

Description

Title of Invention: ONBOARD UNIT, ENTRANCE TOLL COLLECTION FACILITY, EXIT TOLL COLLECTION FACILITY, SERVICE USING SYSTEM, SERVICE USING METHOD, AND PROGRAM

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Technical Field

[0001]

The present disclosure relates to an onboard unit, an entrance toll collection facility, an exit toll collection facility, a service using system, a service using method, and a program.

10

Background Art

[0002]

An electronic toll collection system (ETC system (registered trademark), also called "automatic toll collection system") is used as a technology for collecting a toll fare of a toll road (see, for example, Patent Document 1).

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Citation List

Patent Literature

20 [0003]

Patent Document 1: JP 2021-92850 A

Summary of Invention

Technical Problem

25 [0004]

In recent years, services are considered that are provided in addition to travel on a road, such as a merge assistance service for an autonomous driving vehicle on a toll road and a power feeding service to an electric vehicle (EV) while driving. For example, for the power feeding service while driving, a user (a driver or a passenger of a vehicle) may not want to use the service when, for example, the vehicle has already been charged. However, currently, there is no mechanism that provides the service after the user agrees to use the service. Providable services may vary depending on the road. Therefore, there is a demand for a mechanism that enables a vehicle to use a service by matching a service to be used by a user with a service that a road can provide.

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[0005]

An object of the present disclosure is to provide an onboard unit, an entrance toll collection facility, an exit toll collection facility, a service using

[0006]

20 [0007]

[0008]

According to one aspect of the present disclosure, an exit toll collection facility includes: an exit roadside antenna provided at an exit of a road where a service to be added to travel of a vehicle is providable, the exit roadside antenna being configured to communicate with an onboard unit mounted on a vehicle coming to the exit; a service flag reception unit configured to receive, from the onboard unit through the exit roadside antenna, a service provision

flag by which a service used by the vehicle can be specified; and a usage fee collection processing unit configured to collect a usage fee of a service corresponding to the service provision flag.

[0009]

5 According to one aspect of the present disclosure, a service using system includes the onboard unit described above and the entrance toll collection facility described above.

[0010]

10 According to one aspect of the present disclosure, a service using method includes: by an onboard unit mounted on a vehicle, a step of receiving input from a user and setting a service request flag indicating whether the vehicle is provided with a service to be added to travel on a road; by an entrance toll collection facility, a step of receiving, from the onboard unit through an entrance roadside antenna provided upstream of a section providing
15 the service of the road, a service request flag by which a service that the vehicle wants to use can be specified; by the entrance toll collection facility, a step of transmitting service provision information indicating a service that can be provided by the road among services desired by the user boarding the vehicle on the basis of the service request flag; by the onboard unit, a step of
20 receiving the service provision information and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and by the onboard unit, a step of enabling a function of a service using device of the vehicle corresponding to the service provision flag set on.

[0011]

25 According to one aspect of the present disclosure, a program causes an onboard unit to execute: a step of receiving input from a user and setting a service request flag indicating whether a vehicle is provided with a service to be added to travel on a road; a step of communicating with an entrance roadside antenna provided upstream of a section providing the service of the road and
30 transmitting the service request flag; a step of receiving service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and a step of enabling a function of a service
35 using device of the vehicle corresponding to the service provision flag set on.

Advantageous Effects of Invention

[0012]

The above aspect enables a vehicle to use a service that is added to travel of the vehicle, is desired by a user, and can be provided by a road.

Brief Description of Drawings

5 [0013]

FIG. 1 is a view illustrating an overall configuration of a service using system according to a first embodiment.

FIG. 2 is a view illustrating a functional configuration of an entrance toll collection facility according to the first embodiment.

10 FIG. 3 is a view illustrating a functional configuration of an exit toll collection facility according to the first embodiment.

FIG. 4 is a view illustrating a functional configuration of an onboard unit according to the first embodiment.

15 FIG. 5 is a first view illustrating an example of setting processing of a service request flag according to the first embodiment.

FIG. 6 is a view illustrating a setting example of a service request flag by a terminal device according to the first embodiment.

FIG. 7 is a second view illustrating an example of setting processing of the service request flag according to the first embodiment.

20 FIG. 8 is a view illustrating a setting example a service request flag by the onboard unit according to the first embodiment.

FIG. 9 is a view illustrating an example of service enabling processing according to the first embodiment.

25 FIG. 10 is a view illustrating an example of a service provision flag transmitted from the entrance toll collection facility to the onboard unit.

FIG. 11 is a view illustrating an example of processing during service usage according to the first embodiment.

FIG. 12 is a view illustrating an example of collection processing of a service usage fee according to the first embodiment.

30 FIG. 13 is a schematic block diagram illustrating a configuration of a computer according to the first embodiment.

Description of Embodiments

[0014]

35 First Embodiment

Hereinafter, embodiments will be described in detail with reference to the drawings.

[0015]

Overall Configuration

FIG. 1 is a view illustrating the overall configuration of the service using system according to the first embodiment. A service using system 100 according to the present embodiment automatically makes a service selected by a vehicle V (a user who is a passenger of the vehicle V) available on a road that can provide a service to be added to travel of the vehicle V, and automatically collects a usage fee of the service used by the vehicle V. As illustrated in FIG. 1, the service using system 100 includes an entrance toll collection facility 1, an exit toll collection facility 2, an onboard unit 3 mounted on the vehicle V, and a service providing facility 6.

[0016]

The entrance toll collection facility 1 is provided upstream of a service providing section of a road. The entrance toll collection facility 1 may be a facility provided at an entrance tollgate or a main line tollgate (barrier) upstream of the service providing section or may be a free flow facility provided on a road upstream of the service providing section. In the present embodiment, an example in which the entrance toll collection facility 1 is provided at an entrance tollgate will be described. The entrance tollgate has one or more entrance lanes LI (LI1, LI2,...). The entrance toll collection facility 1 performs wireless communication with the onboard unit 3 of the vehicle V using the automatic toll collection system, transmission/reception of information required for collection of the toll fare of the toll road, and transmission/reception of information regarding a service desired by the vehicle V ((3) of FIG. 1).

[0017]

The exit toll collection facility 2 is provided at an exit tollgate of a toll road. The exit tollgate has one or more exit lanes LO (LO1, LO2,...). The exit toll collection facility 2 performs wireless communication with the onboard unit 3 of the vehicle V using the automatic toll collection system, collects the toll fare of the toll road from the onboard unit 3, and collects the usage fee of the service used by the vehicle V ((6) of FIG. 1).

[0018]

The onboard unit 3 enables a function of a service using device 4 of the vehicle V to make the service designated in advance by the user available ((1), (2), and (4) of FIG. 1). While traveling on the road and when the function is enabled, the service using device 4 can make a service provided from the service providing facility 6 available ((5) of FIG. 1).

[0019]

The service to be added to travel includes, for example, an autonomous driving assistance service, a power feeding service while driving, and an information distribution service.

[0020]

5 The autonomous driving assistance service is a service that provides autonomous driving assistance information so that an autonomous driving vehicle can travel on the road while automatically controlling the position and speed of the own vehicle. For example, the autonomous driving assistance service is a service that provides an autonomous driving vehicle merging into a
10 main line from a merging lane of a toll road with merge assistance information that can detect a position of a vehicle traveling on the main line, a position where the vehicle can merge, and the like. The autonomous driving vehicle merges into the main line by controlling the position, speed, and the like of the own vehicle based on the merge assistance information. The merge assistance
15 information is an example of the autonomous driving assistance information.

[0021]

The power feeding service while driving is a service of supplying power for battery charging to an EV traveling on a panel (power feeding panel) including a power transmission coil for power feeding embedded in the road.

