DESCRIPTION

ON-BOARD UNIT AND COMMUNICATION METHOD USING ON-BOARD UNIT

Technical Field

[0001]

The present invention relates to an on-board unit, more particularly, to an on-board unit performing wireless communications.

Background Art

[0002]

On-board units which perform wireless communications are known in the art. For example, an on-board unit adapted to an automatic toll collection system performs wireless communications with a roadside unit located on the roadside and performs data processing necessary for automatic toll collection.

[0003]

With respect to such wireless communications adapted to vehicles, the dedicated short range communications (DSRC) system is known in the art. In a DSRC system, two types of modulation schemes: ASK (amplitude shift keying) modulation and $\pi/4$-shift QPSK (quadrature phase shift keying) modulation are used. As a technology related to this kind of DSRC system, the following is known:

[0004]

Patent literature 1 discloses a wireless station in

a DSRC system. In this disclosed wireless station, a power amplifier circuit of the transmission signal is commonly used for the above-described two modulation schemes. The wireless station switches the level of the transmission output power depending on the modulation scheme to be used.

[0005]

Patent literature 2 discloses a receiver of a DSRC on-board unit. This receiver determines which of the above-described modulation schemes is used in the modulation of the reception wave, and selects the gain of the amplifier in response to the determined modulation scheme.

[0006]

Patent literature 3 discloses a DSRC on-board unit. The disclosed DSRC on-board unit includes a reception sensitivity setting means which sets the reception sensitivity used in the communication area with a roadside unit in response to vehicle type information of the vehicle. The reception sensitivity setting means compensates for the dependency of the reception field intensity on the vehicle type with the reception sensitivity.

[0007]

Patent literature 4 discloses a DSRC on-board unit. The disclosed DSRC on-board unit includes a reception sensitivity enhancing means which enhances, in response to an entry into a communication start area with a roadside unit, the reception sensitivity used in the communication

area with the roadside unit. The reception sensitivity enhancing means restores the reception sensitivity to a usual reception sensitivity used before the entry, in response to the completion of the communications with the roadside unit.

Citation List

Patent Literature

[0008]

Patent Literature 1: JP 2007-335959 A

Patent Literature 2: JP 2007-281890 A

Patent Literature 3: JP 2001-308740 A

Patent Literature 4: JP 2001-273534 A

Summary of the Invention

[0009]

As discussed above, there are communication schemes for providing an on-board unit with information services, and the number of services available through an on-board unit is expected to increase in future. In such situations, counterparts with which an on-board unit performs wireless communications are not limited to roadside units, and various implementations are expected.

[0010]

An objective of the present invention is to provide a technique for avoiding electromagnetic wave interference and cross-talk in wireless communications

performed by such a multi-purpose on-board unit adapted to multiple types of services.

[0011]

In an aspect of the present invention, an on-board unit is provided. The on-board unit includes: a wireless transmitter section transmitting a transmission signal to a communication counterpart; a wireless receiver section receiving a reception signal from the communication counterpart; and a communication property control section. The communication property control section variably controls communication properties including the transmission output level of the wireless transmitter section and the reception sensitivity of the wireless receiver section, in response to control data included in the reception signal.

[0012]

In one example, a wireless communication range for the case that the communication counterpart is a first communication counterpart is assumed to be wider than that for a case when the communication counterpart is a second communication counterpart. When the communication counterpart is the first communication counterpart, in response to the control data received from the first communication counterpart, the communication property control section sets the transmission output level to a first output transmission level and sets the reception sensitivity to a first reception sensitivity. When the

communication counterpart is the second communication counterpart, in response to the control data received from the second communication counterpart, the communication property control section sets the transmission output level to a second output transmission level lower than the first output transmission level and sets the reception sensitivity to a second reception sensitivity lower than the first reception sensitivity.

[0013]

In an initial state of the communication properties, the communication property control section may set the transmission output level to the first transmission output level and set the reception sensitivity to the first reception sensitivity. The communication property control section may reset the communication properties to the initial state when a communication process with the second communication counterpart is completed.

[0014]

In one example, the first communication counterpart is a different vehicle, and the second communication counterpart is a roadside system.

[0015]

The control data may include service information specifying a service type. The communication property control section may have an association table indicative of an association between the service type and the communication properties. When receiving the control

data, the communication property control section refers to the association table and sets the communication properties to those associated with the service type specified by the service information included in the received control data.

