Radio Communication System Using Partial Leakage Coaxial Cables

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1. Introduction

With the rapid growth of wireless services the various radio waves which frequency and modulation method are different from are radiated between the several equipments. In the environment there are radio waves of the frequency such as, RFID, cellular phone, Bluetooth and wireless LAN. Whereas the communication by wireless has flexibility in the point of the establishment and the employment, the radio wave doesn't reach when there is an obstacle between the communication equipments. The weak place of the radio wave is made by interference due to the multi-path which happens by the reflection wave such as a wall in the neighborhood and so on. If a transmission distance becomes long, radio waves do not reach due to the propagation loss of the free space. On the security side, bugging, interpolation of the information, and so on cause a trouble due to the leakage of the radio wave. On the other hand the security is good in the wire communication, and the transmission distance can be extended with a few transmission losses and stable communications. However, because the equipment is connected with the wire directly, it does not have flexibility like wireless connection.

In this paper, we propose the radio communication system using partial leakage coaxial cables. This system is substituted for the existent signal transmission between the wireless systems with coaxial cables. By doing so, a transmission distance grows, and the unnecessary radio radiation can be restrained by supplying a radio wave only to the necessary place. Obtaining the good security and the high flexibility of the radio is aimed for.

2. The principle of the proposal system and experiment model

When the radio wave is radiated in the free space by a wireless system, for example wireless LAN and Bluetooth, the power radiated by the antenna falls off with r^{-2} (where r is distance from the antenna), as shown in Fig. 1. In the case of the small dipole or loop antenna like RFID, the power drops off with r^{-6}. The graph in the bottom of the Fig.1 shows the power density decayed by distance r. It can't communicate with less threshold level any more. This system transmits the radio waves received in the antenna once with the coaxial cables through the cable between the two points (b) and (d) of Fig. 1. Then, it is radiated from the antenna of the access point (d) of Fig. 1 again. The amount of conductor loss of the coaxial cables' own, the radiations of the antenna and conversion loss are small in comparison with the diffusion loss in these losses. Then, the transmission distance can be extended from the point (c) to the point (e) of Fig. 1 by the

coaxial cable. As a result, there is also an advantage that an access point can be installed by using the coaxial cables in the area which can't communicate by the radio wave.

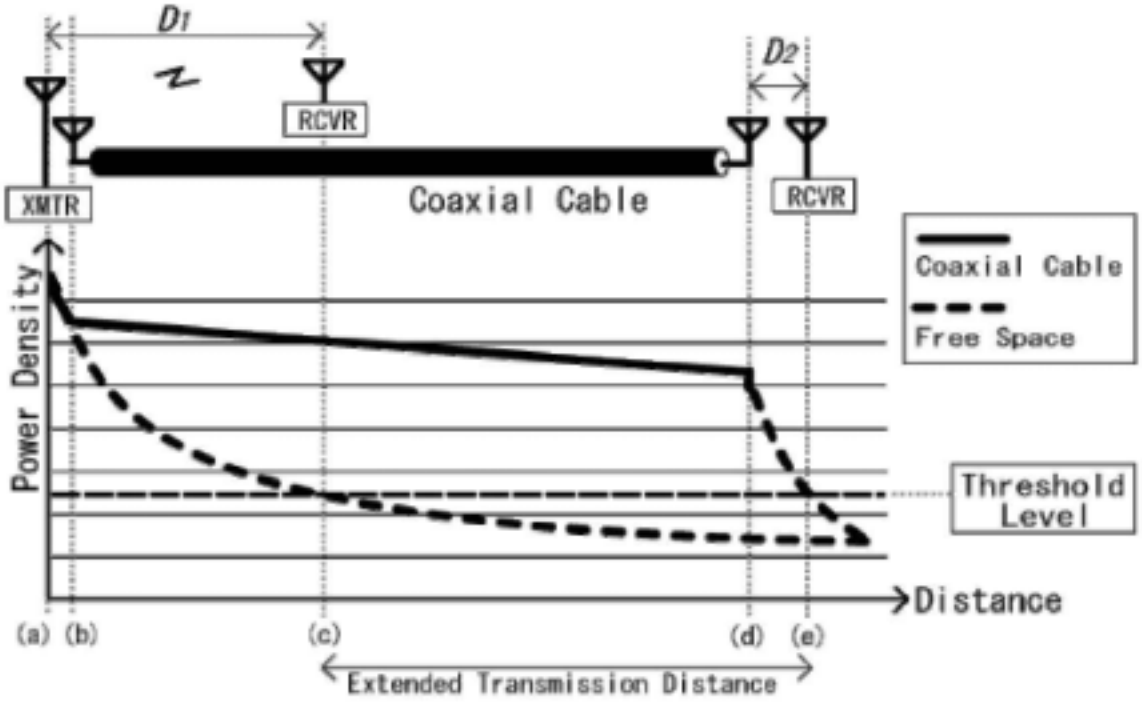

Fig.1 The principle of the proposal system and experiment model

2. Experimental investigation

With the experiment model as shown in Fig.1, the electric field intensity in the receiving antenna was measured. The access point installed in the point where it was extended with the cable of 20m is shown in Fig. 2. For 2.45GHz of wireless LAN it is a parabolic reflector antenna, and for 315MHz of electronic weak wave it is a monopole antenna, and for 13.56MHz of RFID it is a loop antenna. Then, the behavior in the access

(a) 2.45GHz **(b)** 315MHz **(c)** 13.56MHz

Fig.2 The appearance of the antennas for reception and transmission in access point

point of the experiment system, which used each frequency band, was confirmed. The communication distance *D2* for two points (d) and (e) of Fig. 1 becomes short when it is compared with the distance that communication is directly possible from *D1* for two points (a) and (c). For example with measuring at 13.56MHz, *D2* is about 5cm, though *D1* is about 10cm. In other frequency band, though *D2* becomes short, the total transmission distance for two points (a) and (e) of Fig. 1 becomes long also. It confirmed that the same coaxial cable could be used with the wireless system of these different frequency bands, too.