20 [0022]

The information distribution service is a service that distributes information regarding the road where the vehicle V travels. The information distribution service includes, for example, a next-generation highway radio and a look-ahead information distribution service. The next-generation highway
25 radio distributes traffic information and the like including a traffic jam on a road on which the vehicle V travels, a closed road, and an event (a fallen object, a wrong-way driving car, and the like) occurring ahead (downstream of the road) in the traveling direction. The look-ahead information distribution service is a service that distributes information regarding an event (a fallen
30 object, an accident, a wrong-way driving car, road surface freezing, and the like) occurring ahead (downstream of the road) in the traveling direction of the vehicle V before the vehicle V reaches the event occurrence point. For example, the autonomous driving vehicle may control the position, speed, and the like of the own vehicle so as to avoid an event such as a fallen object on the
35 basis of the information distributed by the look-ahead information distribution service. Note that the information distributed by the information distribution service may include map information, image information, voice information, and the like in addition to text information.

[0023]

Note that these services are examples, and other services providable to the vehicle V in motion may be further included.

[0024]

5 The service providing facility 6 includes a management server 60 and a service device 61. The service device 61 includes, for example, a service roadside antenna 62 that can transmit/receive information by wireless communication (e.g., DSRC communication) with the onboard unit 3 and the service using device 4 of the vehicle V and a power feeding panel 63 that can
10 supply power to the EV. The management server 60 performs processing of distributing various types of information from the service roadside antenna 62 to the vehicle V, processing of starting and ending power feeding to the power feeding panel 63, and the like. Note that the management server 60, and the onboard unit 3 and the service using device 4 of the vehicle V may perform
15 transmission/reception of information directly via wireless communication (e.g., cellular communication) or indirectly via the service roadside antenna 62.

[0025]

Functional Configuration of Entrance Toll Collection Facility

20 FIG. 2 is a view illustrating the functional configuration of the entrance toll collection facility according to the first embodiment. As illustrated in FIG. 2, the entrance toll collection facility 1 includes an entrance roadside device 10 provided in each of the one or more entrance lanes LI, an entrance lane server 15, and an interface (I/F) unit 16.

[0026]

25 As illustrated in FIGS. 1 and 2, the entrance roadside device 10 includes a first vehicle detector 11, an entrance roadside antenna 13, and a second vehicle detector 14.

[0027]

30 The first vehicle detector 11 is, for example, a through-beam vehicle detector. The first vehicle detector 11 detects that the vehicle V has entered the entrance lane LI.

[0028]

35 The entrance roadside antenna 13 performs transmission/reception of information by wireless communication (e.g., DSRC communication) with the onboard unit 3 of the vehicle V. The entrance roadside antenna 13 starts radio emission for DSRC communication, for example, when the first vehicle detector 11 detects entry of the vehicle V, and stops radio emission when the second vehicle detector 14 detects passage of the vehicle V.

[0029]

The second vehicle detector 14 is, for example, a through-beam vehicle detector, similarly to the first vehicle detector 11. The second vehicle detector 14 detects that vehicle V has passed through a communication area of the entrance roadside antenna 13.

[0030]

Note that in a case where the entrance toll collection facility 1 is provided at an entrance tollgate, the entrance roadside device 10 may further include various devices installed at the toll, such as various sensors and a security camera used for discrimination of the vehicle type of the vehicle V. In a case where the entrance toll collection facility 1 is provided as a free flow facility on the road, the entrance roadside device 10 may have a configuration of only the entrance roadside antenna 13. In this case, the entrance roadside antenna 13 may constantly perform radio emission.

[0031]

As illustrated in FIG. 2, the entrance lane server 15 includes a provision flag setting unit 151, a request flag reception unit 152, a service provision information transmission unit 153, and an entrance processing unit 154. Note that one entrance lane server 15 may be provided at each of the entrance lanes LI.

[0032]

The provision flag setting unit 151 sets a service provision flag corresponding to the type of service that can be provided by the road on. At the time of activation of the entrance toll collection facility 1, the provision flag setting unit 151 sets the service provision flag corresponding to each service to on or off in accordance with an instruction input from the road business operator or in accordance with a setting file given in advance by the road business operator.

[0033]

The request flag reception unit 152 receives, from the onboard unit 3 through the entrance roadside antenna 13, a service request flag by which a service desired by the vehicle V (user) can be specified.

[0034]

The service provision information transmission unit 153 transmits service provision information indicating a service that can be provided by a road among services desired by the vehicle V on the basis of the service request flag. The service provision information includes a service provision flag set on among service provision flags corresponding to the service request flag.

[0035]

The entrance processing unit 154 performs automatic toll collection processing regarding collection of the toll fare of the toll road at the entrance tollgate. This automatic toll collection processing is the same as processing of an automatic toll collection system executed at a known entrance tollgate.

[0036]

The I/F unit 16 relays transmission/reception of signals between each entrance roadside device 10 and the entrance lane server 15. This signal includes data of a service flag in addition to a control signal and a detection signal.

[0037]

Functional Configuration of Exit Toll Collection Facility

FIG. 3 is a view illustrating the functional configuration of the exit toll collection facility according to the first embodiment. As illustrated in FIG. 3, the exit toll collection facility 2 includes an exit roadside device 20 provided in each of the one or more exit lanes LO, an exit lane server 25, and an interface (I/F) unit 26.

[0038]

As illustrated in FIGS. 1 and 3, the exit roadside device 20 includes a first vehicle detector 21, an exit roadside antenna 23, and a second vehicle detector 24.

[0039]

The first vehicle detector 21 is, for example, a through-beam vehicle detector. The first vehicle detector 21 detects that the vehicle V has entered the exit lane LO.

[0040]

The exit roadside antenna 23 performs transmission/reception of information by wireless communication (e.g., DSRC communication) with the onboard unit 3 of the vehicle V. The exit roadside antenna 23 starts radio emission for DSRC communication, for example, when the first vehicle detector 21 detects entry of the vehicle V, and stops radio emission when the second vehicle detector 24 detects passage of the vehicle V.

[0041]

The second vehicle detector 24 is, for example, a through-beam vehicle detector, similarly to the first vehicle detector 21. The second vehicle detector 24 detects that vehicle V has passed through a communication area of the exit roadside antenna 23.

[0042]

Note that in a case where the exit toll collection facility 2 is provided at an exit tollgate, the exit roadside device 20 may further include various devices installed at the toll, such as various sensors and a security camera used for discrimination of the vehicle type of the vehicle V. In a case where the exit toll
 5 collection facility 2 is provided as a free flow facility on the road, the exit roadside device 20 may have a configuration of only the exit roadside antenna 23. In this case, the exit roadside antenna 23 may constantly perform radio emission.

[0043]

10 As illustrated in FIG. 3, the exit lane server 25 includes a service flag reception unit 251, a usage fee collection processing unit 252, and a toll fare collection processing unit 253. Note that one exit lane server 25 may be provided at each of the exit lanes LO.

[0044]

15 The service flag reception unit 251 receives, from the onboard unit 3 through the exit roadside antenna 23, a service provision flag that can specify a service used by the vehicle V.

[0045]

The usage fee collection processing unit 252 collects the usage fee of a
 20 service corresponding to the service provision flag.

[0046]

The toll fare collection processing unit 253 performs automatic toll collection processing regarding collection of the toll fare of the toll road at the exit tollgate. This automatic toll collection processing is the same as processing
 25 of an automatic toll collection system executed at a known exit tollgate.

[0047]

The I/F unit 26 relays transmission/reception of signals between each exit roadside device 20 and the exit lane server 25. This signal includes data of a service flag in addition to a control signal and a detection signal.

