(19) DANMARK

(10) **DK/EP 2242024 T3**

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: ***G 07 B 15/06 (2011.01)***

(45) Oversættelsen bekendtgjort den: **2015-06-01**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2015-02-25**

(86) Europæisk ansøgning nr.: **09450078.2**

(86) Europæisk indleveringsdag: **2009-04-14**

(87) Den europæiske ansøgnings publiceringsdag: **2010-10-20**

(84) Designerede stater: **AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR**

(73) Patenthaver: **Kapsch TrafficCom AG, Am Europlatz 2, 1120 Wien, Østrig**

(72) Opfinder: **Kersten, Jan, Birkfeldstr. 9/1, 71570 Oppenweiler, Tyskland**
Nagy, Oliver, Leopold Steiner Gasse 48, 1190 Wien, Østrig
Scheiber, Herbert, Akazienhofstr. 61/2, 9020 Klagenfurt, Østrig
Schrödl, Sören, Achsenaugasse 6, A-2340 Mödling, Østrig
Tijink, Jasja, Ketzergasse 191/1/14, 2380 Perchtoldsdorf, Østrig

(74) Fuldmægtig i Danmark: **Dennemeyer & Associates S.A, Bavariastr. 7, D-80336 München, Tyskland**

(54) Benævnelse: **FREMGANGSMÅDE, KOMPONENTER OG SYSTEMER TIL GENERERING AF GEBYRTRANSAKTIONER**

(56) Fremdragne publikationer:
EP-A- 1 089 088
EP-A- 1 333 405
EP-A- 1 457 928
US-A- 5 490 079
US-A1- 2005 216 187

Method, components and systems for creating toll transactions

The present invention relates to a method for creating toll transactions in a road toll system, which has at least a first subsystem for a toll transactions creating localisation of vehicle devices by means of global satellite navigation and at least a second subsystem for a toll transactions creating localisation of vehicle devices by means of local tolling sites, wherein at least some vehicle devices can interact with both subsystems and the subsystems can send their toll transactions to a common central station for processing. The invention further relates to a road toll system of this type, a central station, a proxy, and a vehicle device for such a road toll system.

Vehicle devices (onboard units, OBUs), which can interact with toll systems based on different technologies, e.g., global navigation satellite systems (GNSS) and dedicated short range communication beacons (DSRC beacons), are also referred to as “hybrid OBUs”. Hybrid OBUs are being used to an increasing extent due to the continuous integration of different toll systems by means of new central evaluation stations, which make use of multiple systems.

This can cause problems when the geographical coverage areas of the toll systems overlap, because hybrid OBUs can trigger duplicate toll transactions in the overlapping areas. Currently, such duplicate toll transactions must be filtered out in the central station, which requires a great deal of effort because every toll transaction must be reviewed to determine if it is a duplicate.

With regard to OBUs that function exclusively in GNSS road toll systems, it is known from document US 2005/0216187 A1 that, if there is no satellite navigation signal, it is possible to use the cell identifier (cell ID) of the cellular mobile radio network (GSM), by means of which the OBU signals its location, for the purpose of localisation until the satellite navigation subsystem is operative again.

The objective of the invention is that of creating methods and components for road toll systems that overcome the aforementioned disadvantages of the prior art.

This objective is achieved in a first aspect of the invention with a method of the initially

mentioned type for generating toll transactions in a road toll system, which method is characterized in that the first subsystem does not create toll transactions for road segments which are taken into account by the second subsystem when it creates its toll transactions. As a result, the generation of duplicate toll transactions by hybrid OBUs is suppressed from the start, thereby eliminating the need for a filtering process in the central station for all incoming toll transactions. In addition, the traffic volume in the data transmission between the subsystems and the central station is significantly reduced.

According to a first advantageous embodiment of the invention, this is achieved, in particular, in that for its toll transaction generation the first subsystem uses a first geo-database, and the second subsystem uses a second geo-database of tollable road segments, wherein the first geo-database only contains such tollable road segments which do not occur in the second geo-database.

As an alternative, this can be achieved in a manner that is likewise advantageous in that, for the toll transaction generation, the first subsystem and the second subsystem use a common geo-database of tollable road segments, in which geo-database there is stored at least one flag for each road segment indicating the availability of a local tolling site therefor, wherein the first subsystem only creates toll transactions for vehicle devices on a road segment if the flag of the latter is not set in the geo-database. Both variants are based on the finding that system-wide geo-databases, which contain definitions of the tollable road segments, can be used particularly easily to avoid duplicate transactions by defining segments accordingly.

