communicates with the short-range communicator 32 and the GNSS receiver 33 to enable two way communications.

[0045]

The short-range communicator 32 performs a dedicated short range communication with a roadside short-range communicator 21 of the roadside unit 2 or a short-range communicator 32 of another in-vehicle unit 3. The communication distance of the short-range communicator 32 is about several hundred meters, for example. In addition, the control channel or service channel mentioned above is used for the dedicated short range communication according to the present embodiment. The short-range communicator 32 includes: a short-range receiver 32A that demodulates a signal received via an antenna and outputs to the control circuit 31; and a short-range transmitter 32B that modulates the data inputted from the control circuit 31 and converts into the electric waves to transmit to surroundings.

[0046]

The short-range receiver 32A selects one channel from the control channel and a plurality of service channels and designated the selected one channel as a reception channel which is a frequency channel receiving the radio wave, and receives the radio wave transmitted from the roadside unit 2 via the reception channel. The short-range receiver 32A demodulates the received radio wave to extract a signal and outputs the signal to the control circuit 31.

[0047]

The short-range transmitter 32B selects one channel from the control channel and the plurality of service channels, and designates the selected one channel as a transmission channel which is a frequency channel transmitting the radio wave. The short-range transmitter 32B modulates the data inputted from the control circuit 31, and converts the modulated data into the radio wave having the frequency of the transmission channel to transmit.

[0048]

The GNSS receiver 33, which is an example of a position detector, receives the radio wave from the satellites used in the GNSS, and calculates a current position of the GNSS receiver 33. The current position calculated by the GNSS receiver 33

CLAIMS

1. A wireless communication apparatus comprising:

a short-range receiver configured to

designate, as a reception channel, (i) a control channel or (ii) one of a plurality of service channels, the control channel and the service channels having mutually different frequencies,

receive, under a control channel designated state in which the control channel is designated as the reception channel, a service start informational item containing an informational item identifying the service channel from a service provider station, and

receive, under a service channel designated state in which the service channel is designated as the reception channel, a service execution informational item to execute a service from the service provider station;

a channel switcher section configured to switch between the control channel and the service channel in designating as the reception channel;

a collision determiner section configured to determine presence of a plurality of service provider stations and a collision of a plurality of service start informational items transmitted by the respective service provider stations

based on (i) that a service execution informational item is received under the service channel designated state, and simultaneously (ii) that a reception error is detected under the control channel designated state; and

a collision notice processor section configured to transmit a signal collision notice representing the collision of the plurality of service start informational items from a predetermined notice transmitter to (i) the service provider station or (ii) a management apparatus informing the service provider station of a notice indicating the collision of the service start informational items,

based on that the collision determiner section determines the collision of the plurality of service start informational items transmitted by the respective service provider stations.

2. The wireless communication apparatus according to claim 1, wherein:

the wireless communication apparatus is movable; and

the collision determiner section determines the presence of the plurality of service provider stations and the collision of the plurality of service start informational items transmitted by the respective service provider stations,

based on that states change arises while service execution informational items are able to be received by the short-range receiver under consecutive service channel designated states,

the states change being

from a state in which a service start informational item is receivable under a control channel designated state

into a state in which a reception error is detected under a control channel designated.

3. The wireless communication apparatus according to claim 1 or claim 2, further comprising:

a short-range transmitter configured to transmit a signal to the service provider station,

wherein the collision notice processor section uses the short-range transmitter as the notice transmitter to transmit the signal collision notice to the service provider station.

4. The wireless communication apparatus according to claim 3, further comprising:

a service executor section configured to control the short-range transmitter and transmit successively an informational item to execute the service to the service provider station,

wherein when the service executor section has not completed transmitting of the informational item to execute the service, the collision notice processor section uses the short-range transmitter as the notice transmitter, and transmits the signal collision notice by adding the signal collision notice to the informational item to execute the service.

5. The wireless communication apparatus according to claim 1, further comprising:

a position detector configured to detect a current position of the wireless communication apparatus that is movable,

wherein when determining the collision of the plurality of service start informational items transmitted by the respective service provider stations, the collision determiner section transmits the signal collision notice that contains the current position detected by the position detector.

6. The wireless communication apparatus according to any one of claims 1 to 5, wherein:

the collision determiner section determines a time zone in which the short-range receiver detects the reception error to be a determined time zone in which the plurality of service start informational items transmitted by the respective service provider stations collide with each other; and

the collision notice processor section transmits the signal collision notice that contains the determined time zone from the notice transmitter.

7. The wireless communication apparatus according to claim 1, further comprising:

a position detector configured to detect a current position of the wireless communication apparatus that is movable,

wherein:

the collision determiner section updates successively a signal collision segment that is a segment in which the plurality of service start informational items transmitted by the respective service provider stations collide with each other, based on the current position detected by the position detector when determining the collision of the plurality of service start informational items transmitted by the respective service provider stations; and

the collision notice processor section transmits the signal collision notice

containing the signal collision segment after failing to detect a collision of the plurality of service start informational items.

8. The wireless communication apparatus according to claim 7, further comprising:

a wide-range communicator configured to connect to a wide-range wireless communication network and transmit an informational item,

wherein the collision notice processor section uses the wide-range transmitter as the notice transmitter to transmit the signal collision notice to the management apparatus.

9. The wireless communication apparatus according to claim 7, further comprising:

a short-range transmitter configured to transmit a signal to the service provider station,

wherein when the short-range receiver receives a signal transmitted by a service provider station after the collision determiner section comes to not update the signal collision segment, the collision notice processor section uses the short-range receiver as the notice transmitter to transmit the signal collision notice to the service provider station having transmitted the received signal.

10. The wireless communication apparatus according to claim 1, further comprising:

a travel distance information detector configured to detect a travel distance informational item to calculate a travel distance of the wireless communication apparatus that is movable; and

a failure determiner section configured to determine whether the short-range receiver is in a failed state, when the reception error is detected,

the failure determiner section determining that the short-range receiver is not in the failed state in response to that a ratio of the reception error transitions from a state where the ratio is greater than a predetermined error ratio threshold into a state where the ratio is less than the predetermined error ratio