(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 September 2007 (27.09.2007)

PCT

(10) International Publication Number
WO 2007/107001 A1

(51) International Patent Classification:
G08G 1/123 (2006.01) *G06Q 30/00* (2006.01)
GOlC 21/26 (2006.01) *G06Q 50/00* (2006.01)
GOlC 23/00 (2006.01) *G08G 1/127* (2006.01)
G06Q 20/00 (2006.01)

(21) International Application Number:
PCT/CA2007/000456

(22) International Filing Date: 21 March 2007 (21.03.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/783,855 21 March 2006 (21.03.2006) US
60/858,728 14 November 2006 (14.11.2006) US

(71) Applicant *(for all designated States except US):* **SKYMETER CORPORATION** [CA/CA]; 101 College Street, Suite 200, MaRS Centre South Tower, Toronto, Ontario M5G 1L7 (CA).

(72) Inventor; and

(75) Inventor/Applicant *(for US only):* **GRUSH, Bernard** [CA/CA]; 34 Dodge Road, Toronto, Ontario MlN 2A7 (CA).

(74) Agent: **DEETH WILLIAMS WALL LLP;** 150 York Street, Suite 400, Toronto, Ontario M5H 3S5 (CA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AT, **AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,** CA, **CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ,** EC, EE, **EG,** ES, **FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY,** MA, **MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU,** SC, **SD,** SE, **SG, SK, SL,** SM, **SV, SY, TJ,** TM, **TN, TR,** TT, **TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW**

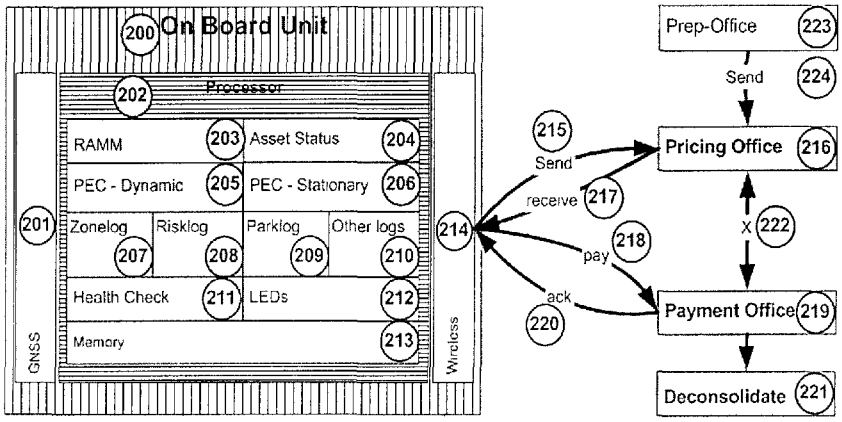
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *with amended claims and statement*

Date of publication of the amended claims and statement:
15 November 2007

[Continued on next page]

(54) **Title:** PRIVATE, AUDITABLE VEHICLE POSITIONING SYSTEM AND ON-BOARD UNIT FOR SAME



(57) **Abstract:** This invention relates to a system and method to generate a private, auditable, evidentiary quality record of the location-history of an asset or person. This invention addresses ten critical improvements over existing systems that are proposed or used for metering for payment services for tolling roads, parking or pay-as-you-drive insurance, namely: 1. cost-effective location accuracy in harsh signal environments 2. evidentiary assurance of location estimation 3. handling of dynamic and stationary positioning in a single device 4. high-ratio compression for a set of stationary positions in urban canyon 5. high-ratio compression for a dynamic tracklog in urban canyon 6. high-ratio compression for a set of asset motion behaviors 7. a method of remote device health check, including anti-tampering 8. removal of residual price assignment errors 9. anonymous use without on-board maps 10. a method of deconsolidating payments to multiple payees with multiple payment regimes This system can be applied to road-pricing, congestion-pricing, metered-by-the-minute parking and pay-as-you-drive insurance, incorporating privacy management, and legal admissibility of the evidentiary record. This same device can also be applied to vehicular fleets, military ordinance, or other location audits for assets whether motorized or not, as might be needed in evidence of contract fulfillment or other forms of non-realtime geofencing audits.

WO 2007/107001 A1

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.