[0016]

The communication property control section receives update information indicative of a latest version of the association table and updates the association table in accordance with the received update information.

[0017]

The present invention effectively avoids electromagnetic wave interference and cross-talk in wireless communications performed by a multi-purpose on-board unit adapted to multiple types of services.

Brief Description of Drawings

[0018]

Fig. 1 is a table illustrating an example of communication processes performed by an on-board unit according to an embodiment of the present invention;

Fig. 2 is a schematic diagram illustrating an example of communication processes performed by an on-board unit according to an embodiment of the present invention;

Fig. 3 is a block diagram schematically illustrating the configuration of an on-board unit according to an embodiment of the present invention;

Fig. 4 is a block diagram illustrating the configuration of a wireless communication unit of an on-board unit according to an embodiment of the present invention;

Fig. 5 is a summarized flowchart illustrating the operation of an on-board unit according to an embodiment of the present invention;

Fig. 6 is a schematic diagram explaining a modification example of the embodiment of the present invention; and

Fig. 7 is a block diagram schematically illustrating the configuration of an on-board unit in the modification example.

Description of Embodiments

[0019]

A description is given of on-board units according to embodiments of the present invention with reference to attached drawings.

[0020]

(Example of Communication Processes Performed by On-Board Unit)

An on-board unit according to the present embodiment is a multi-purpose on-board unit adapted to multiple types of services provided through wireless communications, and performs a wireless communication processes suitable for each of the types of services. A description is first

given of wireless communication processes performed by the on-board unit according to the present embodiment with reference to Figs. 1 and 2. As one example, the following three types of wireless communication processes are discussed.

[0021]

In a first communication process, vehicle-vehicle communications are performed. In other words, the communication counterpart in the first communication process is a different vehicle. Services available through the first communication process include message communications between vehicles and provision of emergency-vehicle approach information. The wireless communication range required by the first communication process is relatively wide (the wireless communication distance is up to 1 km).

[0022]

In a second communication process, vehicle-roadside communications are performed. In other words, the communication counterpart in the second communication process is a roadside system. Services available through the second communication process include toll charge transactions at toll charge points and provision of traffic information. The toll charge transactions may include toll collection on highways and road pricing for restriction of entry into an urban area. The wireless communication range required by the second communication

process is narrower than that required by the first communication process (the wireless communication distance is up to 10 m.)

[0023]

Vehicle-roadside communications are performed also in a third communication process. It should be noted however that the wireless communication range required by the third communication process is further narrower than that required by the second communication process (the wireless communication distance is up to 5 m.) Typical examples of the communication counterpart expected in this case include a parking lot system (roadside system) provided at an entry way of a parking lot. Available services may include toll charge transactions in a parking lot, entry and exit management or the like.

[0024]

As thus described, the required wireless communication range varies among the first to third communication processes. More specifically, the required wireless communication range is widest for the first communication process and narrowest for the third communication range. In the present embodiment, the communication properties are variably controlled in response to the breadth of the required wireless communication range. The controlled communication properties include the transmission output level and the reception sensitivity. For the first communication

process, which has the widest wireless communication range, the transmission output level is set highest and the reception sensitivity is set highest. For the third communication process, which has the narrowest wireless communication range, on the other hand, the transmission output level is set lowest and the reception sensitivity is set lowest. The transmission output level and reception sensitivity for the second communication process are set between those for the first and third communication processes.

[0025]

Discussed below as a comparative example is the case that the communication properties are set equal for the first to third communication processes. This requires setting a high transmission output level and a high reception sensitivity to such an extent that at least the first communication process can be implemented. When the third communication process is performed in a parking lot with such settings, however, there is a possibility of, for example, occurrence of wireless communications with a roadside system at an adjacent lane. In other words, there is a possibility of occurrence of electromagnetic wave interference and cross-talk. Furthermore, an excessive increase in the transmission output level undesirably causes a wasteful increase in the transmission power.

[0026]

In the present embodiment, in contrast, the transmission output level and reception sensitivity of the on-board unit are variably controlled to match the breadth of the wireless communication range. This avoids electric wave interference and cross-talk. A wasteful increase in the transmission power is also avoided.

