NON PATENT LITERATURE

[0012]

NON PATENT LITERATURE 1: Ryuhei Tsukada and two others “Housha sanran kyouyou rifurekuto arei antena no sekkei no kisokento” (provisional translation: “Basic study of designing of reflectarray antenna for both radiation and scattering”), document by transmission engineering study group, Vol. 2016, No. 581, pp. 2-3, Tohoku University, Research Institute of Electrical Communication, Transmission Engineering Study Group, June, 2016

SUMMARY

[0013]

An aspect of the present disclosure is a reflection unit. The reflection unit of the disclosure is installed in a wireless transmission path between a first wireless device configured to at least transmit a wireless communication signal and a second wireless device configured to at least receive the wireless communication signal, in order to change a direction of the wireless transmission path. The reflection unit includes a plurality of reflectors configured to reflect the wireless communication signal. The plurality of reflectors include at least one reflectarray reflector,

the at least one reflectarray reflector is a plurality of reflectarray reflectors,

the plurality of reflectarray reflectors include a first reflectarray reflector and a second reflectarray reflector,

the first reflectarray reflector is configured to reflect a second reflected wave, caused by the second reflectarray reflector, of a second wireless communication signal transmitted from the second wireless device,

the second reflectarray reflector is configured to reflect a first reflected wave,

caused by the first reflectarray reflector, of a first wireless communication signal transmitted from the first wireless device,

the first reflectarray reflector includes

a first concentration reflection part configured such that the first reflected wave is concentrated at a focal point, and

a first non-concentration reflection part configured such that the first reflected wave is not concentrated, and

the second reflectarray reflector includes

a second concentration reflection part configured such that the second reflected wave is concentrated at a focal point, and

a second non-concentration reflection part configured such that the second reflected wave is not concentrated.

[0014]

In another aspect, a reflection unit of the disclosure is installed in a wireless transmission path between a first wireless device configured to at least transmit a wireless communication signal and a second wireless device configured to at least receive the wireless communication signal. The reflection unit includes at least one concentration-type reflectarray reflector configured such that a reflected wave of the wireless communication signal is concentrated at a focal point,

the reflection unit is mountable to a structure that has: a first portion; and a second portion where the wireless communication signal is more easily propagated than in the first portion, and

the concentration-type reflectarray reflector is mounted to the structure such that the reflected wave passes through the second portion.

[0015]

CLAIMS

1. A reflection unit installed in a wireless transmission path between a first wireless device configured to at least transmit a wireless communication signal and a second wireless device configured to at least receive the wireless communication signal, in order to change a direction of the wireless transmission path,

the reflection unit comprising

a plurality of reflectors configured to reflect the wireless communication signal, wherein

the plurality of reflectors include at least one reflectarray reflector,

the at least one reflectarray reflector is a plurality of reflectarray reflectors,

the plurality of reflectarray reflectors include a first reflectarray reflector and a second reflectarray reflector,

the first reflectarray reflector is configured to reflect a second reflected wave, caused by the second reflectarray reflector, of a second wireless communication signal transmitted from the second wireless device,

the second reflectarray reflector is configured to reflect a first reflected wave, caused by the first reflectarray reflector, of a first wireless communication signal transmitted from the first wireless device,

the first reflectarray reflector includes

a first concentration reflection part configured such that the first reflected wave is concentrated at a focal point, and

a first non-concentration reflection part configured such that the first reflected wave is not concentrated, and

the second reflectarray reflector includes

a second concentration reflection part configured such that the second

reflected wave is concentrated at a focal point, and

a second non-concentration reflection part configured such that the second reflected wave is not concentrated.

2. The reflection unit according to claim 1, wherein

the reflection unit is mountable to a structure having a corner where a first face and a second face are in contact with each other, and

the plurality of reflectarray reflectors include: a first reflectarray reflector configured to be mounted to the first face; and a second reflectarray reflector configured to be mounted to the second face.

3. The reflection unit according to claim 1, wherein

the plurality of reflectarray reflectors include at least one non-diffusion reflectarray reflector configured such that the wireless communication signal is reflected in a non-diffused manner.