30 [0048]

Functional Configuration of Onboard Unit

FIG. 4 is a view illustrating the functional configuration of the onboard unit according to the first embodiment. As illustrated in FIG. 4, the onboard unit 3 includes a request flag setting unit 31, a service request unit 32, a
 35 provision service reception unit 33, an enabling processing unit 34, a usage fee processing unit 35, and a toll fare processing unit 36.

[0049]

The request flag setting unit 31 receives input from the user and sets a service request flag indicating whether the vehicle V is provided with a service to be added to travel on a road.

[0050]

5 The service request unit 32 communicates with the entrance roadside antenna 13 of the entrance toll collection facility 1 provided at the entrance of the road and transmits a service request flag to the entrance toll collection facility 1.

[0051]

10 The provision service reception unit 33 receives service provision information indicating a service that can be provided by the road among the services corresponding to the service request flag transmitted and sets on a service provision flag on corresponding to a service that is desired by the user and can be provided by the road.

15 [0052]

 The enabling processing unit 34 enables the function of the service using device 4 of the vehicle V corresponding to the service provision flag set on. For example, the vehicle V includes, as the service using device 4, one or more of an autonomous driving control device 41, a charging control device 42, and an output device 43 that outputs information of an information distribution service. The functions of these service using devices 4 are normally disabled, and when the service provision flag is on, the function of the corresponding service using device 4 is enabled by the enabling processing unit 34.

[0053]

25 The usage fee processing unit 35 processes payment of the usage fee of a service used by the vehicle V based on the service provision flag at the exit of the road.

[0054]

 The toll fare processing unit 36 processes payment of the toll fare of the vehicle V at the exit of the road.

[0055]

Setting Processing of Service Request Flag

 FIG. 5 is a first view illustrating an example of the setting processing of the service request flag according to the first embodiment. FIG. 6 is a view illustrating a setting example of the service request flag by the terminal device according to the first embodiment. First, an example in which the user performs setting using a user terminal device 7 will be described with reference to FIGS. 35 5 and 6. The user terminal device 7 includes, for example, a touch panel that

displays a setting screen and receives a touch operation by the user, and a communication device that can communicate with the onboard unit 3 wirelessly or by wire. The user terminal device 7 may be a portable terminal such as a smartphone carried by the user, or may be a terminal device such as a car navigation system provided in the vehicle V. The user performs setting before reaching the installation position of the entrance toll collection facility 1.

5 [0056]

A service request flag setting screen D1 as illustrated in FIG. 6 is displayed on a display device of the user terminal device 7. The service request flag setting screen D1 displays a list of settings of on or off of the service request flag of each service available for the vehicle V. The user sets a service request flag on, the service request flag of the service to be used among the services displayed on the service request flag setting screen D1. The user terminal device 7 transmits the service request flag of each service set by the user to the onboard unit 3 (step S101).

10 [0057]

The request flag setting unit 31 of the onboard unit 3 stores setting of on or off of each service request flag received from the user terminal device 7 (step S102).

15 [0058]

FIG. 7 is a second view illustrating an example of the setting processing of the service request flag according to the first embodiment. FIG. 8 is a view illustrating a setting example the service request flag by the onboard unit according to the first embodiment. As in the examples of FIGS. 7 and 8, the onboard unit 3 may perform setting of the service request flag without using the user terminal device 7.

20 [0059]

For example, the onboard unit 3 includes setting buttons 37 (37A, 37B, 37C,...) corresponding to the respective services as illustrated in FIG. 7, and can switch on or off of the service request flag corresponding to each service by pressing the respective setting buttons 37. By turning on the setting button 37 corresponding to the service to be used, the user sets the service request flag on. When the setting button 37 is switched to be on, the request flag setting unit 31 of the onboard unit 3 sets the corresponding service request flag on and stores it (step S102). When the setting button 37 is switched to an off state, the request flag setting unit 31 of the onboard unit 3 sets the corresponding service request flag off and stores it.

25 [0060]

Every time the service request flag is switched on or off, the request flag setting unit 31 of the onboard unit 3 notifies the user of which service has been enabled or disabled by a notification device 38 (step S103). For example, the notification device 38 is a speaker, and outputs voice guidance such as "power feeding service while driving of EV is selected" when the service request flag of the power feeding service while driving of the EV is switched on. Note that in other embodiments, the notification device 38 may include a lamp such as an LED provided in the vicinity of each of the setting buttons 37, and may be able to notify the user of on or off of the service request flag by turning on or off the lamp. A pressing state of the setting button 37 may represent on or off of the service request flag.

[0061]

Service Enabling Processing

FIG. 9 is a view illustrating an example of service enabling processing according to the first embodiment. FIG. 10 is a view illustrating an example of the service provision flag transmitted from the entrance toll collection facility to the onboard unit. A flow of processing ((2) to (4) of FIG. 1) of enabling a service desired by the vehicle V coming to the entrance tollgate will be described in detail with reference to FIGS. 9 and 10.

[0062]

When the first vehicle detector 11 detects entry of the vehicle V into the entrance lane LI, the entrance processing unit 154 of the entrance lane server 15 performs wireless communication with the onboard unit 3 of this vehicle V via the entrance roadside antenna 13, and executes automatic toll collection processing similar to the processing of the automatic toll collection system at a known entrance tollgate (step S201). For example, the entrance processing unit 154 transmits, from the entrance roadside antenna 13 to the onboard unit 3 of the vehicle V, identification information on the entrance tollgate and entrance information including the passage time at the entrance tollgate. The onboard unit 3 records the entrance information into an IC card (IC card for automatic toll collection system, for example, an ETC card) inserted into the onboard unit 3.

[0063]

Upon completion of the automatic toll collection processing, the request flag reception unit 152 of the entrance lane server 15 makes an inquiry about the service request flag from the onboard unit 3 (step S202).

[0064]

The service request unit 32 of the onboard unit 3 transmits a service request flag set on by the user in response to the inquiry from the entrance lane server 15 (step S203). For example, as illustrated in FIG. 10, it is assumed that the user has set a service request flag 1 corresponding to an EV (power feeding while driving) and a service request flag 3 corresponding to the look-ahead information distribution service on. In this case, the service request unit 32 of the onboard unit 3 transmits, to the entrance lane server 15, the service request flags 1 and 3 set on.

[0065]

Next, the service provision information transmission unit 153 of the entrance lane server 15 transmits a service provision flag indicating a service that can be provided by the road among the services desired by the vehicle V on the basis of the service request flag received (step S204). For example, as illustrated in FIG. 10, it is assumed that a service provision flag 1 corresponding to the EV (power feeding while driving) and a service provision flag 2 corresponding to autonomous driving (merge assistance) have been set on as services that can be provided by the road. It is assumed that the service request flags 1 and 3 are received from the onboard unit 3. In this case, this road can provide the EV (power feeding while driving) corresponding to the service request flag 1 but cannot provide the look-ahead information distribution service corresponding to the service request flag 3. Therefore, the service provision information transmission unit 153 of the entrance lane server 15 transmits only the service provision flag 1, which is providable (both the service request flag and the service provision flag are set on), to the onboard unit 3.

[0066]

The provision service reception unit 33 of the onboard unit 3 receives the service provision flag from the entrance lane server 15 and records it (step S205). For example, as illustrated in FIG. 10, the service provision flag received from the entrance lane server 15 is set on, and other service provision flags are set off and recorded. The enabling processing unit 34 of the onboard unit 3 instructs the service using device 4 of a target service corresponding to the service provision flag set on to enable the function (step S206). Then, the service using device 4 enables the function to make the service available (step S207). At this time, the onboard unit 3 may notify the user of the enabled service by voice output from the notification device 38 that is a speaker, for example, or a lighting pattern of the notification device 38 that is an LED. When connected to the user terminal device 7, the onboard unit 3 may notify

the user of the enabled service by voice output from a speaker of the user terminal device 7 or by screen display of the user terminal device 7 that is a car navigation.