In a second aspect, the objectives of the invention are achieved with a road toll system, which has at least a first subsystem for a toll transactions creating localisation of vehicle devices by means of global satellite navigation and at least a second subsystem for a toll transactions creating localisation of vehicle devices by means of local tolling sites, wherein at least some vehicle devices can interact with both subsystems and the subsystems are connected to a common central station processing toll transactions, which is distinguished in that the first subsystem does not create toll transactions for road segments which are taken into account by the second subsystem. Reference is made to the descriptions of the method, above, with regard to the advantages and other features of the road toll system.

It is particularly advantageous when the aforementioned geo-database/s are stored in the common central station of the road toll system and, from there, are distributed to the individual subsystems. Therefore, in a third aspect, the invention also creates a central station, which contains thusly modified geo-databases, namely either the aforementioned first and second geo-databases or the aforementioned common geo-database.

The subsystems typically each contain a central proxy computer, e.g., according to the new ISO standard 17575, which central proxy computer is referred to as a “proxy”, wherein said proxy – depending on the variant of the subsystem – either generates toll transactions itself by assigning signaling of locations from so-called “thin client” OBUs to tollable road segments or receives ready toll transactions from so-called “thick client" OBUs, which perform this assignment autonomously. For the first subsystem variant, the invention creates, in another aspect, a proxy for the first subsystem, comprising the common or the first geo-database, respectively, for a toll transactions creating localisation of vehicle devices signaling their location, wherein the proxy only creates a toll transaction for a road segment and sends it to the central station if this road segment is comprised in the first geo-database or is not provided with a flag in the common geo-database.

For the second subsystem variant, the invention creates, as an alternative, a proxy for the first subsystem, comprising the common or the first geo-database, respectively, for distributing this geo-database to vehicle devices generating toll transactions, and, in another aspect, a “thick client” OBU interacting therewith, i.e., a vehicle device containing at least the common or the first geo-database, which only creates a toll transaction for a road segment and sends it to the central station if this road segment is comprised in the first geo-database or is not provided with a flag in the common geo-database.

Further features and advantages of the invention shall become apparent from the description of a preferred exemplary embodiment that follows, with reference to the accompanying drawings, in which:

Fig. 1 schematically shows the physical configuration of a road toll system comprising

hybrid OBUs;

Fig. 2 shows the logical configuration of the road toll system from Fig. 1 in the form of a block diagram; and

Fig. 3 shows the configuration of the geo-databases used within the scope of the invention.

Figure 1 shows a section of a road network 1 comprising four road segments A, B, C and D, as examples. Three of these road segments are tollable (shown with solid lines), namely the road segments B, C, D. Of these road segments, the two road segments C and D each have a local tolling site 2, which are DSRC radio beacons in the example shown.

A vehicle device 3 (onboard unit, OBU) mounted on the vehicle is equipped with a DSRC transponder and is communicating with the tolling site 2 in order to create a toll transaction (toll data record), which is sent via a proxy 4 to a central station 5 for processing, as is explained in greater detail below.

The vehicle device 3 is also a so-called “hybrid OBU”, which not only has a DSRC transponder for communication with DSRC radio beacons, but which can also determine its location in a global satellite navigation system 6 on its own and, on the basis thereof, can send a toll transaction to the central station 5 via a mobile radio network 7 and a proxy 8.

Figure 2 shows the logical-geographical distribution of the system of Fig. 1. The mobile radio system 7, with its proxy 8, forms a first subsystem 9 for vehicle devices 3, 3' interacting therewith (together forming a first “front end”), the geographical coverage range of which is indicated by the reference numeral 10. By comparison, the local tolling sites 2 and their proxy 4 form a second subsystem 11 for vehicle devices 3, 3" interacting therewith (together forming a second “front end”), the geographical coverage range of which is indicated by the reference numeral 12. As is evident, the hybrid vehicle device 3 can interact with both subsystems 9, 11.

The subsystems 9, 11 generate toll transactions 13, 14, respectively, for the common central station 5 by assigning the locations of the vehicle devices 3, 3‘, 3", which were determined by the local tolling sites 2 or the satellite navigation system 6, to the tollable

road segments B, C, D, which are stored in geo-databases 15, 16 of the subsystems 9, 11. The geo-database 16 of the DSRC subsystem 11 contains the tollable road segments C, D that are tollable by means of the subsystem 11, and the geo-database 15 of the GNSS subsystem 9 contains all the other tollable road segments with the exception of the road segments of the geo-database 16. The situation is thereby prevented in which the first subsystem 9 generates toll transactions 13 for hybrid vehicle devices 3, for which the second subsystem 11 already generates toll transactions 14, and sends these toll transactions to the central station 5.

