[0016]

According to a ninth aspect of the invention, there is provided a vehicle (1) in which the in-vehicle device (10) according to any one of the first aspect to the eighth aspect of the invention is mounted.

[0017]

According to a tenth aspect of the invention, there is provided a method for downloading satellite orbit information including a determination information acquisition step of acquiring determination information relating to a vehicle, and a timing decision step of deciding a timing of downloading the satellite orbit information based on the determination information.

[0018]

According to an eleventh aspect of the invention, there is provided a program for downloading satellite orbit information causing a computer as an in-vehicle device to function as a determination information acquisition unit that acquires determination information relating to a vehicle, and a timing decision unit that decides a timing of downloading the satellite orbit information based on the determination information.

Advantageous Effects of Invention

[0019]

With the in-vehicle device, the vehicle, the method

information of a predetermined position (charging map information) and information of a predetermined time (charging time information) as the determination information (Step S101). Specifically, the determination information acquisition unit 11 refers to the determination information storage unit 16 and acquires the charging map information and the charging time information stored in the determination information storage unit 16. The determination information acquisition unit 11 inputs the acquired charging map information and charging time information to the timing decision unit 12.

[0044]

Next, the timing decision unit 12 decides the timing of downloading the satellite orbit information from the AGNSS server 3 based on the input determination information (charging map information as information of the predetermined position and charging time information as information of the predetermined time) (Step S102). Specifically, the timing decision unit 12 decides a timing, at which a current position of the vehicle 1 coincides with any one of predetermined positions included in the charging map information and a current time is a predetermined preparation time before a charging time, as the timing of downloading the satellite orbit information. The current position of the vehicle 1 is input from the

[0071]

In Fig. 8, the learning unit 21 finally stores information of "07:00:00 to 09:00:00" and "18:00:00 to 20:00:00" as information of the time having the high use frequency of the vehicle 1 in the determination information storage unit 16 as the determination information (information of the predetermined time).

[0072]

Next, the determination information acquisition unit 11 acquires information of the predetermined time as the determination information (Step S101). Specifically, the determination information acquisition unit 11 refers to the determination information storage unit 16, and acquires information of the time having the high use frequency of the vehicle 1 stored in the determination information storage unit 16. The determination information acquisition unit 11 inputs the acquired time having the high use frequency of the vehicle 1 to the timing decision unit 12.

[0073]

Next, the timing decision unit 12 decides the timing of downloading the satellite orbit information from the AGNSS server 3 based on the input determination information (the time having the high use frequency of the vehicle 1 that is information of the predetermined time)

Industrial Applicability

[0081]

With the in-vehicle device, the vehicle, the method for downloading satellite orbit information, and the program for downloading satellite orbit information, download of the satellite orbit information using the AGNSS can be performed at an appropriate timing, and suppression of unneeded communication and reduction of battery consumption can be achieved.

Reference Signs List

[0082]

1: vehicle
2: GNSS satellite
3: AGNSS server
9: computer
10: in-vehicle device
11: determination information acquisition unit
12: timing decision unit
13: current position specification unit
14: charging processing unit
15: satellite signal reception unit
16: determination information storage unit
17: satellite orbit information storage unit
18: satellite orbit information reception unit
20: engine information storage unit
21: learning unit

Claims

[Claim 1]

An in-vehicle device comprising:

a determination information acquisition unit that acquires determination information relating to a vehicle;

a timing decision unit that decides a timing at which the vehicle enters a predetermined toll charging area or a predetermined preparation time before the timing at which the vehicle enters the predetermined toll charging area, as a timing of downloading satellite orbit information based on the determination information; and

a charging processing unit that executes a toll charging processing to the vehicle positioned within the predetermined toll charging area using the satellite orbit information downloaded at the timing which is decided.

[Claim 2]

The in-vehicle device according to claim 1,

wherein the determination information includes information of a predetermined position, and

the timing decided by the timing decision unit is a timing at which a current position of the vehicle becomes the predetermined position.

[Claim 3]

The in-vehicle device according to claim 1 or 2,

wherein the determination information includes information of a predetermined time, and

the timing decided by the timing decision unit is a timing at which a current time is the predetermined preparation time before the predetermined time.

[Claim 4]

The in-vehicle device according to claim 3,

wherein the predetermined time is a time when a use frequency of the vehicle is high.

[Claim 5]

The in-vehicle device according to claim 4, further comprising:

a learning unit that learns the predetermined time.

[Claim 6]

The in-vehicle device according to any one of claims 1 to 5,

wherein the timing decision unit decides the timing of downloading the satellite orbit information such that a download frequency is changed based on the determination information.

[Claim 7]

The in-vehicle device according to claim 6,

wherein the determination information includes information of a predetermined vehicle type, and

the timing decision unit decides the timing of downloading the satellite orbit information such that the download frequency becomes higher in a case where a vehicle type of the vehicle is the predetermined vehicle type than in a case where the vehicle type is other than the predetermined vehicle type.

[Claim 8]

The in-vehicle device according to claim 6,

wherein the determination information includes information of a predetermined vehicle type, and

the timing decision unit decides the timing of downloading the satellite orbit information such that the download frequency becomes lower in a case where a vehicle type of the vehicle is the predetermined vehicle type than in a case where the vehicle type is other than the predetermined vehicle type.

[Claim 9]

A vehicle in which the in-vehicle device according to any one of claims 1 to 8 is mounted.

[Claim 10]

An in-vehicle device comprising:

a determination information acquisition unit that acquires determination information relating to a vehicle; and

a timing decision unit that decides a timing of downloading satellite orbit information based on the determination information,

wherein the determination information includes information of a predetermined vehicle type,

wherein the timing decision unit decides the timing of downloading the satellite orbit information such that a download frequency is changed based on the determination information, and

the timing decision unit decides the timing of downloading the satellite orbit information such that the download frequency becomes higher in a case where a vehicle type of the vehicle is the predetermined vehicle type than

in a case where the vehicle type is other than the predetermined vehicle type.

[Claim 11]

An in-vehicle device comprising:

a determination information acquisition unit that acquires determination information relating to a vehicle; and

a timing decision unit that decides a timing of downloading satellite orbit information based on the determination information,

wherein the determination information includes information of a predetermined vehicle type,

wherein the timing decision unit decides the timing of downloading the satellite orbit information such that a download frequency is changed based on the determination information, and

the timing decision unit decides the timing of downloading the satellite orbit information such that the download frequency becomes lower in a case where a vehicle type of the vehicle is the predetermined vehicle type than in a case where the vehicle type is other than the predetermined vehicle type.

[Claim 12]

A method for downloading satellite orbit information, the method comprising:

a determination information acquisition step of acquiring determination information relating to a vehicle;

a timing decision step of deciding a timing at which the vehicle enters a predetermined toll charging area or a predetermined preparation time before the timing at which

the vehicle enters the predetermined toll charging area, as a timing of downloading the satellite orbit information based on the determination information; and

a charging processing step of executing a toll charging processing to the vehicle positioned within the predetermined toll charging area using the satellite orbit information downloaded at the timing which is decided.

[Claim 13]

A program for downloading satellite orbit information, the program causing a computer as an in-vehicle device to function as:

a determination information acquisition unit that acquires determination information relating to a vehicle;

a timing decision unit that decides a timing at which the vehicle enters a predetermined toll charging area or a predetermined preparation time before the timing at which the vehicle enters the predetermined toll charging area, as a timing of downloading satellite orbit information based on the determination information; and

a charging processing unit that executes a toll charging processing to the vehicle positioned within the predetermined toll charging area using the satellite orbit information downloaded at the timing which is decided.