[0067]

5 For example, when receiving the service provision flag 1 indicating the EV (power feeding while driving), the enabling processing unit 34 of the onboard unit 3 instructs the charging control device 42 to enable the function regarding power feeding while driving. Then, the charging control device 42 switches, for example, a power reception device and a battery of the vehicle V
10 to a connected state, and enables a function of supplying (charging) the battery with the power received by the power reception device from the power feeding panel 63. Note that when the function is not enabled, the power reception device and the battery are in a disconnected state, and even if the power reception device receives power from the power feeding panel 63, this power is
15 not supplied to the battery.

[0068]

 When receiving the service provision flag 2 indicating autonomous driving (merge assistance), the enabling processing unit 34 of the onboard unit 3 instructs the autonomous driving control device 41 to enable the autonomous
20 driving function based on the autonomous driving assistance information. Then, the autonomous driving control device 41 enables the function of controlling the position and speed of the vehicle V on the basis of the autonomous driving assistance information transmitted from the service roadside antenna 62, for example. When the autonomous driving assistance information is encrypted, the
25 autonomous driving control device 41 enables a function of decrypting this information. Note that when the function is not enabled, even if receiving the autonomous driving assistance information, the autonomous driving control device 41 does not use and discards or does not decode this autonomous driving assistance information.

30 [0069]

 When the service provision flag 3 indicating the look-ahead information distribution service is set on, the enabling processing unit 34 of the onboard unit 3 instructs the output device 43 to enable the function of the look-ahead information distribution service. Similarly, when the service provision flag 4
35 indicating the next-generation highway radio service is set on, the enabling processing unit 34 of the onboard unit 3 instructs the output device 43 to enable the function of the next-generation highway radio service. When receiving an instruction to enable the function of the look-ahead information distribution

service, for example, the output device 43 enables a function of outputting the look-ahead information distributed from the service roadside antenna 62 toward the passenger of the vehicle V. When the distributed look-ahead information is encrypted, the output device 43 enables a function of decrypting this information. Note that when the function is not enabled, even if receiving the look-ahead information, the output device 43 does not output and discards or does not decode this look-ahead information.

[0070]

Note that when all the service request flags are set off at the onboard unit 3, the service request unit 32 of the onboard unit 3 transmits information indicating absence of the service request flag to the entrance lane server 15 in step S203. In this case, the entrance lane server 15 and the onboard unit 3 may end the processing here. In a case of not desiring to use any service other than the service only for road travel (automatic collection of the toll fare by the automatic toll collection system, or support for vehicle that cannot use the automatic toll collection system), the user can travel on the road without using the service by making all the service request flags off in this manner.

[0071]

When the service corresponding to the service request flag set on is unprovidable (the service provision flag is off), the service provision information transmission unit 153 of the entrance lane server 15 transmits, to the onboard unit 3, information indicating absence of a providable service (absence of the service provision flag) in step S202. In this case, the provision service reception unit 33 of the onboard unit 3 does not record the service provision flag in step S205. Then, since there is no recorded service provision flag, the enabling processing unit 34 of the onboard unit 3 ends the processing (step S206) of enabling the function of the service using device 4 without executing it.

[0072]

When a vehicle equipped with an onboard unit (known onboard unit) that executes only known automatic toll collection processing comes to an entrance tollgate, this known onboard unit does not have a function of transmitting a service request flag or the like. Therefore, even if the onboard unit receives an inquiry about the service request flag in step S202 after the automatic toll collection processing in step S201 ends, the known onboard unit discards this inquiry and ends the processing. When there is no response to the inquiry about the request flag for a certain period of time and timeout occurs, the entrance lane server 15 determines that it is a known onboard unit and does

not execute step S204. For this reason, even if this vehicle is mounted with the service using device 4, the enabling processing (steps S203 to S206) of the function by the known onboard unit is not executed, and therefore this vehicle travels on the road without using the service.

5 [0073]

Processing Example during Service Usage

FIG. 11 is a view illustrating an example of the processing during service usage according to the first embodiment. A flow of processing ((5) of FIG. 1) of service use in the service providing facility 6 and the service using device 4 will be described with reference to FIG. 11. Note that FIG. 11 describes an example of using the power feeding service while driving. It is assumed that the power feeding service while driving of the EV among the services desired by the user is providable as in the example of FIG. 10, and the function of the charging control device 42 of the vehicle V is enabled by the series of processing of FIG. 9.

15 [0074]

For example, it is assumed that the service roadside antenna 62 is installed at the entrance of the section providing the service where the power feeding panel 63 for the power feeding service while driving is installed. When detecting entry of the vehicle V into the section providing the service, the management server 60 of the service providing facility 6 confirms whether the power feeding service while driving is enabled to the charging control device 42 of this vehicle V via the service roadside antenna 62 (step S301). Note that the method of detecting that the vehicle V has entered the section providing the service may be any method such as detection by establishment of communication with the service roadside antenna 62, detection by a sensor not illustrated (a vehicle detector, a camera, or the like), or the like.

25 [0075]

Upon receiving an inquiry from the management server 60 of the service providing facility 6, the charging control device 42 of the vehicle V determines whether the function of the power feeding service while driving is enabled (step S302). When the function is enabled (step S302; YES), the charging control device 42 responds to the management server 60 that the function is "enabled" (step S303). On the other hand, when the function is not enabled (step S302; NO), the charging control device 42 responds to the management server 60 that the function is "disabled" (step S304), and ends the processing.

35 [0076]

When receiving a response that the function is "enabled" from the vehicle V (step S305; YES), the management server 60 of the service providing facility 6 instructs the power feeding panel 63 to start power feeding (step S306). Then, the power feeding panel 63 starts power feeding in accordance with the instruction (step S307). When the vehicle V travels on this power feeding panel 63, the power reception device of the vehicle V receives the power of the power feeding panel 63 and supplies (charges) it to the battery. At this time, the charging control device 42 records the amount of power received by the vehicle V (power reception device) (step S308).

[0077]

When detecting that the vehicle V has exited the section providing the service, the management server 60 of the service providing facility 6 instructs the power feeding panel 63 to stop the power feeding (step S309). Then, the power feeding panel 63 stops the power feeding in accordance with the instruction (step S310).

[0078]

When receiving a response that the function is "disabled" from the vehicle V (step S305; NO), the management server 60 of the service providing facility 6 ends the processing without causing the power feeding panel 63 to feed the power.

[0079]

Note that there is a case where a vehicle that uses the power feeding service while driving and a vehicle that does not use it enter the section providing the service in a line. At this time, in the vehicle that does not use the power feeding service while driving, since the function of the charging control device 42 is not enabled (the power reception device and the battery are disconnected), the power received by the power reception device from the power feeding panel 63 is not supplied (charged) to the battery. Therefore, only the vehicle in which the function of the power feeding service while driving is enabled can use the fed power for charging of the battery.

[0080]

Note that while FIG. 8 illustrates an example in which the service providing facility 6 detects the vehicle V at the entrance and the exit of the providing section of the service, and the power feeding panel 63 can feed power only when the vehicle V in which the service is enabled travels in the service providing section, the present invention is not limited to this. In other embodiments, the service providing facility 6 needs not detect the vehicle V at the entrance and the exit of the providing section, and the power feeding panel

63 may be always in a power feeding-enabled state. The power feeding panel 63 may output power for power feeding only when the vehicle V exists on the panel. The power output by the power feeding panel 63 can be used for charging the battery only in the vehicle V in which the function of the power feeding service while driving is enabled.

