of the secondary systems is not small, consideration of interference between channels may possibly become necessary. However, in order to accurately evaluate such various factors for all of the secondary systems, calculation cost for allocating the transmission power will increase, and extra load will be imposed on a control node controlling the secondary use.

[0008]

Accordingly, it is desirable that a system be provided that suppresses the load to calculate the transmission power of the secondary systems and that appropriately prevents detrimental interference to the primary system.

Solution to Problem

[0009]

According to a first aspect of the present invention, there is provided a communication control device comprising a power allocation unit configured to allocate transmission power for secondary use of a frequency channel protected for a primary system to a secondary system, wherein the power allocation unit switches power allocation methods between a first group of secondary systems of which a distance from the primary system is less than a prescribed threshold and a second group of secondary systems of which a distance from the primary system exceeds the prescribed threshold; ~~a classification~~ wherein the power allocation unit is configured to classify a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system, and wherein after completion of classification into the first and second group of the secondary systems ~~at the classification unit~~, the power allocation unit is configured to calculate the transmission power commonly allocated for each secondary system that belongs to the first group of the secondary systems with a first method, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and the power allocation unit is configured to calculate the transmission power commonly allocated for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method allocating fixed power, a method considering path loss or a method considering accumulative interferences.

[0010]

According to a second aspect of the present invention, there is provided a method for allocating transmission power for secondary use of a frequency channel protected for a primary system to a secondary system, the method comprising: obtaining a distance to the secondary system from the primary system; allocating transmission power to the secondary system with the first power allocation method when the obtained distance is less than a prescribed threshold; allocating transmission power to the secondary system with the second power allocation method that requires calculation cost lower than that of the first power allocation method when the obtained distance exceeds the prescribed threshold, and classifying a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system, wherein after completion of classification into the first and second group of the secondary systems ~~at the classifying step~~, the step of allocating transmission power comprises calculating the transmission power allocated commonly for each secondary system that belongs to the first group of the secondary systems with a first method, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and the step of allocating transmission power comprises calculating the transmission power allocated commonly for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method allocating fixed power, a method considering path loss or a method considering accumulative interferences.

[0011]

According to a third aspect of the present invention, there is provided a program for causing a computer of a communication control device to function as a power allocation unit to allocate transmission power for secondary use of a frequency channel protected for a primary system to a secondary system, wherein the power allocation unit switches power allocation methods between a first group of secondary systems of which a distance from the primary system is less than a prescribed threshold and a second group of secondary systems of which a distance from the primary system exceeds the prescribed threshold; ~~a classification~~ wherein the power allocation unit is configured to classify a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system, and wherein after completion of classification into

the first and second group of the secondary systems ~~at the classification unit~~, the step of allocating transmission power comprises calculating the transmission power allocated commonly for each secondary system that belongs to the first group of the secondary systems, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and the step of allocating transmission power comprises calculating the transmission power allocated commonly for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method allocating fixed power, a method considering path loss or a method considering accumulative interferences.

Advantageous Effects of Invention

[0012]

According to embodiments of the present invention, it is possible to suppress load to calculate transmission power of the secondary systems and to appropriately prevent detrimental interference to the primary system.

Brief Description of Drawings

[0013]

[FIG. 1] FIG. 1 is an explanatory diagram for explaining an interference a node of a primary system suffers upon secondary usage of a frequency.

[FIG. 2] FIG. 2 is an explanatory diagram for explaining an interference in a channel and an interference between channels.

[FIG. 3] FIG. 3 is an explanatory diagram for explaining a configuration of a communication control system according to one embodiment.

[FIG. 4] FIG. 4 is a sequence diagram illustrating an exemplary schematic flow of a communication control processing performed in the communication control system according to one embodiment.

[FIG. 5] FIG. 5 is a block diagram illustrating an exemplary configuration of the communication control device according to one embodiment.

[FIG. 6] FIG. 6 is a flowchart illustrating an exemplary flow of a power allocation process according to one embodiment.

[FIG. 7] FIG. 7 is a block diagram illustrating of an exemplary configuration of a

CLAIMS

1. A communication control device comprising

a power allocation unit configured to allocate transmission power for secondary use of a frequency channel protected for a primary system to a secondary system,

wherein the power allocation unit switches power allocation methods between a first group of secondary systems of which a distance from the primary system is less than a prescribed threshold and a second group of secondary systems of which a distance from the primary system exceeds the prescribed threshold;

~~a classification~~ wherein the power allocation unit is configured to classify a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system, and

wherein after completion of classification into the first and second group of the secondary systems ~~at the classification unit~~,

the power allocation unit is configured to calculate the transmission power commonly allocated for each secondary system that belongs to the first group of the secondary systems with a first method, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and

the power allocation unit is configured to calculate the transmission power commonly allocated for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method allocating fixed power, a method considering path loss or a method considering accumulative interferences.