The geo-databases 15, 16 of the subsystems 9, 11 can be separately set up and made available to the subsystems 9, 11, see Fig. 3. Preferably, however, said geo-databases are derived from a common geo-database 17, which is maintained in the central station 5 and contains all tollable road segments B, C, D, each of which is provided with an identifier or a flag 18, which indicates which tolling technology is available therefor. In the example shown in Fig. 3, the flag 18 indicates that a road segment in the DSRC subsystem 11 is tollable. By means of the flag 18, the common geo-database 17 can be subdivided, e.g., into the two separate geo-databases 15, 16 of the subsystems 9, 11, and can be distributed to said subsystems for application locally.

As an alternative, the common geo-database 17 could also be made available system-wide by the central station 5, and the subsystems 9, 11 consult the common geo-database 17 every time a toll transaction is generated.

According to another alternative, the subsystems 9, 11 receive complete copies of the common geo-database 17 and each use only those tollable road segments that apply to them in order to generate toll transactions. In this case, the GNSS subsystem 9 generates toll transactions 13 for a hybrid vehicle device 3 on a road segment B, C, D only if the flag 18 therefor has not been set in the common geo-database 17, as shown here for the road segment B.

As explained above, in the GNSS subsystem 9, the assignment of a location, which is determined by means of satellite navigation, to a road segment (“map matching”) can be carried out directly by a vehicle device 3, 3' configured as a “thick client” OBU, when said vehicle device has received its copy of the geo-database 15 or 17; or, as an

alternative, from the proxy 8, when the vehicle devices 3, 3' are configured as “thin client” OBUs.

The localisation in the DSRC subsystem 11 is simpler, since the tolling sites 2 have a predefined location, which can be assigned directly to a road segment in the geo-database 16 or 17.

In this sense, the second geo-database 16 (or its portion of the common geo-database 17) can also be simply formed, for example, by a list of locations of all local tolling sites 2 of the DSRC subsystem 11, which uses or is based on the DSRC subsystem 11 for its toll transaction generation, even if this is merely implied.

The invention is not limited to the embodiments presented and, instead, comprises all variants and modifications that fall within the scope of the claims, which follow. For example, the local tolling sites 2 can also be formed in a manner other than by means of the depicted DSRC radio beacons, e.g., in the form of user terminals of manned toll stations, in the form of entry barriers, etc. The mobile radio system 7 of the GNSS subsystem 9 can also be any possible type, e.g., a packet-switched data connection in a GPRS or UMTS network, etc. Finally, the term “road segment” should also be interpreted in its most general form and refers not only to road segments that can be driven on, but also to parking areas, for instance, the use of which is tollable per unit of time.

FREMGANGSMÅDE, KOMPONENTER OG SYSTEMER TIL GENERERING AF GEBYRTRANSAKTIONER

PATENTKRAV

1. Fremgangsmåde til generering af gebyrtransaktioner (13, 14) i et vejgebyrsystem, hvilket har mindst ét første subsystem (9), der omfatter et mobilradiosystem (7) til generering af første gebyrtransaktioner gennem lokalisering af køretøjsudstyr (3, 3') ved hjælp af global satellitnavigation (6), og mindst ét subsystem (11), der omfatter andre lokale gebyrstationer (2) til generering af andre gebyrtransaktioner gennem lokalisering af køretøjsudstyr (3, 3') ved hjælp af disse lokale gebyrstationer (2), hvor mindst ét køretøjsudstyr (3) kan samvirke med begge subsystemer (9, 11), og subsystemerne (9, 11) kan sende deres gebyrtransaktioner (13, 14) til en fælles central (5) til behandling, **kendetegnet ved**, at det første subsystem (9) ikke genererer første gebyrtransaktioner (13) for vejsegmenter (C, D), som det andet subsystem (11) tager højde for ved sin generering af andre gebyrtransaktioner (14).

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved**, at det første subsystem (9) til sin generering af gebyrtransaktioner benytter en første geodatabank (15), og det andet subsystem (11) benytter en anden geodatabank (16) med gebyrpligtige vejsegmenter (B, C, D), hvor den første geodatabank (15) kun indeholder gebyrpligtige vejsegmenter (B), der ikke optræder i den anden geodatabank (16).