[0081]

Collection Processing of Service Usage Fee

FIG. 12 is a view illustrating an example of the collection processing of the service usage fee according to the first embodiment. A flow of the toll collection processing ((6) of FIG. 1) of the vehicle V coming to the exit tollgate will be described in detail with reference to FIG. 12.

[0082]

When the first vehicle detector 21 detects entry of the vehicle V into the exit lane LO, the toll fare collection processing unit 253 of the exit lane server 25 performs wireless communication with the onboard unit 3 of this vehicle V via the exit roadside antenna 23, and executes automatic toll collection processing at a known exit tollgate (step S401). For example, as the automatic toll collection processing, the toll fare collection processing unit 253 of the exit lane server 25 requests the onboard unit 3 for transmission of information required for the collection processing of the toll fare. The toll fare processing unit 36 of the onboard unit 3 transmits the requested information to the exit lane server 25. The information required for the collection processing of the toll fare includes entrance information, the vehicle type of the vehicle V, and a payment means of the toll fare (ETC card number or the like). The toll fare collection processing unit 253 of the exit lane server 25 calculates a toll fare corresponding to a distance from the entrance tollgate specified from entrance information to the exit tollgate at which the machine (the exit lane server 25) is installed and the vehicle type of the vehicle V, and performs collection processing (credit settlement processing or the like) of the toll fare based on the payment means.

[0083]

Next, the service flag reception unit 251 of the exit lane server 25 makes an inquiry about the service provision flag to the onboard unit 3 of the vehicle V via the exit roadside antenna 23 (step S402). The usage fee processing unit 35 of the onboard unit 3 transmits, to the exit lane server 25, information including the service provision flag set on as a response to the inquiry (step S403). Note that when all the service provision flags are set off, information

indicating absence of the service provision flag is transmitted to the exit lane server 25.

[0084]

5 The usage fee collection processing unit 252 of the exit lane server 25 determines presence/absence of use of the service of this vehicle V on the basis of the information received from the onboard unit 3 of the vehicle V (step S404). When receiving information indicating absence of the service provision flag from the onboard unit 3, the usage fee collection processing unit 252 determines that this vehicle V has not used the service (step S404; NO), and
10 proceeds to step S413 without performing the collection processing of the service usage fee. In this case, the exit lane server 25 creates only the breakdown of the toll fare of the vehicle V calculated in step S401 by the toll fare collection processing unit 253 (step S413), and ends the processing. Note that the onboard unit (known onboard unit) that executes only known automatic
15 toll collection processing does not have a function of responding to the inquiry about this service provision flag. Therefore, even if the onboard unit receives the inquiry about this service provision flag after the automatic toll collection processing in step S401 ends, the known onboard unit discards this inquiry and ends the processing. Also when timeout occurs without receiving a response to
20 the inquiry about the service provision flag or when the second vehicle detector 24 detects passage of the vehicle before receiving the response, the usage fee collection processing unit 252 of the exit lane server 25 determines that this vehicle has not used the service (step S404; NO).

[0085]

25 On the other hand, when receiving information including at least one service provision flag from the onboard unit 3 of the vehicle V, the usage fee collection processing unit 252 of the exit lane server 25 determines that this vehicle V has used the service corresponding to the service provision flag (step S404; YES). In this case, the usage fee collection processing unit 252 further
30 makes an inquiry about service usage information to the onboard unit 3 (step S405).

[0086]

Upon receiving the inquiry about the service usage information, the usage fee processing unit 35 of the onboard unit 3 notifies the service using
35 device 4 of this. The service using device 4 generates service usage information and transmits it to the onboard unit 3 (step S406). The usage fee processing unit 35 of the onboard unit 3 transmits the service usage information generated by the service using device 4 to the exit lane server 25. The service usage

information includes a message indicating service content used by the service using device 4. For example, the autonomous driving control device 41 generates service usage information including a reception result of the autonomous driving assistance information provided from the service providing facility 6. The charging control device 42 generates service usage information including the amount of power received by the vehicle V (power reception device). The output device 43 generates service usage information including a reception result of the information distributed from the service providing facility 6.

10 [0087]

The usage fee collection processing unit 252 of the exit lane server 25 executes processing of collecting the usage fee of the service used by the vehicle V on the basis of the service usage information received from the onboard unit 3 (step S407). For example, it is assumed that the autonomous driving assistance service has a fixed price regardless of the provided information amount. In this case, the usage fee collection processing unit 252 collects the fixed fee for the autonomous driving assistance service set on this road from the onboard unit 3 as a service usage fee. In a case of a service of usage-based pricing in which the price varies depending on the usage amount (power reception amount) of the vehicle V such as the power feeding service while driving, the usage fee collection processing unit 252 collects, from the onboard unit 3, the service usage fee in which the usage amount of the vehicle V is multiplied by the unit price of the service. Note that the payment means of the service usage fee may be different from the payment means of the toll fare. In this case, the usage fee collection processing unit 252 acquires the service usage information and the payment means of the service usage fee from the onboard unit 3, and performs collection processing (credit settlement processing or the like).

[0088]

30 Upon completion of the collection processing of the service usage fee, the usage fee collection processing unit 252 of the exit lane server 25 requests the onboard unit 3 to make the service provision flag off (step S408). Then, the provision service reception unit 33 of the onboard unit 3 switches the service provision flag from on to off in accordance with the request of the exit lane server 25 (step S409). When the service provision flag is made off, the enabling processing unit 34 of the onboard unit 3 notifies the service using device 4 of the end of use of the service (step S410). The service using device 4 sets the used service to paid and disables the function (step S411). For example, when

the service provision flag 1 corresponding to the power feeding service while driving of the EV is made off, the enabling processing unit 34 of the onboard unit 3 notifies the charging control device 42 of the end of use of the power feeding service while driving. Then, the charging control device 42 sets the power amount recorded in step S308 of FIG. 11 to paid and disables the charging function (brings the power reception device and the battery into the disconnected state).

[0089]

The provision service reception unit 33 of the onboard unit 3 notifies the exit lane server 25 of the fact that the service provision flag has been made off (step S412). Then, the toll fare collection processing unit 253 and the usage fee collection processing unit 252 of the exit lane server 25 create the breakdown of the toll fare of the vehicle V calculated in step S401 and the breakdown of the service usage fee of the vehicle V calculated in step S407, respectively

(step S413).

[0090]

Computer Configuration

FIG. 13 is a schematic block diagram illustrating the configuration of the computer according to the first embodiment. A computer 900 includes a processor 901, a primary storage device 902, an auxiliary storage device 903, and an interface 904. The entrance lane server 15, the exit lane server 25, and the onboard unit 3 described above are mounted in respective different computers 900. Then, the operation of each processing unit described above is stored in the auxiliary storage device 903 in the form of a program. The processor 901 reads the program from the auxiliary storage device 903, deploys it in the primary storage device 902, and executes the above processing in accordance with the program. The processor 901 secures a storage area used in the above processing in the primary storage device 902 in accordance with the program.

[0091]

The program may be for implementing some of the functions to be exerted by the computer 900. For example, the program may exert the function by a combination with another program already stored in the auxiliary storage device 903 or a combination with another program mounted on another device. Note that in other embodiments, the computer may include a custom large scale integrated circuit (LSI) such as a programmable logic device (PLD) in addition to or in place of the above configuration. Examples of the PLD include a programmable array logic (PAL), a generic array logic (GAL), a complex

programmable logic device (CPLD), and a field programmable gate array (FPGA). In this case, some or all of the functions implemented by the processor may be implemented by the integrated circuit.

