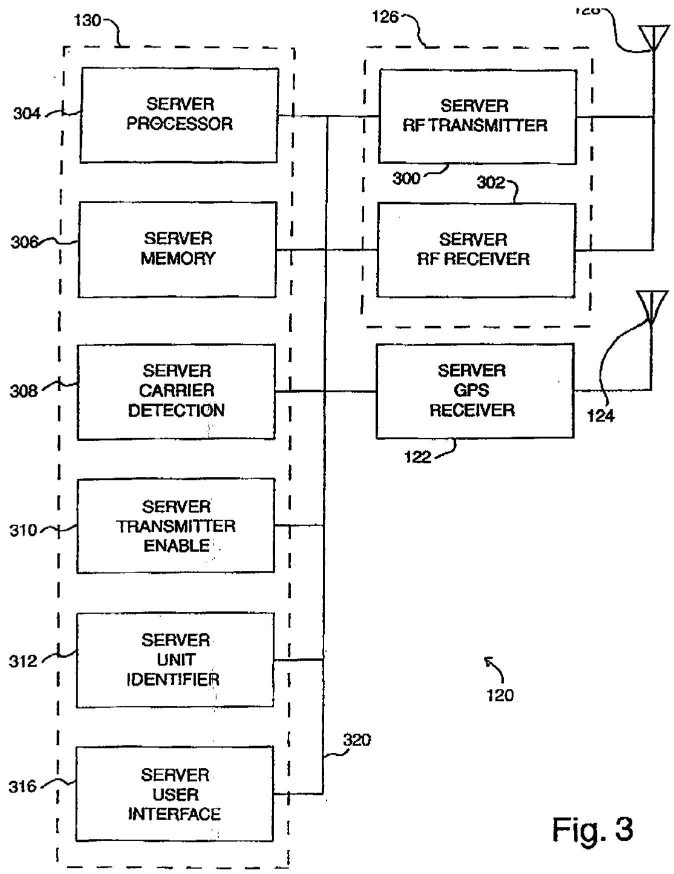

116
108
110
200
CLIENT PROCESSOR
CLIENT RF TRANSMITTER
204
202
CLIENT MEMORY
CLIENT RF RECEIVER
206
CLIENT CARRIER DETECTION
CLIENT GPS RECEIVER
208
106
104
CLIENT TRANSMITTER ENABLE
210
102
CLIENT UNIT IDENTIFIER
212
220
CLIENT USER INTERFACE
216

Fig. 2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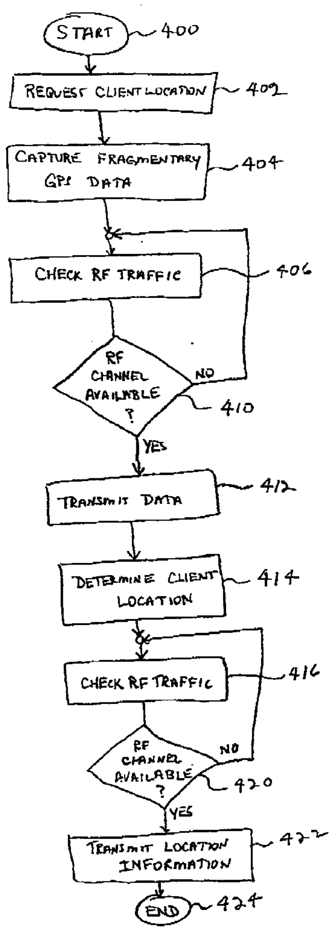
126
SERVER
PROCESSOR
304
SERVER
RF TRANSMITTER
300
302
SERVER
MEMORY
306
SERVER
RF RECEIVER
SERVER
CARRIER
DETECTION
308
SERVER
GPS
RECEIVER
124
122
SERVER
TRANSMITTER
ENABLE
310
SERVER
UNIT
IDENTIFIER
312
120
320
SERVER
USER
INTERFACE
316

Fig. 3


START
400
REQUEST CLIENT LOCATION
402
CAPTURE FRAGMENTARY GPS DATA
404
CHECK RF TRAFFIC
406
RF CHANNEL AVAILABLE ?
NO
410
YES
TRANSMIT DATA
412
DETERMINE CLIENT LOCATION
414
CHECK RF TRAFFIC
416
RF CHANNEL AVAILABLE ?
NO
420
YES
TRANSMIT LOCATION INFORMATION
422
END
424

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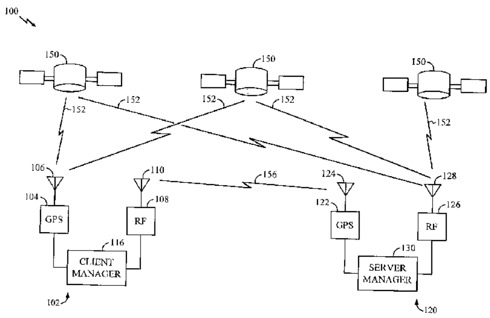
(54) **Title:** SERVER-ASSISTED POSITION DETERMINATION IN A RADIO NETWORK



(57) **Abstract:** According to the principles of the invention, a client unit (102) comprises a client GPS receiver (104) is integrated with a two-way-radio transceiver (108) and a manager (116) for the purpose of performing server-assisted global position fixes, especially in cases where the location or situation makes unassisted fixes impossible or impractical. A server unit (120) is also provided, associated with a second two-way-radio transceiver (126) and a server manager (130). The first and second managers (116 and 130) function as communication managers, each comprising modules for detecting RF channel traffic, enabling transmitter portions of the transceivers (108 and 126). The system may also provide identification codes that accompany data sent from the client unit to the base station to identify the client unit.