3. Fremgangsmåde ifølge krav 1, **kendetegnet ved**, at det første subsystem (9) og det andet subsystem (11) til generering af gebyrtransaktioner (13, 14) benytter en fælles geodatabank (17) med gebyrpligtige vejsegmenter (B, C, D), hvori der for hvert vejsegment (B, C, D) lagres mindst ét flag (18), som indikerer tilgængeligheden af en tilhørende lokal gebyrstation (2), hvor det første subsystem (9) kun genererer første gebyrtransaktioner (13) for køretøjsudstyr (3) på et vejsegment (B), hvis flaget (18) for dette segment ikke er rejst i geodatabanken (17).

4. Fremgangsmåde ifølge ethvert af kravene 1 - 3, **kendetegnet ved**, at der til de lokale gebyrstationer (2) i det andet subsystem (11) anvendes DSCR-radiofyr.

5. Vejgebyrsystem med mindst ét første subsystem (9), der omfatter et mobilradiosystem (7) til generering af første gebyrtransaktioner gennem lokalisering af køretøjsudstyr (3, 3') ved hjælp af global satellitnavigation (6), og mindst ét subsystem (11), der omfatter andre lokale gebyrstationer (2) til generering af andre

gebyrtransaktioner gennem lokalisering af køretøjsudstyr (3, 3') ved hjælp af disse lokale gebyrstationer (2), hvor mindst ét køretøjsudstyr (3) kan samvirke med begge subsystemer (9, 11), og subsystemerne (9, 11) er tilsluttet en fælles gebyrtransaktionsbehandlende central (5), **kendetegnet ved**, at det første subsystem (9) ikke genererer første gebyrtransaktioner (13) for vejsegmenter (C, D), som det andet subsystem (11) tager sig af ved sin generering af andre gebyrtransaktioner (14).

6. Vejgebyrsystem ifølge krav 5, **kendetegnet ved**, at det første subsystem (9) til generering af sine gebyrtransaktioner (13) støtter sig på en første geodatabank (15), og det andet subsystem (11) støtter sig på en anden geodatabank (16) med gebyrpligtige vejsegmenter (B, C, D), hvor den første geodatabank (15) kun indeholder sådanne gebyrpligtige vejsegmenter (B), som ikke optræder i den anden geodatabank (16).

7. Vejgebyrsystem ifølge krav 5, **kendetegnet ved**, at det første subsystem (9) og det andet subsystem (11) til generering af gebyrtransaktioner (13, 14) støtter sig på en fælles geodatabank (17) med gebyrpligtige vejsegmenter (B, C, D), hvori der for hvert vejsegment (B, C, D) lagres mindst ét flag (18), som angiver tilgængeligheden af en tilhørende lokal gebyrstation (2), hvor det første subsystem (9) kun genererer første gebyrtransaktioner (13) for køretøjsudstyr (3) på et vejsegment (B), hvis flaget (18) for dette segment ikke er rejst i geodatabanken (17).

8. Vejgebyrsystem ifølge ethvert af kravene 5-7, **kendetegnet ved**, at det andet subsystems (11) lokale gebyrstationer (2) er DSRC-radiofyr.

9. Central til et vejgebyrsystem ifølge krav 6 eller 7 omfattende den fælles (17) eller den første og anden geodatabank(er) (15, 16) til deling mellem subsystemerne (9, 11).

10. Proxy (8) i et første subsystem (9) i et vejgebyrsystem ifølge krav 6 eller 7 til kommunikation mellem køretøjsudstyrene (3, 3') og centralen (5), omfattende den fælles (17) eller den første geodatabank (15) til generering af gebyrtransaktioner gennem lokalisering af køretøjsudstyr (3, 3'), der signalerer deres lokation, hvor proxyen (8) kun genererer en første gebyrtransaktion (13) til et vejsegment (B), og sender den til centralen (5), når dette vejsegment (b) indeholdes i den første geodatabank (15) eller ikke er forsynet med et flag (18) i den fælles geodatabank (17).

11. Proxy (8) i et første subsystem (9) i et vejgebyrsystem ifølge krav 6 eller 7 til kommunikation mellem køretøjsudstyrene (3, 3') og centralen (5), omfattende mindst den fælles (17) eller den første geodatabank (15) til deling af denne geodatabank (15, 17) mellem de gebyrtransaktionsgenererende køretøjsudstyr (3, 3').

12. Køretøjsudstyr (3) af en type, der genererer gebyrtransaktioner til en proxy (8) ifølge krav 11, hvor køretøjsudstyret (3) indeholder i det mindste den fælles (17) eller den første geodatabank (15), og hvor køretøjsudstyret (3) kun genererer en første gebyrtransaktion (13) til et vejsegment (B) og sender det til centralen (5), hvis dette vejsegment (B) er indeholdt i den første geodatabank (15) eller ikke er forsynet med et flag (18) i den fælles geodatabank (17).