2. The communication control device according to claim 1, wherein the first method has a greater computational cost than the second method.

3. The communication control device according to claim 1 or 2,

wherein a power allocation method selected for the first group is a method that depends on a path loss regarding each secondary system, and

wherein a power allocation method selected for the second group is a method that does not depend on a path loss regarding each secondary system.

4. The communication control device according to claim 1 or 2,

wherein a power allocation method selected for the first group is a method that considers accumulative interferences from a plurality of secondary systems to the primary system, and

wherein a power allocation method selected for the second group is a method that does not consider accumulative interferences from a plurality of secondary systems to the primary system.

5. The communication control device according to claim 1 or 2,

wherein a power allocation method selected for the first group is a method that considers both an interference from a secondary system to the primary system on a same channel and an interference between channels, and

wherein a power allocation method selected for the second group is a method that does not consider the interference from a secondary system to the primary system between channels.

6. The communication control device according to claim 3,

wherein the power allocation method selected for the second group is a method to allocate a fixed value or a value requested from each secondary system as a transmission power value to each secondary system.

7. The communication control device according to claim 4,

wherein the power allocation method selected for the second group is a method to allocate, to the secondary system, a larger transmission power value as a path loss from each secondary system to the primary system becomes larger.

8 The communication control device according to claim 5,

wherein the power allocation method selected for the second group is a method to distribute transmission power into each secondary system so that an accumulative interference amount on a same channel from a plurality of secondary systems to the primary system does not exceed an acceptable interference amount of the primary system.

9. The communication control device according to claim 3,

wherein the power allocation method selected for the first group is a method to distribute transmission power to each secondary system so that a sum of an accumulative interference amount on a same channel from a plurality of secondary systems to the primary system and an accumulative interference amount between channels does not exceed an acceptable interference amount of the primary system.

10. The communication control device according to claim 3,

wherein the power allocation method selected for the first group is a method to distribute transmission power into each secondary system so that an accumulative interference amount on a same channel from a plurality of secondary systems to the primary system does not exceed an acceptable interference amount of the primary system.

11. The communication control device according to claim 3,

wherein the power allocation method selected for the first group is a method to allocate, to the secondary system, a larger transmission power value as a path loss from each secondary system to the primary system becomes larger.

12. A method for allocating transmission power for secondary use of a frequency channel protected for a primary system to a secondary system, the method comprising:

obtaining a distance to the secondary system from the primary system;

allocating transmission power to the secondary system with the first power allocation method when the obtained distance is less than a prescribed threshold;

allocating transmission power to the secondary system with the second power allocation method that requires calculation cost lower than that of the first power allocation method when the obtained distance exceeds the prescribed threshold; and

classifying a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system,

wherein after completion of classification into the first and second group of the secondary systems ~~at the classifying step~~,

the step of allocating transmission power comprises calculating the transmission

power commonly allocated for each secondary system that belongs to the first group of the secondary systems with a first method, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and

the step of allocating transmission power comprises calculating the transmission power commonly allocated for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method allocating fixed power, a method considering path loss or a method considering accumulative interferences.

13. The method according to claim 12, wherein the first method has a greater computational cost than the second method.

14. A program for causing a computer of a communication control device to function as

a power allocation unit to allocate transmission power for secondary use of a frequency channel protected for a primary system to a secondary system,

wherein the power allocation unit switches power allocation methods between a first group of secondary systems of which a distance from the primary system is less than a prescribed threshold and a second group of secondary systems of which a distance from the primary system exceeds the prescribed threshold;

~~a classification~~ wherein the power allocation unit is configured to classify a plurality of the secondary system into a first group including some of the plurality of the secondary system and a second group including the rest of the plurality of the secondary system, and

wherein after completion of classification into the first and second group of the secondary systems ~~at the classification unit~~,

the step of allocating transmission power comprises calculating the transmission power commonly allocated for each secondary system that belongs to the first group of the secondary systems with a first method, the first method comprising any one of a method considering path loss, a method considering accumulative interferences or a method considering interference between channels, and

the step of allocating transmission power comprises calculating the transmission power commonly allocated for each secondary system that belongs to the second group of the secondary systems with a second method, the second method comprising any one of a method

allocating fixed power, a method considering path loss or a method considering accumulative interferences.

15. The program according to claim 14, wherein the first method has a greater computational cost than the second method.