

CLAIMS

1. A vehicle onboard communication terminal (1) in a mobile communication system (100, 100A) that establishes vehicle-to-vehicle communication and road-to-vehicle communication by using a carrier wave having an identical carrier frequency and employs Carrier Sense Multiple Access/Collision Avoidance method as an access method, the vehicle onboard communication terminal comprising:

a reception processing portion (F4) that receives road-to-vehicle communication data transmitted from a roadside device (2) and vehicle-to-vehicle communication data transmitted from a different vehicle onboard communication terminal;

a transmission processing portion (F3) that performs a process transmitting the road-to-vehicle communication data and the vehicle-to-vehicle communication data;

a transmission control portion (F2) that controls an operation of the transmission processing portion (F3) and has a regular transmission mode and a passive transmission mode as a mode of controlling the operation of the transmission processing portion (F3); and

a determination portion (F6) that determines, based on determination data, whether to place the transmission control portion (F2) in the passive transmission mode, the determination data determining whether a transmission of the vehicle-to-vehicle communication data from the vehicle onboard communication terminal is likely to obstruct transmission of the road-to-vehicle communication data from the roadside device (2) or from the different vehicle onboard communication terminal,

wherein:

the transmission control portion (F2) operates in the passive transmission mode when the determination portion (F6) has determined that the transmission control portion (F2) is to be placed in the passive transmission mode, and operates in the regular transmission mode when the determination portion (F6) has not determined that the transmission control portion (F2) is to be placed in the passive transmission mode;

the transmission control portion (F2) detects usage of the carrier frequency when the transmission control portion (F2) is operating in the regular transmission mode, and operates so as to successively transmit the road-to-vehicle communication data and the vehicle-to-vehicle communication data when the carrier frequency is determined to be unused; and

the transmission control portion (F2) stops the transmission of the vehicle-to-vehicle communication data and receives data addressed to the vehicle onboard communication terminal from the roadside device (2) when the transmission control portion (F2) is operating in the passive transmission mode, and operates so as to transmit the road-to-vehicle communication data when a response needs to be transmitted in response to a received data.

2. The vehicle onboard communication terminal according to claim 1, wherein:

the determination portion (F6) includes a positional relationship determination portion (F64) that determines, based on positional relationship determination data defining a positional relationship between the vehicle onboard communication terminal and the roadside device (2), whether the vehicle onboard communication terminal exists in a predetermined transmission inhibition area that is an area where the vehicle-to-vehicle communication data transmitted from the vehicle onboard communication terminal is likely to obstruct the transmission of the road-to-vehicle communication data from the roadside device (2) or from the different vehicle onboard communication terminal; and

when the positional relationship determination portion (F64) has determined that the vehicle onboard communication terminal exists in the transmission inhibition area of the roadside device (2), the determination portion (F6) determines that the transmission control portion (F2) is to be placed in the passive transmission mode.

3. The vehicle onboard communication terminal according to claim 2, wherein:

the positional relationship determination data is a reception level of a signal received from the roadside device (2); and

when the reception level is equal to or greater than a predetermined determination threshold value, the positional relationship determination portion (F61) determines that the vehicle onboard communication terminal exists in the transmission inhibition area of the roadside device (2).

4. The vehicle onboard communication terminal according to claim 2, further comprising:

a position information acquisition portion (F7) that acquires position information about the vehicle onboard communication terminal; and

an area information acquisition portion (F8) that acquires area information indicative of a range where the transmission inhibition area of the roadside device (2) is formed,

wherein:

the positional relationship determination portion (F61) determines, based on the position information acquired by the position information acquisition portion (F7) and on the area information acquired by the area information acquisition portion (F8), whether the vehicle onboard communication terminal exists in the transmission inhibition area of the roadside device (2).

5. The vehicle onboard communication terminal according to claim 4, further comprising:

an area information storage portion (14) that stores the area information,

wherein:

the area information acquisition portion (F8) acquires the area information from the area information storage portion (14).

6. The vehicle onboard communication terminal according to any one of claims 1 to 5, wherein:

the determination portion (F6) includes a carrier usage determination portion (F62) that determines, based on congestion index data indicating a degree of congestion of communication with the carrier wave in a wireless communication area of the roadside device (2), whether data transmission by the roadside device (2) is obstructed by the vehicle-to-vehicle communication; and

when the carrier usage determination portion (F62) has determined that the data transmission by the roadside device (2) is obstructed by the vehicle-to-vehicle communication, the determination portion (F6) determines that the transmission control portion (F2) is to be placed in the passive transmission mode.