[0092]

5 Examples of the auxiliary storage device 903 include a hard disk drive (HDD), a solid state drive (SSD), a magnetic disk, a magneto-optical disk, a compact disc read only memory (CD-ROM), a digital versatile disc read only memory (DVD-ROM), and a semiconductor memory. The auxiliary storage device 903 may be an internal medium directly connected to a bus of the
10 computer 900 or may be an external medium (an external storage device 910) connected to the computer 900 via the interface 904 or a communication line. In a case where this program is distributed to the computer 900 via the communication line, the computer 900 having received the distribution may deploy the program in the primary storage device 902 and execute the above
15 processing. In at least one embodiment, the auxiliary storage device 903 is a non-transitory tangible storage medium.

[0093]

Operational Effects

As described above, the onboard unit 3 according to the present
20 embodiment includes: the request flag setting unit 31 that receives input from a user and sets a service request flag indicating whether the vehicle V is provided with a service to be added to travel on a road; the service request unit 32 that communicates with the entrance roadside antenna 13 provided upstream of a section providing the service of the road and transmit the service request flag;
25 the provision service reception unit 33 that receives service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and set on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and the enabling processing unit 34 that enables a
30 function of the service using device 4 of the vehicle V corresponding to the service provision flag set on.

[0094]

Doing this enables the onboard unit 3 to specify the service actually available on the road among the services that the user has agreed to use by the
35 service request flag, and to make the service available in the vehicle V. This can prevent the user from using an undesired service while the vehicle V is traveling on the road where the service is providable. By separating the service request flag and the service provision flag in this manner, only the setting of

the service provision flag of the onboard unit 3 changes in accordance with the route, and the service request flag input from the user does not change. By this, even when the vehicle V travels by transferring to routes with different provision services, the service request flag is not made off, and therefore the service desired by the user can be received in each route. That is, if a desired service is provided in preceding and subsequent routes, the service can be used in both routes. Even if a desired service is not provided in a preceding route, if the service is provided in a subsequent route, this service can be automatically made available when transferring to the subsequent route.

10 [0095]

When not receiving service provision information indicating that a service corresponding to the service request flag transmitted is providable, the provision service reception unit 33 sets the service provision flag corresponding to the service request flag off.

15 [0096]

Doing this enables the onboard unit 3 to set the service provision flag off for the service that cannot be provided by the road even if it is a function desired by the user, and to disable the function of the service using device 4 of the vehicle V. This can prevent wasteful consumption of power and the like of the vehicle V due to the function of the service using device 4 being enabled on a road where no service is provided.

[0097]

The onboard unit 3 further includes the usage fee processing unit 35 that communicates with the exit roadside antenna 23 provided at the exit lane of the road and processes payment of the usage fee of the service corresponding to the service provision flag set on.

[0098]

Doing this enables the onboard unit 3 to automatically pay the usage fee of the used service at the exit of the road.

30 [0099]

When the service provision flag corresponding to the information distribution service is on, the enabling processing unit 34 makes the information provided from the service providing facility 6 in the output device 43 of the vehicle V available.

35 [0100]

Doing this enables the onboard unit 3 to enable the function of the output device 43 only when the user agrees to use the information distribution service and the road can provide this service. By this, for example, even in a

case where the service roadside antenna 62 of the service providing facility 6 performs broadcast distribution to all nearby vehicles, it is possible to enable only the vehicle V that has agreed to use the service to use the distributed information and to disable the vehicle V that has not agreed to use the service to use the distributed information. On a road where the information distribution service is not provided, it is possible to suppress power consumption by disabling the function corresponding to the service of the output device 43.

[0101]

When the service provision flag corresponding to the autonomous driving assistance service is on, the enabling processing unit 34 enables use of the autonomous driving function based on the autonomous driving assistance information provided from the service providing facility 6 at the autonomous driving control device 41 of the vehicle V.

[0102]

Doing this enables the onboard unit 3 to enable the function based on the autonomous driving assistance information of the autonomous driving control device 41 only when the user agrees to use the autonomous driving assistance service and the road can provide this service. By this, for example, even in a case where the service roadside antenna 62 of the service providing facility 6 performs broadcast distribution to all nearby vehicles, it is possible to enable only the vehicle V that has agreed to use the service to use the distributed autonomous driving assistance information and to disable the vehicle V that has not agreed to use the service to use the distributed autonomous driving assistance information. On a road where the autonomous driving assistance service is not provided, it is possible to suppress power consumption by disabling the function corresponding to the service of the autonomous driving control device 41.

[0103]

The enabling processing unit 34 enables, when a service provision flag corresponding to a power feeding service while driving is on, the charging control device 42 of the vehicle V to use power supplied from the service providing facility 6 for charging a battery of the vehicle V.

[0104]

Doing this enables the onboard unit 3 to enable the function regarding the power feeding while driving of the charging control device 42 only when the user agrees to use the power feeding service while driving and the road can provide this service. By this, even in a case where a vehicle that has agreed to use the power feeding service while driving and a vehicle that has not agreed to

do so are traveling in a mixed manner in the section providing the service of power feeding while driving, for example, only the vehicle V that has agreed can charge the battery, and the vehicle V that has not agreed cannot charge the battery. On a road where the power feeding service while driving is not provided, it is possible to suppress power consumption by disabling the function corresponding to the service of the charging control device 42.

[0105]

The entrance toll collection facility 1 according to the present embodiment includes: the entrance roadside antenna 13 provided upstream of a section providing a service on a road where the service to be added to travel on a road is providable, the entrance roadside antenna 13 communicating with the onboard unit 3 mounted on the vehicle V; the request flag reception unit 152 that receives, from the onboard unit 3 through the entrance roadside antenna 13, a service request flag by which a service desired by a user boarding the vehicle V can be specified; and the service provision information transmission unit 153 that transmits service provision information indicating a service that can be provided by the road among services desired by the user on the basis of the service request flag.

[0106]

This enables the entrance toll collection facility 1 to notify the onboard unit 3 of the vehicle V of the service that the road can provide among the services desired by the user. This enables the onboard unit 3 of the vehicle V to specify a service actually available on the road among the services that the user has agreed to use by the service request flag, and to make the service available in the vehicle V. This can prevent the user from using an undesired service while the vehicle V is traveling on the road where the service is providable.

[0107]

The entrance roadside antenna 13 is provided at the entrance tollgate of the road.

[0108]

This enables the entrance toll collection facility 1 to be configured at low cost by using the configuration of the entrance roadside device 10 and the like of an existing entrance tollgate.

[0109]

The entrance roadside antenna 13 is provided at a position where the entrance roadside antenna 13 can communicate with the onboard unit 3 of the vehicle V traveling on the road upstream of the section providing the service.

[0110]

For example, in a case where the function of the service using device 4 of the vehicle V is enabled at the entrance tollgate, there is a possibility that the power of the service using device 4 is wastefully consumed if the distance from the entrance tollgate to the section providing the service is long. On the other hand, by installing the entrance roadside antenna 13 on the road before the section providing the service as described above, the vehicle V can enable the function of the service using device 4 after approaching the section providing the service, and therefore power consumption can be suppressed.

[0111]

The exit toll collection facility 2 according to the present embodiment includes: the exit roadside antenna 23 provided at an exit of a road where a service to be added to travel of the vehicle V is providable, the exit roadside antenna 23 communicating with the onboard unit 3 mounted on the vehicle V coming to the exit; the service flag reception unit 251 that receives, from the onboard unit 3 through the exit roadside antenna 23, a service provision flag by which a service used by the vehicle V can be specified; and the usage fee collection processing unit 252 that collects a usage fee of a service corresponding to the service provision flag.

[0112]

Doing this enables the exit toll collection facility 2 to automatically collect the usage fee of the service used by the vehicle V from the onboard unit 3 of the vehicle V about to exit from the road. That is, while the vehicle V travels on the exit lane LO, the exit toll collection facility 2 can perform both the known automatic toll collection processing for the toll fare and the collection processing for the service usage fee.