[0027]

Note that the on-board unit according to the present embodiment is responsive to externally-received control data for variably controlling the transmission output level and reception sensitivity. More specifically, the control data are transmitted from the respective communication counterparts of the first to third communication processes. In other words, the on-board unit according to the present embodiment variably controls the transmission output level and reception sensitivity in response to control data received from a communication counterpart. In the following, a detailed description is given of the configuration and operation of an on-board unit according to the present embodiment.

[0028]

(Configuration of On-Board Unit and Process Flow)

Fig. 3 is a block diagram schematically illustrating the configuration of an on-board unit 1 according to the present embodiment. The on-board unit 1 includes a control unit 10, a storage unit 20, a display unit 30, a notification unit 40 and a GPS receiver unit 50.

[0029]

The control unit 10 executes a control program to perform various arithmetic processes and controls of respective components. Examples of the control unit 10 include a CPU and a microcomputer.

[0030]

The storage unit 20 stores therein the control program executed by the control 10 and various data including map data and the like. Examples of the storage unit 20 include a RAM and an HDD.

[0031]

The display unit 30 displays a variety of information such as a map, the location of the own vehicle and toll charge message. Examples of the display unit 30 include a liquid crystal display device and a tough panel.

[0032]

The notification unit 40 notifies the driver of information by generating a buzzer sound or melody sound.

[0033]

The GPS receiver unit 50 receives electromagnetic waves from GPS satellites to determine the location (degrees of latitude and longitude) of the on-board unit 1. The location information measured by the GPS receiver unit 50 is transmitted to the control unit 10. The control unit 10 displays the location of the own vehicle on the basis of the location information.

[0034]

Additionally, the on-board unit 1 according to the present embodiment can accommodate provisions of various services illustrated in Figs. 1 and 2 via wireless communications. To achieve this, the on-board unit 1 further includes a wireless communication unit 100 and an antenna 150. The wireless communication unit 100 performs wireless communications with communication counterparts via the antenna 150 to implement the first to third communication processes described above. For example, the wireless communication unit 100 receives emergency-vehicle-approach information through the first communication process (vehicle-vehicle communications). The emergency-vehicle-approach information is forwarded to the control unit 10. The control unit 10 displays the location of an emergency vehicle and a message on the basis of the received emergency-vehicle-approach information.

[0035]

Fig. 4 is a block diagram illustrating the configuration of the wireless communication unit 100 in the present embodiment. The wireless communication unit 100 includes a wireless transmitter section 110, a wireless receiver section 120, an antenna switch 130 and a communication property control section 140.

[0036]

The wireless transmitter section 110 receives from the control unit 10 a signal to be transmitted. This signal is referred to as the "transmission signal DT",

hereinafter. The wireless transmitter section 110 wirelessly transmits the transmission signal DT to a communication counterpart via the antenna 150.

[0037]

More specifically, the wireless transmitter section 110 includes a modulation circuit 111, a transmission amplifier 112 and a variable attenuator 113. The modulation circuit 111 receives the transmission signal DT from the control unit 10 and performs modulation of the transmission signal DT. The transmission amplifier 112 receives the modulated transmission signal DT and performs amplification of the received transmission signal DT. The amplified transmission signal DT is forwarded to the variable attenuator 113.

[0038]

The variable attenuator 113 attenuates the signal level of the transmission signal DT. The attenuation factor can be variably set. The transmission output level of the transmission signal DT is increased when the attenuation factor is set small, and decreased when the attenuation factor is set large. In the present embodiment, the attenuation factor of the variable attenuator 113 is variably set in response to the breadth of the required wireless communication range (that is, the type of communication process). As a result, the transmission output level of the wireless transmitter section 110 is variably set in response to the type of

communication process. Details will be described later.

[0039]

The transmission signal DT output from the variable attenuator 113 is forwarded to the antenna 150 via the antenna switch 130 and transmitted to a transmission counterpart from the antenna 150.

[0040]

The wireless receiver section 120 wirelessly receives a signal from a communication counterpart via the antenna 150. The received signal is referred to as the "reception signal DR", hereinafter. The wireless receiver section 120 forwards the reception signal DR to the controller 10.

[0041]

More specifically, the wireless receiver section 120 includes a variable gain amplifier 121 and a demodulation circuit 122.

[0042]

The variable gain amplifier 121 receives the reception signal DR via the antenna 150 and the antenna switch 130. The variable gain amplifier 121 performs amplification of the received signal DR. The gain of the variable gain amplifier 121 can be variably set. The reception sensitivity of the reception signal DR is increased when the gain is set large, and decreased when the gain is set small. In the present embodiment, the gain of the variable gain amplifier 121 is variably set in

response to the breadth of the required wireless communication range (that is, the type of communication process). As a result, the reception sensitivity of the wireless receiver section 120 is variably set in response to the type of communication process.