AMENDED CLAIMS
received by the International Bureau on 14 September 2007 (14.09.2007)

15. An on-board unit for tracking the position of a vehicle, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ü) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the moving vehicle by:

applying a fault detection and elimination algorithm; and

applying a constraint analysis;

(iii) compiling a zonelog of the positioning data with respect to the vehicle while moving; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as positioning data streams to a system to enable billing a user of the vehicle for use of the vehicle according to the zonelog.

16. An on-board unit for tracking the position of a vehicle that is moving or stationary, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ü) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the stationary vehicle by:

applying a fault detection and elimination algorithm; and

(iii) compiling a parklog of the positioning data with respect to the vehicle while parked; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as positioning data streams to a system to enable billing a user of the vehicle for use of the vehicle according to the parklog.

17. An on-board unit for tracking the position of a vehicle, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ii) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the moving vehicle by:

applying a fault detection and elimination algorithm;

applying a constraint analysis; and

calculating speed and acceleration of the vehicle;

(iii) compiling a zonelog of the positioning data with respect to the vehicle while moving;

(iv) compiling a risklog of the positioning data comprising a compilation of the zonetog marked with the speed data represented as a speed profile and the acceleration data represented as an acceleration profile of the vehicle; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as positioning data streams to a system to enable billing a user of the vehicle for use of the vehicle according to the zonelog and the risklog.

18. An on-board unit for tracking the position of a vehicle that is moving or stationary, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ii) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the moving vehicle by;

applying a fault detection and elimination algorithm;

applying a constraint analysis; and

for the stationary vehicle by;

applying a fault detection and elimination algorithm; and

(iii) compiling a zonelog of the positioning data with respect to the vehicle while moving;

(iv) compiling a parklog of the positioning data with respect to the vehicle while parked; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as positioning data streams to a system to enable billing a user of the vehicle for use of the vehicle according to the zonelog and the parklog.

19. An on-board unit for tracking the position of a vehicle, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ii) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the moving vehicle by.

applying a fault detection and elimination algorithm;

applying a constraint analysis; and

calculating speed and acceleration of the vehicle;

(iii) compiling a zonelog of the positioning data with respect to the vehicle while moving;

(iv) compiling a risklog of the positioning data comprising a compilation of the zonelog marked with the speed data represented as a speed profile and the acceleration data represented as an acceleration profile of the vehicle; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as positioning data slreams to a system to enable billing a user of the vehicle for use of the vehicle according to the risklog.

20. An on-board unit for tracking the position of a vehicle that is moving or stationary, the unit comprising:

(a) a GNSS receiver, including an antenna, for receiving positioning data with respect to the vehicle's position in timed intervals;

(b) a processor in communication with the receiver and programmed for:

(i) determining if the vehicle is moving or stationary;

(ii) processing the positioning data to generate an estimated position of the vehicle by mitigating multipath error in the positioning data,

for the moving vehicle by:

applying a fault detection and elimination algorithm;

applying a constraint analysis; and

calculating speed and acceleration of the vehicle; and

for the stationary vehicle by:

applying a fault detection and elimination algorithm;

(iii) compiling a zonelog of the positioning data with respect to the vehicle while moving;

(iv) compiling a parklog of the positioning data with respect to the vehicle while parked;

(v) compiling a risklog of the positioning data comprising a compilation of the zonelog marked with the speed data represented as a speed profile and the acceleration data represented as an acceleration profile of the vehicle; and

(c) a memory and a wireless means to store the processed positioning signals after processing, and to forward them as separate positioning data streams to a system to enable billing a user of the vehicle for use of the vehicle according to the parklog and risklog.

STATEMENT UNDER ARTICLE 19(1)

PCT Application No.;	PCT/CA2007/000456
Title:	PRIVATE, AUDITAEJLE VEHICLE POSITIONING SYSTEM AND ON-BOARD UNIT FOR SAME
Applicant:	Skymeter Corporation
Iπt'l Filing Date:	21 March 2007

Claims 1-14 were in the application. New claims 15-20 are presently added (see attached claim pages 42-46). A set of 20 claims is now in the application.

New claims 15-20 have been added to more particularly claim certain aspects of the invention. The claims do not go beyond the disclosure in the International application as filed.