[0113]

Other Embodiments

While one embodiment has been described in detail with reference to the drawings, the specific configuration is not limited to that described above, and various design changes and the like can be made. That is, in other embodiments, the order of the above-described processing may be appropriately changed. Parts of processing may be executed in parallel.

[0114]

Supplementary Notes

The above-described embodiments are understood as follows, for example.

[0115]

(1) According to a first aspect, the onboard unit 3 includes: the request flag setting unit 31 configured to receive input from a user and set a service request flag indicating whether the vehicle V is provided with a service to be added to travel on a road; the service request unit 32 configured to

5 communicate with the entrance roadside antenna 13 provided upstream of a section providing the service of the road and transmit the service request flag; the provision service reception unit 33 configured to receive service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and to set on a
10 service provision flag corresponding to a service that is desired by the user and can be provided by the road; and the enabling processing unit 34 configured to enable a function of the service using device 4 of the vehicle V corresponding to the service provision flag set on.

[0116]

15 Doing this enables the onboard unit 3 to specify the service actually available on the road among the services that the user has agreed to use by the service request flag, and to make the service available in the vehicle V. This can prevent the user from using an undesired service while the vehicle V is traveling on the road where the service is providable. By separating the service
20 request flag and the service provision flag in this manner, only the setting of the service provision flag of the onboard unit 3 changes in accordance with the route, and the service request flag input from the user does not change. This does not make, even when the vehicle V travels by transferring to routes with different provision services, the service request flag off, allowing the service
25 desired by the user to be received in each route. That is, if a desired service is provided in preceding and subsequent routes, the service can be used in both routes. Even if a desired service is not provided in a preceding route, if the service is provided in a subsequent route, this service can be automatically made available when transferring to the subsequent route.

30 [0117]

(2) According to a second aspect, in the onboard unit 3 according to the first aspect, the provision service reception unit 33 sets, when not receiving service provision information indicating that a service corresponding to the service request flag transmitted is providable, a service provision flag
35 corresponding to the service request flag off.

[0118]

Doing this enables the onboard unit 3 to set the service provision flag off for the service that cannot be provided by the road even if it is a function

desired by the user, and to disable the function of the service using device 4 of the vehicle V. This can prevent wasteful consumption of power and the like of the vehicle V due to the function of the service using device 4 being enabled on a road where no service is provided.

5 [0119]

(3) According to a third aspect, the onboard unit 3 according to the first or second aspect further includes the usage fee processing unit 35 configured to communicate with the exit roadside antenna 23 provided at an exit lane LO of the road and to process payment of a usage fee of a service corresponding to

10 the service provision flag set on.
[0120]

Doing this enables the onboard unit 3 to automatically pay the usage fee of the used service at the exit of the road.

[0121]

15 (4) According to a fourth aspect, in the onboard unit 3 according to any one of the first to third aspects, the enabling processing unit 34 enables, when a service provision flag corresponding to an information distribution service is on, the output device 43 of the vehicle V to use information provided from the service providing facility 6.

20 [0122]

Doing this enables the onboard unit 3 to enable the function of the output device 43 only when the user agrees to use the information distribution service and the road can provide this service. By this, for example, even in a case where the service roadside antenna 62 of the service providing facility 6 performs broadcast distribution to all nearby vehicles, it is possible to enable

25 only the vehicle V that has agreed to use the service to use the distributed information and to disable the vehicle V that has not agreed to use the service to use the distributed information. On a road where the information distribution service is not provided, it is possible to suppress power consumption by

30 disabling the function corresponding to the service of the output device 43.

[0123]

(5) According to a fifth aspect, in the onboard unit 3 according to any one of the first to fourth aspects, the enabling processing unit 34 enables, when a service provision flag corresponding to an autonomous driving assistance

35 service is on, the autonomous driving control device 41 of the vehicle V to use an autonomous driving function based on autonomous driving assistance information provided from the service providing facility 6.

[0124]

Doing this enables the onboard unit 3 to enable the function based on the autonomous driving assistance information of the autonomous driving control device 41 only when the user agrees to use the autonomous driving assistance service and the road can provide this service. By this, for example, even in a case where the service roadside antenna 62 of the service providing facility 6 performs broadcast distribution to all nearby vehicles, it is possible to enable only the vehicle V that has agreed to use the service to use the distribute autonomous driving assistance information and to disable the vehicle V that has not agreed to use the service to use the distribute autonomous driving assistance information. On a road where the autonomous driving assistance service is not provided, it is possible to suppress power consumption by disabling the function corresponding to the service of the autonomous driving control device 41.

[0125]

(6) According to a sixth aspect, in the onboard unit 3 according to any one of the first to fifth aspects, the enabling processing unit 34 enables, when a service provision flag corresponding to a power feeding service while driving is on, the charging control device 42 of the vehicle V to use power supplied from the service providing facility 6 for charging a battery of the vehicle V.

[0126]

Doing this enables the onboard unit 3 to enable the function regarding the power feeding while driving of the charging control device 42 only when the user agrees to use the power feeding service while driving and the road can provide this service. By this, even in a case where a vehicle that has agreed to use the power feeding service while driving and a vehicle that has not agreed to do so are traveling in a mixed manner in the section providing the service of power feeding while driving, for example, only the vehicle V that has agreed can charge the battery, and the vehicle V that has not agreed cannot charge the battery. On a road where the power feeding service while driving is not provided, it is possible to suppress power consumption by disabling the function corresponding to the service of the charging control device 42.

[0127]

(7) According to a seventh aspect, the entrance toll collection facility 1 includes: the entrance roadside antenna 13 provided upstream of a section providing a service on a road where the service to be added to travel on a road is providable, the entrance roadside antenna 13 being configured to communicate with the onboard unit 3 mounted on the vehicle V; the request flag reception unit 152 configured to receive, from the onboard unit 3 through

the entrance roadside antenna 13, a service request flag by which a service desired by a user boarding the vehicle V can be specified; and the service provision information transmission unit 153 configured to transmit service provision information indicating a service that can be provided by the road among services desired by the user on the basis of the service request flag.

[0128]

This enables the entrance toll collection facility 1 to notify the onboard unit 3 of the vehicle V of the service that the road can provide among the services desired by the user. This enables the onboard unit 3 of the vehicle V to specify a service actually available on the road among the services that the user has agreed to use by the service request flag, and to make the service available in the vehicle V. This can prevent the user from using an undesired service while the vehicle V is traveling on the road where the service is providable.

[0129]

(8) According to an eighth aspect, in the entrance toll collection facility 1 according to the seventh aspect, the entrance roadside antenna 13 is provided at an entrance tollgate upstream of a section providing the service.

[0130]

This enables the entrance toll collection facility 1 to be configured at low cost by using the configuration of the entrance roadside device 10 and the like of an existing entrance tollgate.

[0131]

(9) According to a ninth aspect, in the entrance toll collection facility 1 according to the seventh aspect, the entrance roadside antenna 13 is provided at a position where the entrance roadside antenna 13 can communicate with the onboard unit 3 of the vehicle V traveling on a road upstream of a section providing the service.

[0132]

For example, in a case where the function of the service using device 4 of the vehicle V is enabled at the entrance tollgate, there is a possibility that the power of the service using device 4 is wastefully consumed if the distance from the entrance tollgate to the section providing the service is long. On the other hand, by installing the entrance roadside antenna 13 on the road before the section providing the service as described above, the vehicle V can enable the function of the service using device 4 after approaching the section providing the service, and therefore power consumption can be suppressed.

[0133]

(10) According to a tenth aspect, the exit toll collection facility 2 includes: the exit roadside antenna 23 provided at an exit of a road where a service to be added to travel of the vehicle V is providable, the exit roadside antenna 23 being configured to communicate with the onboard unit 3 mounted on the vehicle V coming to the exit; the service flag reception unit 251 configured to receive, from the onboard unit 3 through the exit roadside antenna 23, a service provision flag by which a service used by the vehicle V can be specified; and the usage fee collection processing unit 252 configured to collect a usage fee of a service corresponding to the service provision flag.