[0043]

The demodulation circuit 122 receives the amplified reception signal DR and performs demodulation of the reception signal DR. The demodulated reception signal DR is forwarded to the control unit 10. The reception signal DR incorporates service data DAT related to a service, and the control unit 10 performs a process related to the service on the basis of the service data DAT. For example, when the service data DAT includes emergency-vehicle-approach information, the control unit 10 displays the location of an emergency vehicle and a message on the display unit 30 on the basis of the received emergency-vehicle-approach information.

[0044]

The antenna switch 130 performs switching between the transmission of the transmission signal DT and the reception of the reception signal DR in response to a switch signal SW output from the control unit 10. Specifically, during a transmission period, the antenna switch 130 outputs the transmission signal DT output from the wireless transmitter section 110 to the antenna 150. During a reception period, on the other hand, the antenna switch

130 outputs the reception signal DR received via the antenna 150 to the wireless reception section 120.

[0045]

The communication property control section 140 is disposed to variably control communication properties of the wireless communication unit 100. More specifically, in the present embodiment, the reception signal DR received from a communication counterpart includes not only service data DAT related to a service but also "control data CON" for specifying the communication properties. The communication property control section 140 receives the control data CON from the demodulation circuit 122 of the wireless receiver section 120. The communication property control section 140 variably controls communication properties of the wireless communication unit 100 in response to the control data CON.

[0046]

The communication properties of the wireless communication unit 100 include the transmission output level of the wireless transmitter section 110 and the reception sensitivity of the wireless receiver section 120. As illustrated in Figs. 1 and 2, the preferred transmission output level and reception sensitivity are dependent on the breadth of the wireless communication range, that is, the type of communication process. In the present embodiment, a preferred transmission output level and reception sensitivity are specified in the control data

CON received from the communication counterpart. Accordingly, the communication property control section 140 can set the transmission output level and reception sensitivity to the specified values by referring to the control data CON. It should be noted that the transmission output level of the wireless transmitter section 110 can be adjusted by adjusting the attenuation factor of the variable attenuator 113 as described above. It should be also noted that the reception sensitivity of the wireless receiver section 120 can be adjusted by adjusting the gain of the variable gain amplifier 121 as described above.

[0047]

The communication counterpart for the first communication process is a different vehicle. The wireless communication range required in this case is relatively wide. A first transmission output level and a first reception sensitivity which are suitable for the wide wireless communication range are specified in the control data CON received from the different vehicle. By referring to the control data CON, the communication property control section 140 sets the transmission output level of the wireless transmitter section 110 to the first transmission output level and sets the reception sensitivity of the wireless receiver section 120 to the first reception sensitivity.

[0048]

The communication counterpart for the second

communication process is a roadside system. The wireless communication range required in this case is narrower than that for the first communication process. A second transmission output level and a second reception sensitivity which are suitable for the narrow wireless communication range are specified in the control data CON received from the roadside system. It should be noted that the second transmission output level is lower than the first transmission output level and the second reception sensitivity is lower than the first reception sensitivity. By referring to the control data CON, the communication property control section 140 sets the transmission output level of the wireless transmitter section 110 to the second transmission output level and sets the reception sensitivity of the wireless receiver section 120 to the second reception sensitivity.

[0049]

The communication counterpart for the second communication process is a roadside system (parking lot system). The wireless communication range required in this case is further narrower than that for the second communication process. A third transmission output level and a third reception sensitivity which are suitable for the further narrower wireless communication range are specified in the control data CON received from the roadside system (parking lot system). It should be noted that the third transmission output level is further lower

than the second transmission output level and the third reception sensitivity is further lower than the second reception sensitivity. By referring to the control data CON, the communication property control section 140 sets the transmission output level of the wireless transmitter section 110 to the third transmission output level and sets the reception sensitivity of the wireless receiver section 120 to the third reception sensitivity.

[0050]

As thus described, the transmission output level and reception sensitivity of the wireless communication unit 100 are flexibly switched in response to the wireless communication range required by each service in the present embodiment. This effectively avoids electromagnetic wave interference and cross-talk. A wasteful increase in the transmission power is also avoided.