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SERVER-ASSISTED POSITION DETERMINATION IN A RADIO NETWORK

RELATED APPLICATIONS

[0000] This application claims priority to pending Provisional application number 60/274,494, filed on March 9, 2001, incorporated herein by reference.

FIELD OF THE INVENTION

[1001] The present invention relates generally to position determination and, in particular, concerns to server-assisted position determination technology in a radio network.

BACKGROUND OF THE INVENTION

[1002] Global Positioning System (GPS) receivers normally determine their position by computing relative times of arrival of signals transmitted simultaneously from a multiplicity of GPS (or NAVSTAR) satellites. These satellites transmit, as part of their message, both satellite positioning data as well as data on clock timing, so-called "ephemeris" data. The process of searching for and acquiring GPS signals, reading the ephemeris data for a multiplicity of satellites and computing the location of the receiver from this data is time consuming, often requiring several minutes. In many cases, this lengthy processing time is unacceptable and, furthermore, greatly limits battery life in micro-miniaturized portable applications.

[1003] Another limitation of current GPS receivers is that successful operation is limited to situations in which multiple satellites are clearly in view, without obstructions, and where a good quality antenna is properly positioned to receive such signals. As such, they normally are unusable in portable, body-mounted applications, in areas where there is significant foliage or building blockage (*e.g.*, urban canyons), and in in-building applications.

[1004] One known solution to this problem involves the use of a cellular telephone, integrated with a GPS receiver. A cellular link is established between the mobile GPS unit, or client, and a second, stationary, GPS receiver, which is associated with a second cellular unit and a computer processor, or server. The mobile GPS receiver takes what is referred to as a snapshot of the available satellite signals. That is to say, the mobile GPS receiver records a short duration of signals from as many satellites as are available in its line of sight. As described above, these signals are likely to be attenuated and fragmented, due to the location of the mobile GPS receiver, which may be in close proximity to buildings or foliage, etc.

[1005] According to one known method, described in U.S. Patent No. 6,131,067, these fragmented signals are digitized, and transmitted, via a cellular link, from the client to the second GPS receiver and server. The second GPS receiver, meanwhile, is recording signals from GPS satellites within line of sight of its own antenna, which is a stationary mounted antenna, situated in a location where it receives unobstructed transmissions from the available satellites. The server associated with the second GPS receiver is then tasked with comparing the signals of the two receivers. By analyzing the fragmented signals from the mobile GPS receiver to the complete signals received by the second GPS receiver, the server can essentially "fill in the blanks" and complete the signals as received at the mobile GPS receiver. The server can then take those reconstructed signals and, using known methods, accurately determine the location of the mobile GPS receiver.

[1006] The amount of assistance afforded by the second GPS receiver or base station, can vary significantly. It may be as little as transmitting stored information regarding specific satellites, up to performing the matching process and signal analysis as previously described. In all cases however, the server-assisted location technology requires the use of a cellular link, or some other dedicated transmission medium such that a two-way communication link is continuously established between the client and server.

[1007] In other circumstances, a cellular telephone network is not available and radio communication is provided between parties. As those skilled in the art can appreciate, radio communication is intermittent with a single transmitter transmitting at a selected frequency and any receiver tuned to the selected frequency being capable of detecting the transmitted signals. When the transmitter completes transmitting, the selected frequency is available for use by any other transmitter. Thus, a particular frequency or channel is available for use by any transmitter. The server-assisted location technology described above cannot be implemented in a conventional two-way radio because radio communication, does not permit a dedicated two-way communication link. Therefore, it can be appreciated that there is a significant need for server-assisted location technology in a two-way radio system. The present invention provides this, and other advantages, as will be apparent from the following detailed description and accompanying figures.

SUMMARY OF THE INVENTION

[1008] A server-assisted position detection device comprises a client global positioning system (GPS) receiver circuit to receive satellite positioning signal data from GPS satellites. The satellite position data received by the client GPS receiver is insufficient to independently establish the location of the client GPS receiver. The client further includes a transmitter to transmit satellite data. A client carrier detection module is used to detect radio traffic on a selected radio frequency (RF) channel. A client transmit enable module enables the client transmitter when no radio traffic is detected on the RF channel.

[1009] A server receiver receives data from the client transmitter. A server coupled to the server receiver is configured to analyze the satellite data received by the server receiver. The server uses the received satellite data and additional satellite data to generate location information regarding the location of the client GPS receiver.

[1010] The location information may be used remotely or returned to the client unit. To return the location information to the client unit, the system may further comprise a client receiver to receive the location information and a server transmitter to transmit the location information to the client receiver. The server unit further comprises a server carrier detection module to detect radio traffic on an RF channel and a server transmit enable module to enable the server transmitter when no radio traffic is detected on the RF channel to thereby transmit the location information to the client receiver. In alternative embodiments, the client may further comprise a client user interface for displaying the location information. The client user interface may further comprise representation of a local map to indicate the location information.

BRIEF DESCRIPTION OF THE DRAWINGS

[1011] FIG. 1 illustrates a functional block diagram of an exemplary embodiment of the present invention.

[1012] FIG. 2 is a functional block diagram illustrating the components of a client unit of FIG. 1.

[1013] FIG. 3 is a functional block diagram illustrating the components of a base station of FIG. 1.

[1014] FIG. 4 is a flowchart illustrating the operation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[1015] This invention concerns the method and apparatus for establishing a global position using a client two-way radio. For the sake of convenience, the invention is described in the form of a client-server architecture where the term "client" refers to a portion of the system integrated into or associated with a two-way radio and for which accurate location information is desired. The term "server" refers to a portion of the system associated with a server two-way radio and which provides data by which the location of the client may be accurately determined.

