

of a combination of the plurality of communication nodes and a plurality of frequency channel candidates, for example. However, this is what is called a NP-hard problem, and its solution is not calculated uniquely. Hence, full search for combinations of a plurality of communication nodes and a plurality of frequency channel candidates is forced to be performed. The number of the combinations increases in an exponential fashion according to the number of the communication nodes and the number of the frequency channel candidates, and therefore the calculation amount can become enormous.

[0008]

Thus, it is desirable to provide a scheme that improves the communication of a communication node that utilizes a radio resource (frequency channel) under an environment in which there is an interference from communication involving a communication node that is not control target, with less calculation amount.

Solution to Problem

[0009]

~~According to a first aspect of the present invention, there is provided a communication control device including: an acquisition unit configured to acquire first interference information indicating a first interference from communication involving a communication node that is not control target and second interference information indicating a second interference from communication involving another communication node of control target, with respect to each of a plurality of communication nodes of control target; and a classifying unit configured to classify the plurality of communication nodes into a plurality of groups related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes.~~

According to a first aspect of the present invention, there is provided a communication control device comprising an interference estimating unit configured to set a provisional frequency channel utilized by each of a plurality of communication nodes, estimate a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes, and estimate a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes; an acquisition unit configured to acquire the first interference information and the second interference

information with respect to each of the plurality of communication nodes of the control target; a classifying unit configured to classify the plurality of communication nodes into first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes; and a channel deciding unit configured to: decide an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the first group, and decide an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.

[0010]

~~According to a second aspect of the present invention, there is provided a communication control method including: acquiring first interference information indicating a first interference from communication involving a communication node that is not control target and second interference information indicating a second interference from communication involving another communication node of control target, with respect to each of a plurality of communication nodes of control target; and classifying the plurality of communication nodes into a plurality of groups related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes.~~

According to a second aspect of the present invention, there is provided a communication control method comprising: setting a provisional frequency channel utilized by each of a plurality of communication nodes; estimating a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes; estimating a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes; acquiring the first interference information and the second interference information with respect to each of the plurality of communication nodes of the control target; classifying the plurality of communication nodes into first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes; deciding an utilizable

frequency channel with respect to each of the plurality of communication nodes classified into the first group; and deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.

[0011]

~~According to a third aspect present invention, there is provided an information processing apparatus including: a memory that stores a predetermined program; and a processor configured to execute the predetermined program. The predetermined program is a program for executing acquiring first interference information indicating a first interference from communication involving a communication node that is not control target and second interference information indicating a second interference from communication involving another communication node of control target, with respect to each of a plurality of communication nodes of control target, and classifying the plurality of communication nodes into a plurality of groups related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes.~~

According to a third aspect of the present invention, there is provided an information processing apparatus comprising: a memory that stores a predetermined program; and a processor configured to execute the predetermined program, wherein the predetermined program is a program for executing setting a provisional frequency channel utilized by each of a plurality of communication nodes; estimating a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes; estimating a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes; acquiring the first interference information and the second interference information with respect to each of the plurality of communication nodes of the control target, and classifying the plurality of communication nodes into first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes, deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the first group; and deciding an utilizable frequency channel with respect to each of the

plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.

Advantageous Effects of Invention

[0012]

As described above, embodiments of the present disclosure improve communication of a communication node that utilizes a radio resource (frequency channel) under an environment in which there is an interference from communication involving a communication node that is not control target, with less calculation amount.

Brief Description of Drawings

[0013]

[FIG. 1] FIG. 1 is an explanatory diagram illustrating an example of a schematic

CLAIMS

~~Claim 1~~

1. A communication control device comprising:

an interference estimating unit configured to:

set a provisional frequency channel utilized by each of a plurality of communication nodes,

estimate a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes, and

estimate a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes;

an acquisition unit configured to acquire ~~the~~ first interference information ~~diating a first interference from communication involving a communication node that is not control target and~~ the second interference information ~~indicating a second interference from communication involving another communication node of control target,~~ with respect to each of a the plurality of communication nodes of the control target; and

a classifying unit configured to classify the plurality of communication nodes into a ~~plurality of groups~~ first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes; and

a channel deciding unit configured to:

decide an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the first group, and

decide an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.

~~Claim 2~~

2. The communication control device according to claim 1, wherein

the plurality of groups are a plurality of groups ~~the first group and the second group~~ corresponding to an order in which the radio resource is decided.

~~Claim 3~~

3. The communication control device according to claim 2, wherein
the plurality of groups include at least a first group and a second group, and
a communication node classified into the first group is a communication node in
which a level of the first interference relative to the second interference is larger, as compared
with a communication node classified into the second group.

~~Claim 4~~

4. The communication control device according to claim 3, wherein
the second group is a group for which the radio resource is decided after the first
group.

~~Claim 5~~

5. The communication control device according to claim 4, further comprising:
a deciding unit configured to decide the radio resource with respect to each of the
plurality of communication nodes,
wherein the deciding unit decides the radio resource with respect to each of one or
more communication nodes classified into the first group, and decides the radio resource with
respect to each of one or more communication nodes classified into the second group, on the
basis of a decision result of the radio resource in the first group.

~~Claim 6~~

6. The communication control device according to claim 5, wherein
the deciding unit decides one or more radio resource candidates having a smaller
level of the first interference among two or more radio resource candidates, as the radio
resource for the communication node classified into the first group.