7. The vehicle onboard communication terminal according to claim 6, wherein:

the congestion index data is an elapsed time from a last reception of periodic transmission data, the periodic transmission data being transmitted at predetermined transmission intervals from the roadside device (2); and

when the elapsed time is longer than the transmission intervals by a length of time not shorter than a predetermined value, the carrier usage determination portion (F62) determines that the data transmission by the roadside device (2) is obstructed by the vehicle-to-vehicle communication.

8. The vehicle onboard communication terminal according to claim 6, wherein:

the road-to-vehicle communication data transmitted from the roadside device (2) includes information about a generation time at which the data has been generated;

the congestion index data is a difference between a reception time at which data transmitted from the roadside device (2) has been received by the reception processing portion and the generation time included in the data; and

when the difference between the reception time and the generation time is equal to or greater than a predetermined permissible time lag, the carrier usage determination portion (F62) determines that the data transmission by the roadside device (2) is obstructed by the vehicle-to-vehicle communication.

9. The vehicle onboard communication terminal according to claim 4, further comprising:

a communication portion (14) that communicates with a management server (3) that is disposed outside a vehicle to store the area information,

wherein:

the area information acquisition portion (F8) acquires the area information from the management server through the communication portion.

10. The vehicle onboard communication terminal according to any one of claims 1 to 8, further comprising:

a threshold value storage portion (134) that stores a threshold value used by the determination portion (F6) to determine whether to place the transmission control portion (F2) in the passive transmission mode; and

a communication portion (14) that is placed outside the vehicle and communicates with a management server (3) managing a distribution threshold value different from the threshold value stored in the threshold value storage portion (134),

wherein:

the communication portion receives the distribution threshold value from the management server (3); and

when the communication portion receives the distribution threshold value from the management server (3), the determination portion (F6) determines whether to place the transmission control portion (F2) in the passive transmission mode by using the distribution threshold value received by the communication portion in preference to the threshold value stored in the threshold value storage portion (134).

11. A mobile communication system (100, 100A) that establishes vehicle-to-vehicle communication and road-to-vehicle communication by using a carrier wave having an identical carrier frequency and employs Carrier Sense Multiple Access/Collision Avoidance method as an access method, the mobile communication system comprising:

a plurality of vehicle onboard communication terminals (1); and
a roadside device (2),

wherein:

the roadside device (2) includes

a roadside device transmission processing portion (G3) that performs a process of transmitting road-to-vehicle communication data, and

a roadside device transmission control portion (G2) that detects usage of the carrier frequency, and when the carrier frequency is determined to be unused, operates so as to transmit the road-to-vehicle communication data;

each of the vehicle onboard communication terminals includes

a reception processing portion (F4) that receives the road-to-vehicle communication data transmitted from the roadside device (2) and vehicle-to-vehicle communication data transmitted from a different vehicle onboard communication terminal,

a transmission processing portion (F3) that performs a process transmitting the road-to-vehicle communication data and the vehicle-to-vehicle communication data,

a transmission control portion (F2) that controls an operation of the transmission processing portion (F3) and has a regular transmission mode and a passive transmission mode as a mode of controlling the operation of the transmission processing portion (F3), and

a determination portion (F6) that determines based on determination data whether to place the transmission control portion (F2) in the passive transmission mode, the determination data determining whether a transmission of the vehicle-to-vehicle communication data from the vehicle onboard communication terminal is likely to obstruct the transmission of the

road-to-vehicle communication data from the roadside device (2) or from the different vehicle onboard communication terminal;

the transmission control portion (F2) operates in the passive transmission mode when the determination portion (F6) has determined that the transmission control portion (F2) is to be placed in the passive transmission mode, and operates in the regular transmission mode when the determination portion (F6) has not determined that the transmission control portion (F2) is to be placed in the passive transmission mode;

the transmission control portion (F2) detects the usage of the carrier frequency when the transmission control portion (F2) is operating in the regular transmission mode, and operates so as to successively transmit the road-to-vehicle communication data and the vehicle-to-vehicle communication data when the carrier frequency is determined to be unused; and

the transmission control portion (F2) stops the transmission of the vehicle-to-vehicle communication data and receives data addressed to the vehicle onboard communication terminal from the roadside device (2) when the transmission control portion (F2) is operating in the passive transmission mode, and operates so as to transmit the road-to-vehicle communication data when a response needs to be transmitted in response to the received data.