[1016] Two-way radio frequency communication, in general, has developed an informal protocol to manage traffic on any given radio frequency (RF) channel. The term "channel" as used herein refers to any radio frequency. Some portions of the RF spectrum are allocated into channels having predetermined frequencies. However, the principles of the present invention are not limited to portions of the spectrum having predetermined frequencies. Thus, channel simply refers to any frequency selected by the user.

[1017] A user, wishing to broadcast on a given channel, first listens to a receiver tuned to that channel, to detect the existence of other communication traffic on the channel. In the absence of other traffic on the channel, the user presses a button, sometimes referred to as a push-to-talk (PTT) button, which activates a transmitter on the same frequency, and speaks into the microphone. The user releases the button to cease transmitting and listens for a response on the channel. A second user, wishing to respond, follows the same procedure before responding, first listening for other traffic on the channel, then pressing the PTT button, and speaking into a microphone in response. In regions where radio traffic is heavy, it is not uncommon for two or three conversations to proceed more or less simultaneously. In such an event, user A might wish to converse with user B, while user C wishes to converse with user D. User A might ask a question of user B, but before user B responds, user C might address user D. According to the accepted protocol, user B must wait until there is a break in the traffic on the channel before responding to the question of user A. Failure to follow this informal protocol may result in two users (*e.g.*, user B and user C) transmitting at the same time. The resultant interference may make it impossible for any users to communicate on that channel.

[1018] When a mobile device, such as a cellular telephone, determines its position using a cellular link, or some other dedicated transmission medium, the devices (*i.e.*, the client and the server) can operate as though they are cabled together. That is, the cellular network assigns dedicated channels over which the client and server may communicate without disruption. In other wireless systems, such as a code division multiple access (CDMA) wireless system, each client unit is assigned a unique code such that each client unit effectively has a continuous dedicated communication link with a base station. In contrast, devices operating using two-way radio communication must contend with the fact that the radio frequency channel is neither private nor exclusive.

[1019] In the case of a server-assisted GPS positioning system, the informal protocol described above would make it impossible to function according to the methods developed for cellular communication. During the period of time that the server is calculating the accurate position of the client, there is no communication on the link between the client device and the server device. For example, there is a certain time requirement in performing the snapshot, in which the client GPS receiver records available signals from the local satellites. It may also take many seconds, or even minutes, for the server to perform the various steps required in establishing the position of the client. The client device cannot maintain the transmitter in an active state since such activation prevents other users from transmitting on that channel without interference. Furthermore, the client device would be incapable of receiving response data from the server device if the client device were constantly maintained in a transmit mode. Thus, a conventional radio system transmits in only one direction at a time and requires that the transmitting device cease transmission in order to receive. During these breaks in transmission other radio traffic can disrupt the link between the client and the server.

[1020] FIG. 1 illustrates, in a functional block diagram format, the basic operation of a system **100** constructed according to the principles of the invention. A client unit **102** comprises a GPS receiver **104** coupled to a GPS antenna **106** and a two-way radio transceiver **108** coupled to a radio antenna **110**.

[1021] The client unit **102** also includes a client manager **116**. The term "client manager" is used for convenience only, and is not intended to suggest that all the functions performed as described herein are performed by a single device or component. Rather, according to the principles of the invention, the functions may be performed by a single device or a plurality of devices, incorporating hardware, software or firmware, or a combination thereof.

[1022] A server unit **120** comprises a GPS receiver **122** coupled to GPS antenna **124** and a two-way radio transceiver **126** coupled to a radio antenna **128**. The server unit **120** also includes a server manager **130**. The term "server manager" is also used in a very broad sense to indicate a plurality of functions which are performed by a device, or devices, according to the principles of the invention.

[1023] As noted above, the term "client" refers to a portion of the system **100** which cannot independently determine its precise location while the term "server" refers to a portion of the system that receives data from the client and uses the client data in conjunction with independently derived data to precisely determine the location of the client device.

[1024] In a typical embodiment, the client unit **102** may be implemented in a mobile two-way radio, such as may be used by a police officer or firefighter. The server unit **120** may be implemented in a base-station, such as a central dispatch center for a police or fire department. However, those skilled in the art can appreciate that the client unit **102** may be in a fixed location while the server unit **120** may be a mobile unit. The present invention simply has one component (*i.e.*, the client unit **102**) that is incapable of independently calculating its own location, but which can transmit fragmentary or incomplete location data to a second component (*i.e.*, the server unit **120**) to permit the calculation of the client unit location by the server unit.

[1025] When the location of the client unit **102** is required, the position is determined in a manner that is similar to that described with respect to the cellular telephone system. That is, the client GPS receiver **104** captures the available GPS satellite transmissions from one or more GPS satellites **150** via a satellite link **152**. If the client unit **102** were capable of establishing satellite links **152** with a sufficient number of satellites **150**, the client unit could determine its own location using conventional GPS techniques. However, the present invention is intended for operation in circumstances where the client unit **102** cannot establish satellite links **152** with a sufficient number of satellites **150** or cannot establish the satellite links for a sufficient length of time. Instead of a complete set of GPS data, the client unit **102** captures only fragmentary or incomplete GPS data in what may be referred to as a "snapshot" of GPS data. The term "snapshot" is used to refer to the task of seeking the satellite signals, from satellites **150** in line of sight with the GPS receiver **104**, and recording fragmentary or incomplete GPS signals that are insufficient to permit location determination.

[1026] With the client manager **116** and the server manager **130** managing the two-way-radio interface, the data collected from the snapshot are transmitted via a radio transmission **156** from the client unit **102** to the server unit **120**. The server unit **120** compares the data collected by the client unit **102** with data collected simultaneously by the server GPS receiver **122**, thereby permitting reconstruction of the fragmentary data as required. The resulting information is analyzed by the server unit **120** to accurately determine the location of the client unit **102**.