~~Claim 7~~

7. The communication control device according to claim 3, wherein
the second group is a group for which the radio resource is decided before the first
group.

~~Claim 8~~

8. The communication control device according to claim 7, further comprising:
a deciding unit configured to decide the radio resource with respect to each of the plurality of communication nodes,
wherein the deciding unit decides the radio resource with respect to each of one or more communication nodes classified into the second group, and decides the radio resource with respect to each of one or more communication nodes classified into the first group, on the basis of a decision result of the radio resource in the second group.

~~Claim 9~~

9. The communication control device according to claim 8, wherein
the deciding unit decides one or more radio resource candidates having a smaller level of a third interference with the one or more communication nodes classified into the second group among two or more radio resource candidates, as the radio resource for the communication node classified into the first group.

~~Claim 10~~

10. The communication control device according to claim 3, further comprising:
a deciding unit configured to decide the radio resource with respect to each of the plurality of communication nodes,
wherein, when deciding the radio resource with respect to each of the one or more communication nodes classified into the second group, the deciding unit decides the radio resource with respect to the communication node having a smaller level of the second interference, and decides, on the basis of a decision result of the radio resource with respect to the communication node, the radio resource with respect to the communication node having a larger level of the second interference.

~~Claim 11~~

11. The communication control device according to claim 3, further comprising:
a deciding unit configured to decide the radio resource with respect to each of the plurality of communication nodes,
wherein the deciding unit decides one or more radio resource candidates having a smaller level of interference including the first interference and the second interference

among two or more radio resource candidates, as the radio resource for the communication node classified into the second group.

~~Claim 12~~

12. The communication control device according to claim 3, wherein
the first interference information indicates the first interference in each of two or more radio resource candidates,
the second interference information indicates the second interference in each of the two or more radio resource candidates, and
the level of the first interference relative to the second interference corresponds to the number of the radio resource candidates for which a level of the first interference is larger than a level of the second interference by a predetermined threshold value or more.

~~Claim 13~~

13. The communication control device according to claim 1, further comprising:
a deciding unit configured to decide the radio resource with respect to each of the plurality of communication nodes,
wherein the plurality of communication nodes are communication nodes of a higher priority than one or more low priority communication nodes of control target, and
the deciding unit further decides the radio resource with respect to each of the one or more low priority communication nodes, on the basis of a decision result of the radio resource with respect to the plurality of communication nodes.

~~Claim 14~~

14. The communication control device according to claim 13, further comprising:
a determination unit configured to determine whether a predetermined condition for a fourth interference with communication involving the plurality of communication nodes is satisfied, with respect to each of the one or more low priority communication nodes,
wherein the deciding unit decides the radio resource with respect to each of the one or more low priority communication nodes, on the basis of a determination result with respect to the predetermined condition.

~~Claim 15~~

15. The communication control device according to claim 1, wherein
the first interference is an interference by a downlink signal transmitted by the communication node that is not control target or an uplink signal transmitted to the communication node that is not control target, and
the second interference is an interference by a downlink signal transmitted by the other communication node or an uplink signal transmitted to the other communication node.

~~Claim-16~~

16. The communication control device according to claim 15, wherein
the interference by the uplink signal transmitted to the other communication node is an interference estimated under an assumption that a transmission node that transmits the uplink signal to the other communication node exists in a predetermined range or at a predetermined position which are closer to the communication node of control target within a communication range of the other communication node.

~~Claim-17~~

17. The communication control device according to claim 1, wherein
the communication node that is not control target includes a communication node of a primary system, and
each of the plurality of communication nodes is a communication node of a secondary system that secondarily utilizes a radio resource for the primary system.

~~Claim-18~~

18. The communication control device according to claim 1, wherein
the communication node that is not control target includes a base station of a macro cell, and
each of the plurality of communication nodes is a base station of a small cell that overlaps the macro cell partially or entirely.

~~Claim-19~~

19. A communication control method comprising:
setting a provisional frequency channel utilized by each of a plurality of communication nodes;

estimating a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes;

estimating a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes;

acquiring the first interference information indicating a first interference from communication involving a communication node that is not control target and the second interference information indicating a second interference from communication involving another communication node of control target, with respect to each of a the plurality of communication nodes of the control target; and

classifying the plurality of communication nodes into a plurality of groups first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes;

deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the first group; and

deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.

Claim 20

20. An information processing apparatus comprising:

a memory that stores a predetermined program; and

a processor configured to execute the predetermined program,

wherein the predetermined program is a program for executing

setting a provisional frequency channel utilized by each of a plurality of communication nodes;

estimating a first interference from communication involving a communication node that is not control target with respect to each of the plurality of communication nodes;

estimating a second interference from communication involving another communication node of control target with respect to each of the plurality of communication nodes;

acquiring the first interference information ~~indicating a first interference from communication involving a communication node that is not control target and~~ the second interference information ~~indicating a second interference from communication involving another communication node of control target,~~ with respect to each of a the plurality of communication nodes of the control target, and

classifying the plurality of communication nodes into a ~~plurality of groups~~ first group and second group related to a decision of a radio resource that a communication node is able to utilize, on the basis of the first interference information and the second interference information with respect to the plurality of communication nodes,

deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the first group; and

deciding an utilizable frequency channel with respect to each of the plurality of communication nodes classified into the second group, on the basis of the decision result of the frequency channel of the first group.