to the Internet and the like through a meshed network. Further, as long as the plurality of communication devices form a mesh as above, when these communication devices perform communication with one another, the communication is completed in the network (the mesh network), so that it is efficient.

[0005] With regard to the secondary users that can form a mesh network, management for maintaining the mesh network is required, and further, communication is performed by using the white space, so that management for the communication is also required. Particularly, it is conceived that well maintaining communication qualities while accommodating a change in momentarily changeable communication environment is important for the secondary users capable of forming a mesh network in the white space.

PRIOR ART DOCUMENT

NON-PATENT DOCUMENT

[0006] Non-Patent Document 1: IEEE802.11af Task Group, http://mentor.ieee.org/802.11/

Non-Patent Document 2: IEEE802.19.1 Task Group, http://mentor.ieee.org/802.802.19/documents

Non-Patent Document 3: Federal Communications Commission, Unlicensed Operation in the TV Broadcast Bands, Second Memorandum Opinion and Order, FCC, 10-17-4, Sept. 23, 2010.

Non-Patent Document 4: Ofcom, Digital Dividend: Cognitive Access, Consultation on License Exempting Cognitive Devices using Interleaved Spectrum, July 2009.

Non-Patent Document 5: IETF RFC 3626, Optimized Link State Routing Protocol (OLSR)

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007] ~~The~~Embodiments of the present invention ~~has an object to~~ provide a communication management device ~~provided~~ for the purpose of managing communication devices to operate under a

television white space (TVWS) environment and a communication management method thereof, the communication management device and the communication management method thereof being applied to a parallel network structure (a mesh network) formed by a plurality of managed devices making a group and being capable of well maintaining communication qualities while accommodating a momentarily changeable communication environment.

MEANS OF SOLVING THE PROBLEMS

[0008] ~~In order to solve the above-described problems,~~ According to a first aspect of the present invention, there is provided a communication management device ~~being one embodiment of the present invention includes~~ including: a storing unit configured to store and retain a corresponding list, the list making each geographical position of a plurality of managed devices to be managed correspond to available frequencies indicating frequencies available at the each geographical position; a first specifying unit configured to specify, for each combination pair being arbitrary two managed devices out of the plurality of managed devices, frequencies available in common by the arbitrary two managed devices as pair available frequencies based on the corresponding list; a notifying unit configured to notify the pair available frequencies to each of the arbitrary two managed devices related to the pair available frequencies; an acquiring unit configured to acquire each of pair communication qualities being a quality of communication in the each combination pair obtained when each of the pair available frequencies specified for the each combination pair is used from each of the plurality of managed devices; a defining unit configured to define, for the each combination pair, a best pair available frequency out of the pair available frequencies, being capable of obtaining a best of the pair communication qualities and to define a best pair communication quality out of the pair communication qualities, corresponding to the best pair available frequency; a second specifying unit configured to specify, for the each combination pair, all of paths connecting one and another of the each combination pair, each of the paths being capable of relaying other managed devices out of the plurality of managed devices as candidate paths of the each combination pair; a calculating unit configured to calculate, for the each combination pair, based on information of the best pair communication quality, each of path communication

path where the best path communication quality is obtained from the candidate paths as a use path for each of the combination pairs.

[0012] Finally, it directs each of the plurality of managed devices to perform communication between one and another of the combination pair by using the use path where one or more communications connecting the combination pair using the best pair available frequency is made. According to the communication through such a use path, it is possible to well maintain the communication qualities while accommodating a momentarily changeable communication environment. This is because originally, each of the pair communication qualities being quality of communication between the combination pair obtained when the pair available frequencies are used is acquired from each of the plurality of managed devices, and based on it, the communication between one and another of the combination pair by using the use path connecting one or more communications using the best pair available frequency is performed.

[0013] ~~Further,~~According to a second aspect of the present invention, there is provided a communication management method ~~being another embodiment of the present invention includes~~ including: storing and retaining a corresponding list, the list making each geographical position of a plurality of managed devices to be managed correspond to available frequencies indicating frequencies available at the each geographical position; specifying, for each combination pair being arbitrary two managed devices out of the plurality of managed devices, frequencies available in common by the arbitrary two managed devices as pair available frequencies based on the corresponding list; notifying the pair available frequencies to each of the arbitrary two managed devices related to the pair available frequencies; acquiring each of pair communication qualities being a quality of communication in the each combination pair obtained when each of the pair available frequencies specified for the each combination pair is used from each of the plurality of managed devices; defining, for the each combination pair, a best pair available frequency out of the pair available frequencies, being capable of obtaining a best of the pair communication qualities and defining a best pair communication quality out of the pair communication qualities, corresponding to the best pair available frequency; specifying, for the each combination pair, all of paths connecting one and another of

the each combination pair, each of the paths being capable of relaying other managed devices out of the plurality of managed devices as candidate paths of the each combination pair; calculating, for the each combination pair, based on information of the best pair communication quality, each of path communication qualities being a quality of communication in each of the candidate paths connecting one or more communications in the each combination pair using the best pair available frequency; selecting, for the each combination pair, a path out of the candidate paths, the path having a best quality in the path communication qualities as a use path for the each combination pair; and directing each of the plurality of managed devices to perform communication between one and another of the each combination pair by using the use path connecting one or more communications in the each combination pair using the best pair available frequency.

[0014] This communication management method is a management method conforming to the above-described communication management device.

EFFECT OF THE INVENTION

[0015] According to embodiments of the present invention, it is possible to provide a communication management device provided for the purpose of managing communication devices to operate under a television white space (TVWS) environment and a communication management method thereof, the communication management device and the communication management method thereof being applied to a mesh network and being capable of well maintaining communication qualities while accommodating a momentarily changeable communication environment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a system configuration diagram used for explaining a mesh network under a white space where a communication management device (MM) being one embodiment of the present invention can be provided;

FIG. 2 is a functional block diagram illustrating a configuration of the communication management device being one embodiment of the present invention;