[1027] The client manager **116** and the server manager **136** control the flow of data between the client unit **102** and the server unit **120**. FIG. 2 shows, in greater detail, the functional modules of the client unit **102**, while FIG. 3 similarly illustrates the server unit **120**.

[1028] In one embodiment of the invention, illustrated in FIG. 2, the transceiver **108** is functionally illustrated as a transmitter **200** and receiver **202**. In one embodiment, the transceiver **108** may be integrated with the GPS receiver **104** into a single unit. The transceiver **108** may have one antenna **110**, and the GPS receiver a second antenna **106**, as shown in FIG. 2, or they may share a single antenna (not shown).

[1029] Also integrated into the same unit is the client manager **116**, having a processor **204** and memory **206**. The processor **204** may be implemented by any conventional processing device, such as a microprocessor, microcontroller, application specific integrated circuit, digital signal processor, or the like. The client memory **206** may comprise random access memory (RAM) and read-only memory (ROM) and may also include nonvolatile RAM. The client memory **206** contains instructions and data executed by the CPU **204** to implement many of the functions of the client unit **102**. For example, the client memory **206** may be supplied with software or firmware comprising a carrier detection module **208**, a transmitter enable module **210**, and a unit identifier module **212**.

[1030] A user interface module **216** configured according to the specific requirements of the application is further included. A typical user interface **216** might comprise a small display with a keypad, in the case of a hand held or body mounted device, or a larger computer screen with keyboard, such as might be used in a vehicle mounted unit. If the client user interface **216** includes a small display, such as a liquid crystal display (LCD), the client user interface can indicate the position of the client unit **102** using, by way of example, latitude and longitude coordinates. If the client user interface **216** includes a computer display, other optional data may be provided to the user. For example, a graphical representation of a map of the local region with means for indicating the position of the client unit **102** in relation to the immediate surroundings is another possible user interface.

[1031] The various components described above are coupled together by a bus system **220**, which may include a data bus, control bus, address bus, power bus, and the like. However, for the sake of clarity, the various buses are illustrated in FIG. 2 as the bus system **220**. A person skilled in the art will recognize that the actual communication links between the various modules will vary according to the configuration, and may be as simple as conductive pathways in an integrated circuit in an implementation where the modules are integrated into a single device, or may be printed circuit board traces, electronic cables, connectors, optical cables or any other medium that will serve to provide reliable communication between the modules of the client unit **102**.

[1032] FIG. 3 shows a typical configuration of a server unit **120**. The various components of the base station may or may not be integrated into a single unit. For example, the server unit **120** may be an integrated system in which the server transceiver **126** is integrated with the GPS receiver **122**. The server transceiver **126** may have one antenna **128** and the GPS receiver **122** a second antenna **124** (as shown in FIG. 3), or they may share a single antenna (not shown). The server manager **130** may be integrated into the server unit **120** or may be located at some distance from the server transceiver **126** and GPS receiver **122**. In yet another alternative embodiment, a remote processor (not shown) may receive the fragmentary data from the client unit **102** via the server transceiver **126** and the complete GPS data from the GPS receiver **122** and perform calculations. The resultant location information may be relayed back to the client unit **102** via the server transceiver **126**. However, the calculations described above need not be performed by the server unit **120**. The server transceiver **126** is functionally illustrated in FIG. 3 as a RF transmitter **300** and a RF receiver **302**.

[1033] The server manager **130**, performs a similar function as the client manager **116** in the client unit **102** and includes similar components, such as a server processor **304** and server memory **306**. The processor **304** may be implemented by any conventional processing device, such as a microprocessor, microcontroller, application specific integrated circuit, digital signal processor, or the like. The client memory **306** may comprise random access memory (RAM) and read-only memory (ROM) and may also include nonvolatile RAM. The client memory **306** contains instructions and data executed by the processor to implement many of the functions of the server unit **120**. For example, the client memory **306** may be supplied with firmware or software programs comprising a carrier detection module **308**, a transmitter enable module **310**, and a base identifier module **312**.

[1034] A user interface module **316** is configured according to the specific requirements of the application. As noted above with respect to the client user interface **216** (see FIG. 2) the server user interface **316**, may comprise a display and user input device, such as a keypad or keyboard. For the sake of brevity, those elements are not illustrated in FIG. 3. However, as noted above, the display (not shown) portion of the server user interface **316** may be a simple alphanumeric display to provide data indicating the position of the client unit **102** or may be a computer display to provide additional data, such as a map overlay to indicate the position of the client unit relative to immediate surroundings.

[1035] The various components described above are coupled together by a bus system **320**, which may include a data bus, control bus, address bus, power bus, and the like. However, for the sake of clarity, the various buses are illustrated in FIG. 3 as the bus system **320**. Furthermore, the bus system **320**, which is illustrated functionally rather than structurally, may actually be one or more of several types of connections. Inasmuch as the components of the server unit **120** may be physically remote from each other, the connectors will be selected according to the specific requirements, but may include electronic cables, optical cables, network connections, internet links, or other means for establishing the required communication between the components.

[1036] With reference to FIGs. 1-3, the operation of the system **100** may now be described. When the location of the client unit **102** is desired, the user initiates the location request at the client user interface **216** (see FIG. 2). In response to the location request, the GPS receiver **104** takes a snapshot, capturing a segment of transmission from as many of the GPS satellites **150** (see FIG. 1) as are in line of sight when the GPS receiver **104** is enabled to perform the capture process. The GPS receiver **104** then digitizes the transmission segments and collects them into data packets, which are passed to the client manager **116**.

[1037] The unit identifier module **212** generates a unique ID code that identifies the particular client unit **102**, and appends the ID code to the data packets, which include the code and the digitized information from the GPS receiver **104**. The ID code is particularly useful when many different client units **102** may be operating in a geographic region. For example, the system **100** may be used to track a fleet of taxi cabs in a city. The unique ID code can differentiate between each of the taxi cabs. If only a single client unit **102** is present in the system, then the unique ID code is not necessary.