[0134]

Doing this enables the exit toll collection facility 2 to automatically collect the usage fee of the service used by the vehicle V from the onboard unit 3 of the vehicle V about to exit from the road. That is, while the vehicle V travels on the exit lane LO, the exit toll collection facility 2 can perform both the known automatic toll collection processing for the toll fare and the collection processing for the service usage fee.

[0135]

(11) According to an eleventh aspect, the service using system 100 includes: the onboard unit 3 according to any one of the first to sixth aspects; and the entrance toll collection facility 1 according to any one of the seventh to ninth aspects.

[0136]

(12) According to a twelfth aspect, a service using method includes: by the onboard unit 3 mounted on the vehicle V, a step of receiving input from a user and setting a service request flag indicating whether the vehicle V is provided with a service to be added to travel on a road; by the entrance toll collection facility 1, a step of receiving, from the onboard unit 3 through the entrance roadside antenna 13 provided upstream of a section providing the service of the road, a service request flag by which a service desired by the user can be specified; by the entrance toll collection facility 1, a step of transmitting service provision information indicating a service that can be provided by the road among services desired by the user on the basis of the service request flag; by the onboard unit 3, a step of receiving the service provision information and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and by the onboard unit 3, a step of enabling a function of the service using device 4 of the vehicle V corresponding to the service provision flag set on.

[0137]

(13) According to a thirteenth aspect, the program causes the onboard unit 3 to execute a step of receiving input from a user and setting a service request flag indicating whether the vehicle V is provided with a service to be added to travel on a road; a step of communicating with the entrance roadside antenna 13 provided upstream of a section providing the service of the road and transmitting the service request flag; a step of receiving service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and a step of enabling a function of the service using device 4 of the vehicle V corresponding to the service provision flag set on.

Reference Signs List

15 [0138]
 100 Service using system
 1 Entrance toll collection facility
 10 Entrance roadside device
 11 First vehicle detector
 20 13 Entrance roadside antenna
 14 Second vehicle detector
 15 Entrance lane server
 151 Provision flag setting unit
 152 Request flag reception unit
 25 153 Service provision information transmission unit
 154 Entrance processing unit
 16 Interface (I/F) unit
 2 Exit toll collection facility
 20 Exit roadside device
 30 21 First vehicle detector
 23 Exit roadside antenna
 24 Second vehicle detector
 25 Exit lane server
 251 Service flag reception unit
 35 252 Usage fee collection processing unit
 253 Toll fare collection processing unit
 26 Interface (I/F) unit
 3 Onboard unit

- 31 Request flag setting unit
- 32 Service request unit
- 33 Provision service reception unit
- 34 Enabling processing unit
- 5 35 Usage fee processing unit
- 36 Toll fare processing unit
- 37 Setting button
- 38 Notification device
- 4 Service using device
- 10 41 Autonomous driving control device
- 42 Charging control device
- 43 Output device
- 6 Service providing facility
- 60 Management server
- 15 61 Service device
- 62 Service roadside antenna
- 63 Power feeding panel
- 7 User terminal device
- V Vehicle

Claims

[Claim 1]

An onboard unit, comprising:

a request flag setting unit configured to receive input from a user and set a service request flag indicating whether a vehicle is provided with a service to be added to travel on a road;

a service request unit configured to communicate with an entrance roadside antenna provided upstream of a section providing the service of the road and transmit the service request flag;

a provision service reception unit configured to receive service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and to set on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and

an enabling processing unit configured to enable a function of a service using device of the vehicle corresponding to the service provision flag set on.

[Claim 2]

The onboard unit according to claim 1, wherein the provision service reception unit sets, when not receiving service provision information indicating that a service corresponding to the service request flag transmitted is providable, a service provision flag corresponding to the service request flag off.

[Claim 3]

The onboard unit according to claim 1, further comprising

a usage fee processing unit configured to communicate with an exit roadside antenna provided at an exit of the road and to process payment of a usage fee of a service corresponding to the service provision flag set on.

[Claim 4]

The onboard unit according to any one of claims 1 to 3, wherein the enabling processing unit enables, when a service provision flag corresponding to an information distribution service is on, an output device of the vehicle to use information provided from a service providing facility.

[Claim 5]

The onboard unit according to any one of claims 1 to 3, wherein the enabling processing unit enables, when a service provision flag corresponding to an autonomous driving assistance service is on, an autonomous driving control device of the vehicle to use an autonomous driving function based on autonomous driving assistance information provided from a service providing facility.

[Claim 6]

The onboard unit according to any one of claims 1 to 3, wherein the enabling processing unit enables, when a service provision flag corresponding to a power feeding service while driving is on, a charging control device of the vehicle to use power supplied from a service providing facility for charging a battery of the vehicle.

[Claim 7]

An entrance toll collection facility, comprising:

an entrance roadside antenna provided upstream of a section providing a service on a road where the service to be added to travel on a road is providable, the entrance roadside antenna being configured to communicate with an onboard unit mounted on a vehicle;

a request flag reception unit configured to receive, from the onboard unit through the entrance roadside antenna, a service request flag by which a service desired by a user boarding the vehicle can be specified; and

a service provision information transmission unit configured to transmit service provision information indicating a service that can be provided by the road among services desired by the user on the basis of the service request flag.

[Claim 8]

The entrance toll collection facility according to claim 7, wherein the entrance roadside antenna is provided at an entrance tollgate upstream of a section providing the service.

[Claim 9]

The entrance toll collection facility according to claim 7, wherein the entrance roadside antenna is provided at a position where the entrance roadside antenna can communicate with the onboard unit of the vehicle traveling on a road upstream of a section providing the service.

[Claim 10]

An exit toll collection facility, comprising:

an exit roadside antenna provided at an exit of a road where a service to be added to travel of a vehicle is providable, the exit roadside antenna being configured to communicate with an onboard unit mounted on a vehicle coming to the exit;

a service flag reception unit configured to receive, from the onboard unit through the exit roadside antenna, a service provision flag by which a service used by the vehicle can be specified; and

a usage fee collection processing unit configured to collect a usage fee of a service corresponding to the service provision flag.

[Claim 11]

A service using system, comprising

the onboard unit according to any one of claims 1 to 3; and

the entrance toll collection facility according to any one of claims 7 to 9.

[Claim 12]

A service using method, comprising:

by an onboard unit mounted on a vehicle, a step of receiving input from a user and setting a service request flag indicating whether the vehicle is provided with a service to be added to travel on a road;

by an entrance toll collection facility, a step of receiving, from the onboard unit through an entrance roadside antenna provided upstream of a section providing the service of the road, a service request flag by which a service desired by the user can be specified;

by the entrance toll collection facility, a step of transmitting service provision information indicating a service that can be provided by the road among services desired by the user on the basis of the service request flag;

by the onboard unit, a step of receiving the service provision information and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and

by the onboard unit, a step of enabling a function of a service using device of the vehicle corresponding to the service provision flag set on.

[Claim 13]

A program that causes an onboard unit to execute:

a step of receiving input from a user and setting a service request flag indicating whether a vehicle is provided with a service to be added to travel on a road;

a step of communicating with an entrance roadside antenna provided upstream of a section providing the service of the road and transmitting the service request flag;

a step of receiving service provision information indicating a service that can be provided by the road among services corresponding to the service request flag transmitted and setting on a service provision flag corresponding to a service that is desired by the user and can be provided by the road; and

a step of enabling a function of a service using device of the vehicle corresponding to the service provision flag set on.