4. The reflection unit according to claim 1, wherein

the plurality of reflectarray reflectors include

at least one diffusion reflectarray reflector configured such that the wireless communication signal is reflected in a diffused manner, and

at least one non-diffusion reflectarray reflector configured such that the wireless communication signal is reflected in a non-diffused manner.

5. The reflection unit according to claim 3 or 4, wherein

the at least one non-diffusion reflectarray reflector includes at least one

concentration-type reflectarray reflector configured such that a reflected wave of the wireless communication signal is concentrated at a focal point.

6. The reflection unit according to claim 5, wherein

the reflection unit is mountable to a structure that has: a first portion; and a second portion where the wireless communication signal is more easily propagated than in the first portion, and

the concentration-type reflectarray reflector is mounted to the structure such that the reflected wave passes through the second portion.

7. The reflection unit according to claim 5, wherein

the concentration-type reflectarray reflector is configured such that the focal point is present at a position where an obstacle present in the wireless transmission path is avoided.

8. The reflection unit according to any one of claims 5 to 7, wherein

the plurality of reflectors include another reflector that is configured to further reflect the reflected wave caused by the concentration-type reflectarray reflector, and

the other reflector is smaller than the concentration-type reflectarray reflector.

9. The reflection unit according to claim 1, wherein

the plurality of reflectarray reflectors include a first reflectarray reflector, and a second reflectarray reflector configured to reflect a reflected wave, caused by the first reflectarray reflector, of the wireless communication signal,

the first reflectarray reflector and the second reflectarray reflector are each one of a diffusion reflectarray reflector, a concentration-type reflectarray reflector, and a non-diffusion

and non-concentration-type reflectarray reflector,

the second reflectarray reflector is one of the diffusion reflectarray reflector, the concentration-type reflectarray reflector, and the non-diffusion and non-concentration-type reflectarray reflector,

the diffusion reflectarray reflector is a reflectarray reflector configured such that the wireless communication signal is reflected in a diffused manner,

the concentration-type reflectarray reflector is a reflectarray reflector configured such that a reflected wave of the wireless communication signal is concentrated at a focal point, and

the non-diffusion and non-concentration-type reflectarray reflector is a reflectarray reflector configured such that: the wireless communication signal is not reflected in a diffused manner; and a reflected wave of the wireless communication signal is not concentrated at a focal point.

10. The reflection unit according to claim 1, wherein

the reflection unit is mountable to a structure having an installation surface,

the plurality of reflectarray reflectors include: a first reflectarray reflector configured to form a first reflected wave by reflecting the wireless communication signal; and a second reflectarray reflector configured to form a second reflected wave by reflecting the first reflected wave, and

the second reflectarray reflector is configured to radiate the second reflected wave into a range including a direction orthogonal to the installation surface.

11. The reflection unit according to claim 1, wherein

the plurality of reflectarray reflectors include

a first reflectarray reflector,

a second reflectarray reflector, and

a third reflectarray reflector,

the first reflectarray reflector is configured to form

a first reflected wave toward the second reflectarray reflector by reflecting a first incident wave having a first incident angle, and

a second reflected wave toward the third reflectarray reflector by reflecting a second incident wave having a second incident angle different from the first incident angle,

the second reflectarray reflector is configured to form a third reflected wave by reflecting the first reflected wave,

the third reflectarray reflector is configured to form a fourth reflected wave by reflecting the second reflected wave, and

the third reflected wave and the fourth reflected wave have radiation ranges overlapping each other.

12. The reflection unit according to claim 1, wherein

the plurality of reflectarray reflectors include

a first reflectarray reflector, and

a second reflectarray reflector,

the reflection unit further includes a radio wave absorber, and

the first reflectarray reflector is configured to form

a first reflected wave toward the second reflectarray reflector by reflecting a first incident wave having a first incident angle, and

a second reflected wave toward the radio wave absorber by reflecting a second incident wave having a second incident angle different from the first incident angle.