[1038] The carrier detection module **212** (see FIG. 2) detects radio traffic on a radio frequency channel. The carrier detection module **212** uses known techniques, such as monitoring an RF channel for transmitted signals having an energy level above a predetermined threshold. If radio traffic is present on the RF channel, the transmitter enable module **210** prevents activation of the transmitter **200**. This avoids RF collision and the resultant interference. In the absence of radio traffic on the RF channel, the transmitter enable module **210** enables the transmitter **200** to transmit one or more data packets to the server unit **120** via the radio transmission **156** (see FIG. 1).

[1039] With reference to FIG. 3, the receiver **302** of the server unit **120** receives the transmitted data packets. The server unit identifier **312** recognizes the unique code of the client unit **104** and the server manager **130** accepts the transmission. The server processor **304** extracts the data and performs the location analysis as previously described, and establishes the precise location of the client unit **104**. The process of locating the client unit **104** using the snapshot data in conjunction with GPS data from the server GPS receiver **122** is well known in the art and need not be described in detail herein.

[1040] The server processor **304** can accurately establish the location of the client unit **104** using data transmitted over the radio transmission **156** (see FIG. 1). The server processor **304** generates location information concerning the client unit **102**. The location information is assembled digitally into a location information packet. The server identifier module 312 then generates and attaches the unique code identifying the client unit **102**.

[1041] The server carrier detection module **308** detects radio traffic on a radio frequency channel. If radio traffic is present on the RF channel, the transmitter enable module **310** prevents activation of the transmitter **300**. This avoids RF collision and the resultant interference. In the absence of radio traffic on the RF channel, the transmitter enable module **310** enables the transmitter **300** to transmit location information to the client unit **102** via the radio transmission **156** (see FIG. 1). Thus, the system **100** permits the exchange of information between the client unit **102** and the server unit **120** via the radio transmission **156**. At the same time, the system **100**

prevents the inadvertent transmission by either the client unit **102** or the server unit **120** that may cause interference by transmitting when other RF traffic is already on the selected RF channel.

[1042] Returning again to FIG. 2, the RF receiver **202** of the client unit **102** receives the transmitted location information packet. The client unit identifier module **212** detects the unique ID code, which identifies the location information packet as being pertinent to the client unit **102**, and decodes the location information packet, extracting the location information. The location of the client unit **102** is presented at the user interface **216**.

[1043] The operation of the system **100** is illustrated in the flowchart of FIG. 4 where at a start **400**, at least one client unit **102** (see FIG. 1) and one server unit **120** are available. In step **402**, there is a request to determine the location of the client unit **102**. In one example embodiment, discussed above, the user of the client unit **102** manually requests the location via the user interface **216** (see FIG. 2). However, those skilled in the art will appreciate that a number of different techniques may be used to request the client location. For example, the client **102** may automatically generate the client location request at predetermined time intervals. In yet another alternative embodiment, the client unit **102** may generate the request for client location periodically unless the user has recently generated a manual request via the user interface **216**.

[1044] In yet another alternative embodiment, the server unit **120** may request the client location in step **402**. In this embodiment, the server unit **120** may transmit a location request via the radio transmission **156** (see FIG. 1). In this embodiment, the client unit **102** may automatically respond to the request transmitted by the server unit **120** or may prompt the user to activate the request for client location via the user interface **216**. If the client unit **102** responds automatically, the location of the client unit **102** may be determined in a manner that is transparent to the user.

[1045] Regardless of the specific entity requesting the client location in step **402**, the client unit **102** responds to the request by capturing fragmentary GPS data in step **404**. As previously discussed, fragmentary GPS data simply refers to GPS data that is insufficient or incomplete in some manner such that the client unit **102** cannot determine its own location independently.

[1046] In step **406**, the client carrier detection module **208** (see FIG. 2) monitors the RF traffic on a selected RF channel. In decision **410**, the client unit **102** determines whether the RF channel is available. If the RF channel is not available (*i.e.*, radio traffic is already present on the RF channel), the result of decision **410** is NO. In that event, the client unit **102** returns to step **406** and continues to monitor RF traffic until an RF channel is available. If the RF channel is available, the result of decision **410** is YES. In that event, in step **412**, the transmitter enable module **210** enables the transmitter **200** to allow the transmission of the digitized fragmentary GPS data via the two-way radio transmission **156**.

[1047] In step **414**, the server processor **304** uses the transmitted data along with data provided by the server GPS receiver **122** to accurately determine the location of the client unit **102**.

[1048] Once the location of the client **102** has been accurately determined, the server unit **120** can transmit location information back to the client unit **102** via the radio transmission **156**. In step **416**, the server carrier detection module **308** (see FIG. 3) checks RF traffic on the selected RF channel. In decision **420**, the system determines whether the RF channel is available. If the RF channel is not available (*i.e.*, other radio traffic is already transmitting on the RF channel), then the result of decision **420** is NO. In that event, the server unit **120** returns to step **416** and continues to monitor the RF traffic until the RF channel is available. When the RF channel is available, the result of decision **420** is YES. In that event, in step **422**, the server transmitter enable module **310** enables the server transmitter **300** to permit the transmission of location information from the server unit **120** to the client unit **102** via the radio transmission **156**. Once the location information has been transmitted, the process ends at **424**.

[1049] In this manner, the system **100** provides server-assisted techniques for accurately determining the location of the client unit using a radio frequency link between the client unit **102** and the server unit **120**.

[1050] It will be apparent to one skilled in the art that there are other variations to the scenario described above. The request for the location of the client unit **102** could originate at the client unit **102** or the server unit **120**, in which case, the server unit **120** transmits a location request with the unique identifying code attached.