[0051]

The communication property control section 140 may reset the communication properties to an initial state in response to a reset signal RST received from the control unit 10. In one example, the initial state is the state of the first communication process. In other words, in the initial state, the communication property control section 140 sets the transmission output level of the wireless transmitter section 110 to the first transmission output level, and sets the reception sensitivity of the wireless receiver section 120 to the first reception

sensitivity. This allows detecting an available service without fail, since the reception sensitivity is set highest in the initial state.

[0052]

Discussed below is the case that control data CON are received from a roadside system after the communication properties are set to the initial state. In this case, as described above, the communication property control section 140 switches the transmission output level of the wireless transmitter section 110 to the second transmission output level and switches the reception sensitivity of the wireless receiver section 120 to the second reception sensitivity. The wireless communication process with the roadside system is performed with the second transmission output level and the second reception sensitivity. After the wireless communication process with the roadside system is completed, the control unit 10 detects the completion from the reception signal DR. In this case, the control unit 10 outputs the reset signal RST to the communication property control section 140. In response to the reset signal RST, the communication property control section 140 resets the communication properties to the initial state.

[0053]

The control unit 10 may output the reset signal RST to the communication property control section 140, also when service data DAT are not successfully received within

a given time after the reception of the control data CON. Also in this case, the communication properties are reset to the initial state.

[0054]

Although Fig. 4 illustrates the communication property control section 140 as being incorporated in the wireless communication unit 100, an implementation is not limited to this configuration. For example, the communication property control section 140 may be incorporated in the control unit 10. In this case, the control unit 10 extracts control data CON from the reception signal DR received from the demodulation circuit 122, and forwards the control data CON to the communication property control section 140. In any cases, a requirement is that the communication property control section 140 variably controls the communication properties in response to the control data CON.

[0055]

Fig. 5 is a summarized flowchart illustrating the operation of the on-board unit 1 according to the present embodiment. Discussed below is the case that, in the initial state, the transmission output level of the wireless transmitter section 110 is set to the first transmission output level and the reception sensitivity of the wireless receiver section 120 is set to the first reception sensitivity. This allows detecting an available service without fail, since the reception

sensitivity is set highest in the initial state.

[0056]

Step S10:

The wireless receiver section 120 receives control data CON from a communication counterpart.

[0057]

Step S20:

The communication property control section 140 sets the transmission output level of the wireless transmitter section 110 and the reception sensitivity of the wireless receiver section 120 in response to the received control data CON.

[0058]

Step S30:

The wireless communication unit 100 performs a wireless communication process with the communication counterpart with the transmission output level and reception sensitivity set at step S20. The control unit 10 performs a process related to the service on the basis of service data DAT received from the communication counterpart.

[0059]

Step S40:

The control unit 10 determines whether or not the wireless communication process with the communication counterpart is completed, on the basis of the reception signal DR. When the wireless communication process with

the communication counterpart is completed (step S40; Yes), the procedure goes to step S50.

[0060]

Step S50:

The control unit 10 outputs the reset signal RST to the communication property control section 140. In response to the reset signal RST, the communication property control section 140 initializes the transmission output level of the wireless transmitter section 110 and the reception sensitivity of the wireless receiver section 120.

[0061]

The control unit 10 may output the reset signal RST to the communication property control section 140 also when service data DAT are not successfully received within a given time after the reception of the control data CON. Also in this case, the communication properties are reset to the initial state.

[0062]

(Modification Example)

Fig. 6 is a schematic view explaining a modification example of the present embodiment. In the present modification example, the communication property control section 140 has an association table 141 indicative of the association between each "service type" and the "communication properties." The service type means the type of service available to the on-board unit 1, including

provision of emergency-vehicle-approach information, toll charge transactions at a toll charge point and the like. The service type may be specified, for example, with a service number allocated to each service. The communication properties include the transmission output level of the wireless transmitter section110 and the reception sensitivity of the wireless receiver section 120 as described above.

[0063]

In the present modification example, the control data CON received from the communication counterpart do not specify a desired transmission output level and reception sensitivity in themselves. Alternatively, the control data CON received from the communication counterpart include service information specifying the service type. When receiving the control data CON, the communication property control section 140 refers to the service information included in the received control data CON and identifies the service type. The communication property control section 140 then retrieves the communication properties associated with the identified service type by referring to the association table 141. Finally, the communication property control section 140 sets the communication properties of the wireless communication unit 100 to those retrieved from the association table 141. In other words, the communication property control section 140 refers to the association table 141 and sets the

communication properties to those associated with the service type specified by the service information included in the control data CON. The same effect and result as those of the above-described embodiments can be also obtained through this configuration.

