Construction of a Secure and Flexible Network Using RADIOSCAPE-PRO

Wireless LAN has recently been expanding its field of application from households to other fields by making use of features that employ radio waves. These include the construction of flexible environments for meeting rooms and the offices of private businesses and wireless IP telephones. On the other hand, the system properties that are inherent in wireless communications have led to the emergence of information leakage risks.

To help customers build wireless LAN systems that can be used with security of mind, NEC Fielding, Ltd. is enabling identification of the theoretical radio wave propagation environment, by using the innovative wireless LAN simulation software "RADIOSCAPE-PRO." The system evaluates the radio waves that are present on the actual site and proposes optimum access points, antenna installation locations and specific wireless LAN security/radio wave leakage prevention measures before proceeding to the actual installation. This report is intended to introduce the case study of a successful wireless LAN installation system that NEC Fielding has developed and introduced with the aid of the RADIOSCAPE-PRO software.

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Three Issues That Relate to the Introduction of Wireless LAN

The customer in the present case wished to introduce wireless LAN, aiming at building a flexible office environment in which network access would be available throughout the building including in the offices and meeting rooms. At present, the wireless LAN environment is implemented on all of the 14 floors of the building by running approximately 100 wireless LAN access points and 5000 wireless LAN clients.

Wireless communication is advantageous in that it can increase freedom of access, but it is also accompanied with some insecure factors such as the invisibility of radio wave propagation situations and the possibility of their indiscriminate reception by other persons. Since the communication medium is formless, which is unlike wired communication, the network needs to be designed for a defined area and not merely as a series of access ports.

In this case, we explained about the features and insecure factors of the wireless LAN to the customer, studied the issues to be cleared up in order to create a secure, comfortable network and identified the following three that had to be overcome prior to the introduction.

The first issue was to reduce the time and cost of selection of the access point installation locations. Usually, the access point locations are designed by plotting circles having a radius equal to the radio wave range on a plan of the relevant area and setting the center of the circle as the location of each access point. Based on the design data, the actual communication areas in the field are confirmed by using Ping command and FTP devices. When the system scale is large as in the present case, it is very time-consuming work to measure the radio wave conditions for all of the design areas.

The second issue was to identify the effects of extraneous noise and radio wave interference to the other floors. An office district layout should be designed by considering the effects of the wireless LAN systems on the adjacent buildings and of radio wave interference from public wireless LAN services. It is usually not possible to accurately estimate these extraneous effects from the design desk and they should be measured on site using a spectrum analyzer, etc. With regard to the effects of interference from other floors, it is also necessary to install two access points in the floors above and below each of the floors under test and to measure the effects of Ping commands and FTP operations by running them simultaneously. It therefore takes a very long time to measure interference on all of the floors.

The third issue was the security. Installation of an access point means a risk of bugging, virus attacks or illegal access due to the radio waves leaking through walls and windows. Situations resulting from radio wave leakages vary depending on the access point location and the transmittance of the materials used in the window glass and outer walls of the building. These factors also cannot be estimated on the designer's desk but should be measured by installing actual access points

on site and measuring specific situations around the building using a spectrum analyzer and other devices. Therefore it takes a very long time to measure the radio wave leakages for all of the designed access points.

In the present case, we have succeeded in clearing up all of the above issues and in launching the system smoothly by introducing the wireless LAN simulation software RADIOSCAPE-PRO at the system design and pre-installation survey stages.

Solutions Using RADIOSCAPE-PRO

RADIOSCAPE-PRO simulates the interference and range of radio waves from wireless LAN access points in actual environments (offices, households, etc.) and visualizes the results on a PC. It can be used as a tool for the optimum design of wireless LAN environments and for the construction of theoretical networks.

For the first issue, which is the selection of access point installation locations, RADIOSCAPE-PRO divides each communication area into three separate areas that are colored differently, viz. **Fig.1.** Namely the high-quality communication area is colored white, the communication unavailable area is colored black, and the low-quality communication area is colored gray. This makes it possible to limit the actual measurement locations in the pre-installation surveys to the gray area plus any locations with high frequency utilization. In addition to a reduction in the number of measured locations it becomes possible to record measurements at the actual dead spots. Here, access is usually difficult due to radio wave reflections even where there is no visible obstacle. This method improves the reliability of the pre-installation survey compared to the conventional survey method, which needed to measure everywhere in the building without any theoretical guidance. Furthermore, the simulation results can be used to group those floors with similar environments into separate groups. We are enabled to actually reduce the measurement time significantly by obtaining measurements only for a representative floor from each group.

With regard to the second issue, which is the extraneous noise, RADIOSCAPE-PRO can confirm the presence of noise effects by simulating noise sources outside the building (**Fig.2**). The simulation results can be used to determine by on site survey, the actual locations where the extraneous radio waves tend to reach.