The client unit **102** having the corresponding ID code responds by taking the snapshot, and the process would continue as described, except that the location information would be presented at the server user interface **316**. If the server unit **120** initiates the location request, it may not be necessary to provide location to the client unit **102**. In this example, it is not necessary to perform the processes **416-422** illustrated in FIG. 4.

[1051] According to the principles of the invention, and in various embodiments thereof, the device described can be useful in many applications. For example, client units carried by taxis and messengers could be programmed to automatically take a snapshot and transmit the data packets at timed intervals, providing a dispatcher with accurate location information in real time.

[1052] Client units carried by police or other emergency personnel could be programmed to take snapshots at periodic intervals and store the data. In the event of an emergency, the user would transmit the most recent snapshot data. This would eliminate the time lag associated with the snapshot procedure, and would also provide a general location in situations in which the unit is completely shadowed from the GPS satellite transmissions, within buildings etc.

[1053] It will be obvious to those skilled in the art that there are many other applications for the invention, each of which will require variations on the embodiments described herein, and which are considered to be encompassed within the scope of the invention.

CLAIMS

What is claimed is:

1. A server-assisted position detection system, comprising:

a client global positioning system (GPS) receiver circuit, for receiving a first set of satellite positioning signal data from GPS satellites, the first set of data being insufficient to independently establish the location of the client GPS receiver;

a client transmitter to transmit the first set of data;

a client carrier detection module to detect radio traffic on a radio frequency (RF) channel;

a client transmit-enable module to enable the client transmitter when no radio traffic is detected on the RF channel;

a server receiver to receive the first set of data from the client transmitter; and

a server coupled to the server receiver and configured to analyze the satellite data received by the server receiver, the server using the first set of data and additional satellite positioning signal data to generate location information regarding the location of the client GPS receiver.

2. The system of claim 1, further comprising an additional GPS receiver circuit associated with the server to generate the additional satellite positioning signal data.

3. The system of claim 1, further comprising a client identifier module to generate a unique code identifying the client transmitter.

4. The device of claim 1, further comprising a client processor wherein the client carrier detect module and the client transmit enable module comprise a series of program instructions executed by the client processor.

5. The device of claim 1, further comprising a server user interface module, including a display screen and keyboard to display the location information.

6. The device of claim 5 wherein the server user interface module comprises a representation of a local map for indicating the location information.

7. The device of claim 1, further comprising;

a client receiver to receive the location information;

a server transmitter to transmit the location information to the client receiver;

a server carrier detection module for detecting radio traffic on an RF channel; and

a server transmit-enable module to enable the server transmitter when no radio traffic is detected on the RF channel to thereby transmit the location information to the client receiver.

8. The device of claim 7, further comprising a client user interface, including a display to display the location information.

9. The device of claim 8 wherein the client user interface further comprises a representation of a local map for indicating the location information.

10. The device of claim 7, further comprising a base processor wherein the base carrier detect module and the base transmit enable module comprise a series of program instructions executed by the base processor.

11. A method of server-assisted location detection, comprising:

requesting a location of a client unit;

detecting a plurality of satellite global position signals at the client unit in response to the location request;

capturing segments of the plurality of satellite signals;

transmitting data packets indicative of the captured satellite signals to a server unit via two way radio;

determining the location of the client unit by analysis of the satellite signal segments;

presenting the location of the client unit at a user interface.

12. The method of claim 10 wherein transmitting the data packets to the station comprises:

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in the absence of existing radio traffic, transmitting the data packets from the client unit to the server unit on the selected RF channel.

13. The method of claim 12, further comprising appending identification data to the transmitted data packets, the identification data providing a unique identification of the client unit.

14. The method of claim 11, further comprising:

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in absence of existing radio traffic, transmitting the location information from the server unit to the client unit on the selected RF channel.

15. The method of claim 11 wherein the location request originates at the client unit, the method further comprising transmitting data indicating the location to the client unit via the two-way radio.

16. The method of claim 15 wherein transmitting the location data to the client unit comprises:

compiling the location data into a location information packet;

observing a selected radio frequency (RF) channel to detect existing radio traffic on the selected RF channel; and

in the absence of existing radio traffic, transmitting the location information packet from the server unit to the client unit on the selected RF channel.

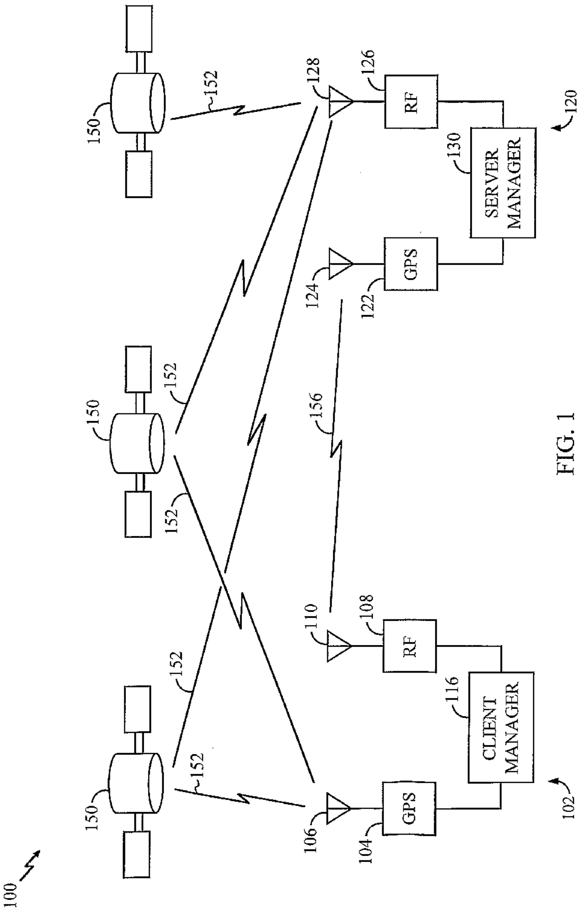
17. The method of claim 16, further comprising appending identification data to the location information packet, the identification data providing a unique identification of the client unit.