13. The reflection unit according to any one of claims 1 to 12, wherein

the at least one reflectarray reflector includes a multi-focal point reflectarray reflector, and

the multi-focal point reflectarray reflector is configured such that a first focal point in a first radiation plane included in a radiation range of a reflected wave of the wireless communication signal and a second focal point in a second radiation plane orthogonal to the first radiation plane are present at different positions.

14. The reflection unit according to claim 1, wherein

the first concentration reflection part and the second concentration reflection part are each implemented by a reflectarray including a plurality of reflection elements.

15. The reflection unit according to claim 1 or 14, wherein

the first non-concentration reflection part is configured to reflect the second reflected wave caused by the second concentration reflection part, and

the second non-concentration reflection part is configured to reflect the first reflected wave caused by the first concentration reflection part.

16. The reflection unit according to any one of claims 1 to 15, wherein

the first reflectarray reflector includes a first low reflection region around the first non-concentration reflection part,

the first low reflection region has a reflectance lower than a reflectance, as to the second reflected wave, of the first non-concentration reflection part,

the second reflectarray reflector includes a second low reflection region around

the second non-concentration reflection part, and

the second low reflection region has a reflectance lower than a reflectance, as to the first reflected wave, of the second non-concentration reflection part.

17. The reflection unit according to claim 16, wherein

the first low reflection region and the second low reflection region each include a radio wave absorber.

18. The reflection unit according to any one of claims 1 to 17, wherein

the first concentration reflection part is formed in a ring shape,

the first non-concentration reflection part is disposed on an inner side of the first concentration reflection part,

the second concentration reflection part is formed in a ring shape, and

the second non-concentration reflection part is disposed on an inner side of the second concentration reflection part.

19. The reflection unit according to any one of claims 1 to 17, wherein

the reflection unit is mountable to a structure having a corner where a first face and a second face are in contact with each other,

the first reflectarray reflector is mounted to the first face,

the second reflectarray reflector is mounted to the second face,

the first non-concentration reflection part is disposed at a position closer to the second face than the first concentration reflection part, or a position farther away from the second face than the first concentration reflection part, and

the second non-concentration reflection part is disposed at a position closer to the

first face than the second concentration reflection part, or a position farther away from the first face than the second concentration reflection part.

20. The reflection unit according to any one of claims 1 to 19, wherein

the first non-concentration reflection part is configured such that the first reflected wave is diffused, or is configured such that the first reflected wave is not diffused and is not concentrated, and

the second non-concentration reflection part is configured such that the second reflected wave is diffused, or is configured such that the second reflected wave is not diffused and is not concentrated.

21. The reflection unit according to claim 20, wherein

the first non-concentration reflection part and the second non-concentration reflection part are each implemented by a reflectarray including a plurality of reflection elements.

22. The reflection unit according to any one of claims 1 to 21, wherein

the first non-concentration reflection part is attachable to and detachable from the first concentration reflection part, and

the second non-concentration reflection part is attachable to and detachable from the second concentration reflection part.

23. The reflection unit according to any one of claims 1 to 22, embedded in a construction member.

24. A reflection unit installed in a wireless transmission path between a first wireless device configured to at least transmit a wireless communication signal and a second wireless device configured to at least receive the wireless communication signal,

the reflection unit comprising

at least one concentration-type reflectarray reflector configured such that a reflected wave of the wireless communication signal is concentrated at a focal point,

the reflection unit is mountable to a structure that has: a first portion; and a second portion where the wireless communication signal is more easily propagated than in the first portion, and

the concentration-type reflectarray reflector is mounted to the structure such that the reflected wave passes through the second portion.

25. The reflection unit according to claim 24, wherein

the concentration-type reflectarray reflector is configured such that the focal point is present at a position where an obstacle present in the wireless transmission path is avoided.

26. The reflection unit according to claim 24 or 25, further comprising another reflector configured to further reflect the reflected wave, wherein

the other reflector is smaller than the concentration-type reflectarray reflector.

27. A wireless transmission system comprising:

a first wireless device configured to at least transmit a wireless communication signal;

a second wireless device configured to at least receive the wireless communication signal; and

the reflection unit according to any one of claims 1 to 23 installed in a wireless transmission path between the first wireless device and the second wireless device in order to change a direction of the wireless transmission path.