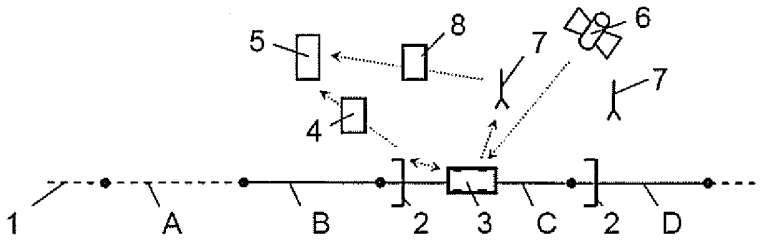

Fig. 1

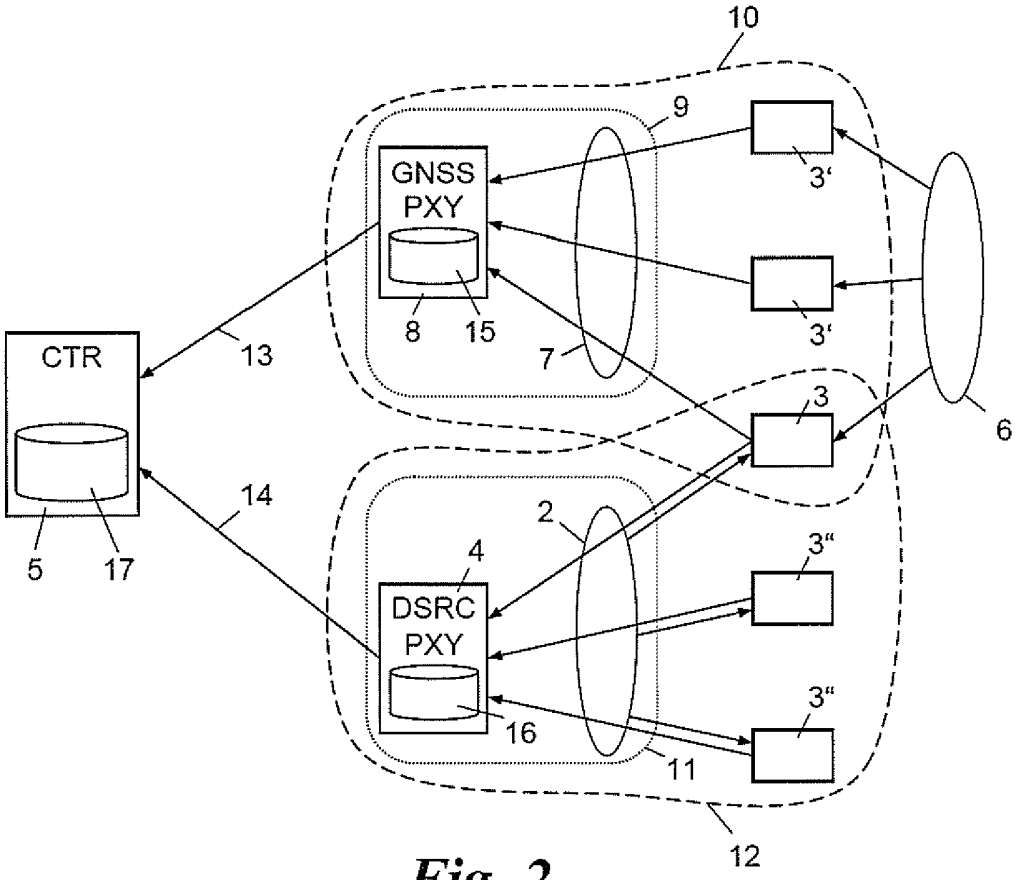

Fig. 2

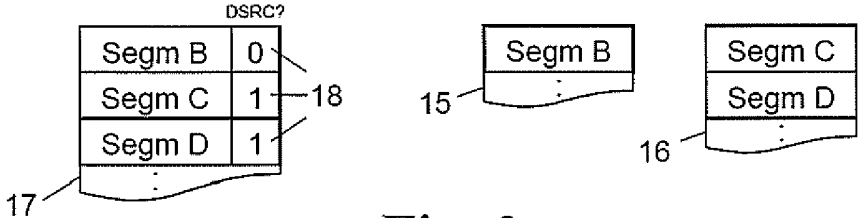

Fig. 3