18. The method of claim 11 wherein detecting the plurality of satellite global position signals at the client unit and capturing segments occur in advance of receiving the location request.

19. The method of claim 18 wherein detecting the plurality of satellite global position signals at the client unit and capturing segments are performed periodically, and wherein the transmitting data packets to the server following step of receiving a request comprises transmitting the most recent data packets.

20. The method of claim 11 wherein the user interface is a portion of the client unit and presenting the location of the client unit comprises displaying the location on a display.

21. The method of claim 20, further comprising displaying a local map and displaying the location of the client unit on the local map.



100
150
152
128
126
RF
120
130
SERVER MANAGER
GPS
124
122
156
110
108
116
CLIENT MANAGER
106
104
102

FIG. 1

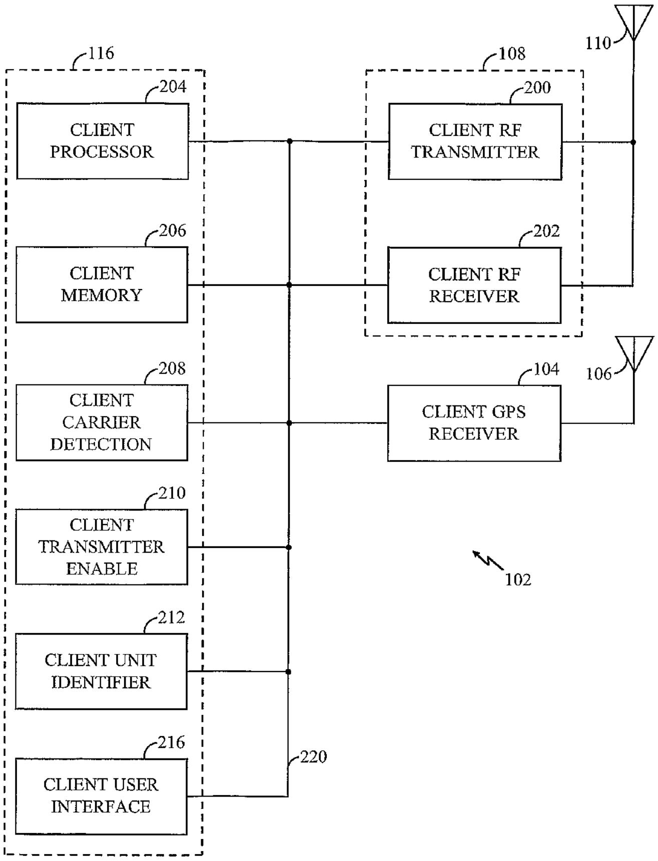

116
204
CLIENT PROCESSOR
206
CLIENT MEMORY
208
CLIENT CARRIER DETECTION
210
CLIENT TRANSMITTER ENABLE
212
CLIENT UNIT IDENTIFIER
216
CLIENT USER INTERFACE
220
108
200
CLIENT RF TRANSMITTER
202
CLIENT RF RECEIVER
110
104
CLIENT GPS RECEIVER
106
102

FIG. 2

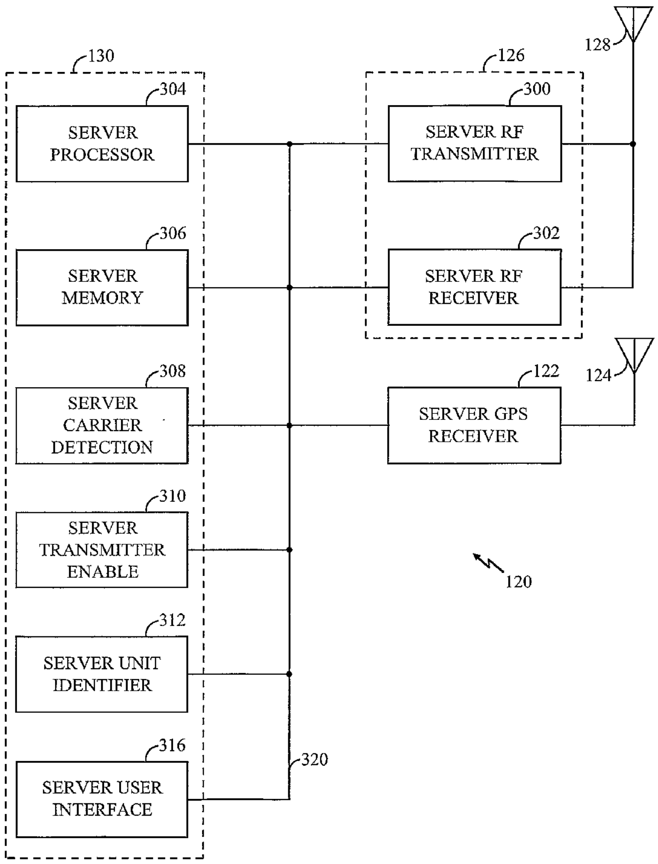
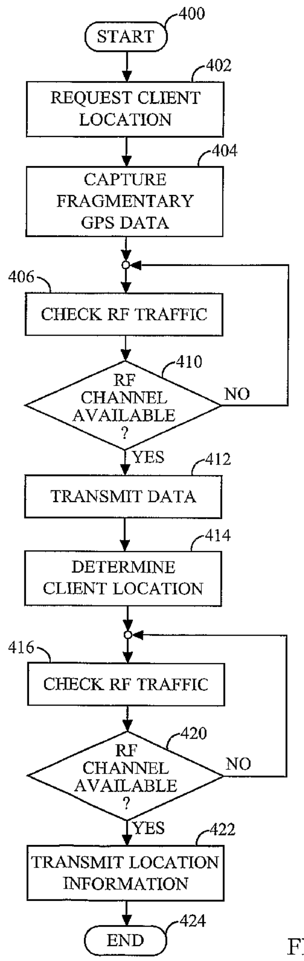