[0064]

In the present modification example, the communication property control section 140 may update the association table 141 in accordance with the necessity. More specifically, the communication property control section 140 receives update information UPD indicating the latest version of the association table 141. The communication property control section 140 updates the association table 141 in accordance with the received update information UPD.

[0065]

Fig. 7 illustrates one example of the configuration for externally obtaining the update information UPD. Compared with the above-mentioned configuration illustrated in Fig. 3, a network communication unit 200 and an antenna 250 are added. The network communication unit 200 establishes a connection with an external network via the antenna 250 and performs wireless communications with a server. For example, the network communication unit 200 performs communications with a center server by using a cellular phone communication network. The network communication unit 200 obtains the update information UPD

from the server through the above-described network communications. The control unit 10 forwards the update information UPD to the communication property control section 140 to update the association table 141.

[0066]

Such update of the association table 141 in accordance with the necessity allows flexibly adapting to modification of the specification of the communication scheme and use of a future communication scheme.

[0067]

In the above, embodiments of the present invention have been described with reference to the attached drawings. It should be noted however that the present invention is not limited to the above-described embodiments; implementations may be modified by a person skilled in the art as long as not departing from the scope of the invention.

CLAIMS

1. An on-board unit, comprising:

a wireless transmitter section transmitting a transmission signal to a communication counterpart;

a wireless receiver section receiving a reception signal from the communication counterpart; and

a communication property control section variably controlling communication properties including a transmission output level of the wireless transmitter section and a reception sensitivity of the wireless receiver section, in response to control data included in the reception signal,

wherein the control data include service information specifying each service type,

wherein the communication property control section has an association table indicative of an association between service types and the communication properties,

wherein, when receiving the control data, the communication property control section refers to the association table and sets the communication properties to those associated with the service type specified by the service information included in the received control data, and

wherein the communication property control section receives update information indicative of a

latest version of the association table and updates the association table in accordance with the received update information.

2. The on-board unit according to claim 1, wherein a wireless communication range for a case when the communication counterpart is a first communication counterpart is wider than that for a case when the communication counterpart is a second communication counterpart,

wherein, when the communication counterpart is the first communication counterpart, in response to the control data received from the first communication counterpart, the communication property control section sets the transmission output level to a first output transmission level and sets the reception sensitivity to a first reception sensitivity, and

wherein, when the communication counterpart is the second communication counterpart, in response to the control data received from the second communication counterpart, the communication property control section sets the transmission output level to a second output transmission level lower than the first output transmission level and sets the reception sensitivity to a second reception sensitivity lower than the first reception sensitivity.

3. The on-board unit according to claim 2, wherein, in an initial state of the communication properties, the communication property control section sets the transmission output level to the first transmission output level and sets the reception sensitivity to the first reception sensitivity, and

wherein the communication property control section resets the communication properties to the initial state when a communication process with the second communication counterpart is completed.

4. The on-board unit according to claim 2 or 3, wherein the first communication counterpart is a different vehicle, and

wherein the second communication counterpart is a roadside system.

5. The on-board unit according to claim 1, further comprising:

a network communication unit provided separately from a wireless communication unit including the wireless transmitter section and the wireless receives section,

wherein the network communication unit receives the update information from an external network, and the update information received by the network communication unit is transferred to the communication

property control section.

6. The on-board unit according to claim 5, wherein the network communication unit receives the update information through a network communication using a cellular phone communication network.

7. A communication method using an on-board unit, the method comprising:

receiving a reception signal from a communication counterpart; and

providing an association table indicative of an association between service types and communication properties,

in response to control data included in the reception signal from the communication counterpart, variably controlling communication properties including a transmission output level of a transmission signal to be transmitted to the communication counterpart and a reception sensitivity of the reception signal,

wherein the control data include service information specifying a service type, and

wherein, the step of controlling the communication properties includes:

referring to the association table to set the communication properties to those associated with the

service type specified by the service information included in the received control data

wherein the communication method further comprises:

receiving update information indicative of a latest version of the association table and

updating the association table in accordance with the received update information.