130
304
SERVER PROCESSOR
306
SERVER MEMORY
308
SERVER CARRIER DETECTION
310
SERVER TRANSMITTER ENABLE
312
SERVER UNIT IDENTIFIER
316
SERVER USER INTERFACE
320
126
300
SERVER RF TRANSMITTER
302
SERVER RF RECEIVER
128
122
SERVER GPS RECEIVER
124
120

FIG. 3

4/4



START
400
REQUEST CLIENT LOCATION
402
CAPTURE FRAGMENTARY GPS DATA
404
406
CHECK RF TRAFFIC
RF CHANNEL AVAILABLE ?
410
NO
YES
TRANSMIT DATA
412
DETERMINE CLIENT LOCATION
414
416
CHECK RF TRAFFIC
RF CHANNEL AVAILABLE ?
420
NO
YES
TRANSMIT LOCATION INFORMATION
422
END
424

FIG. 4

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(71) Applicant: QUALCOMM INCORPORATED [US/US]; 5775 Morehouse Drive, San Diego, CA 92121-1714 (US).

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Published:
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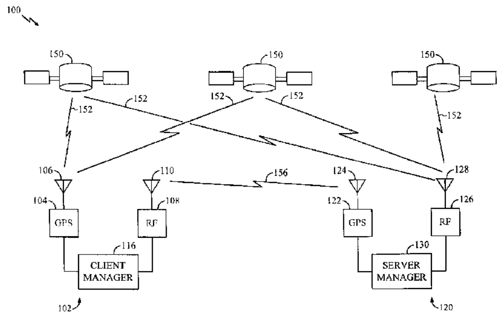
(15) Information about Correction:

[Continued on next page]

(54) Title: SERVER-ASSISTED POSITION DETERMINATION IN A RADIO NETWORK



(57) Abstract: According to the principles of the invention, a client unit (102) comprises a client GPS receiver (104) is integrated with a two-way-radio transceiver (108) and a manager (116) for the purpose of performing server-assisted global position fixes, especially in cases where the location or situation makes unassisted fixes impossible or impractical. A server unit (120) is also provided, associated with a second two-way-radio transceiver (126) and a server manager (130). The first and second managers (116 and 130) function as communication managers, each comprising modules for detecting RF channel traffic, enabling transmitter portions of the transceivers (108 and 126). The system may also provide identification codes that accompany data sent from the client unit to the base station to identify the client unit.

WO 02/073231 A3

WO 02/073231 A3

Previous Correction:
see PCT Gazette No. 05/2003 of 30 January 2003, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/07354

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01S5/14 G01S5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, PAJ, EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	US 6 389 291 B1 (ATURETZKY GREGORY BRET ET AL) 14 May 2002 (2002-05-14) abstract column 3, line 21 -column 15, line 11; figures 1-8	1-5,7,8,10
P,X	& WO 02 15612 A (XATURETZKY GREGORY BRET ET AL) 21 February 2002 (2002-02-21) ---	1-5,7,8,10
X	WO 00 49695 A (MOTOROLA INC) 24 August 2000 (2000-08-24) abstract	1
A	page 4, line 3 -page 18, line 7; figures 1-8 --- -/--	2-5,7,8,10

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search
11 March 2003

Date of mailing of the international search report
26.03.2003

Name and mailing address of the ISA
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Fax: (+31-70) 340-3016

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Blondel, F

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/07354

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 10028 A (ERICSSON INC) 24 February 2000 (2000-02-24) abstract page 9, line 23 -page 35, line 25; figures 1-6	1-4,7,10
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A	page 2, line 31 -page 4, line 18; figure	13,15, 17,20
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A	DE 196 40 068 A (ALSTHOM CGE ALCATEL) 2 April 1998 (1998-04-02) abstract column 2, line 9 -column 5, line 18; figures 1-4	11-17,20
A	DE 299 11 439 U (CHANG SHIH PING) 4 November 1999 (1999-11-04) abstract page 3, line 30 -page 6, line 13; figures 1-9	11-16

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

International application No.
PCT/US 02/07354

INTERNATIONAL SEARCH REPORT

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. [X] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[X] No protest accompanied the payment of additional search fees.

International Application No. PCT/US 02 /07354

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-10

   server assisted position system by means of a client global positioning system receiver circuit

2. Claims: 11-21

   method of server assisted location detection by means of requesting a location of a client unit

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 02/07354

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INTERNATIONAL SEARCH REPORT

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(81)指定国　AP(GH,GM,KE,LS,MW,MZ,SD,SL,SZ,TZ,UG,ZM,ZW),EA(AM,AZ,BY,KG,KZ,MD,RU,TJ,TM),EP(AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE,TR),OA(BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,ML,MR,NE,SN,TD,TG),AE,AG,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CO,CR,CU,CZ,DE,DK,DM,DZ,EC,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NO,NZ,OM,PH,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TN,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZM,ZW

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Ｆターム(参考)　5J062 AA07　AA08　CC07　DD11　DD23　FF01　HH05
5K067 BB21　DD20　EE02　EE10　FF03　JJ52　JJ56

(54)【発明の名称】無線ネットワークにおけるサーバ支援された位置決定システムと方法この出願は、２００１年３月９日に提出され、引用によりこの中に組込まれる、未決定の仮出願番号第６０／２７４，４９４号への優先権を主張する。