These procedures make it possible to decide theoretically on the locations to be measured, as an alternative method to ran-

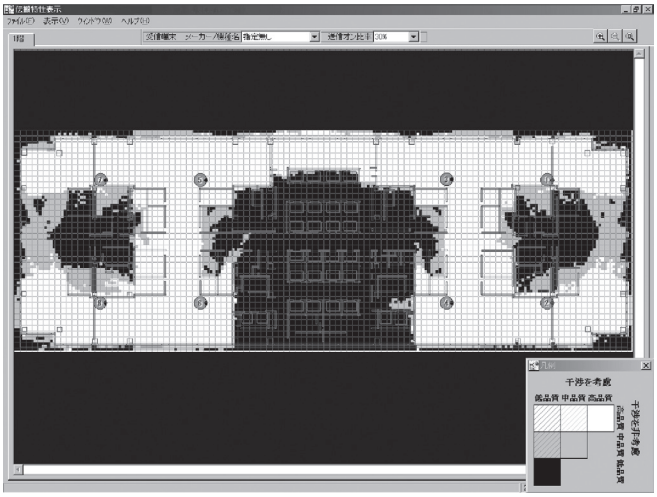

Fig. 1 Results of a wireless LAN simulation for an office.

domly measuring extraneous noise in the field and also to measure the extraneous noise intensity and determine if it will affect communications. In the case in question, we did not detect radio waves strong enough to affect communications in our actual measurements and judged that the field was free from the effects of extraneous noise. With regard to interference due to radio waves from other floors, we simulated this by considering the reflection and transmittance rates of various ceiling and floor materials, and determined the access point locations and channel allocations in advance.

For the third issue, which is radio wave leakage, RADIOSCAPE-PRO is capable of simulation while taking

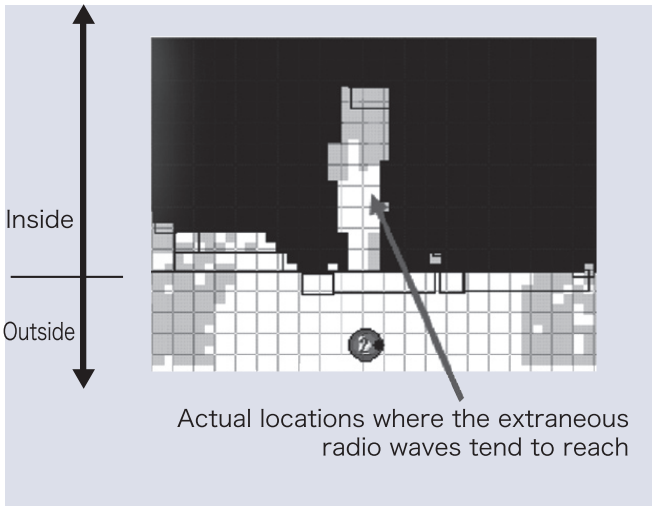

Fig. 2 Effects of external radio wave transmittance.

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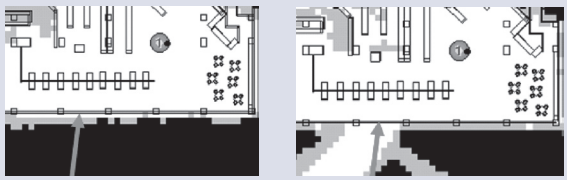

Fig. 3 Simulations of wave transmittance via windows.

the transmittances of windows and walls into consideration. We therefore confirmed situations of leakage through windows and determined the access point locations in order to minimize such occurrences (**Fig. 3**).

However, it is difficult to prevent radio wave leakage simply by selecting optimum installation locations. For the present, leakage cannot be prevented completely unless physical measures such as electromagnetic shielding are applied to the building. As a result, we provided the constructed network with security by encrypting data and adopting the IEEE802.1x-based authentication function.

As described above, the strong points of RADIOSCAPE-PRO lie in its ability to identify potential problems in advance of network construction, thus enabling us to propose an optimum system for each customer following a survey and case study based on the simulation results. This procedure helps the customer to feel secure before the actual network construction is carried out.

Total Support for Large-Scale Wireless LAN

Simulations using RADIOSCAPE-PRO enable early countermeasure proposals and the installation of flexible networks that are free from radio LAN-specific problems such as radio wave leakage. This provision applies even when the system scale is very large, as in the present case. It is expected that the requirements for building wireless LAN systems of an even larger scale and with higher security standards will increase with the introduction of high-speed communications media for mobile solutions including wireless IP phone solutions. What is expected to increase in importance in the construction of these large-scale networks is the wireless LAN management system. At NEC Fielding, we are capable of providing total support for the introduction to the construction and administration of wireless LAN networks of network management systems that make full use of data obtained with RADIOSCAPE-PRO. In addition, RADIOSCAPE-PRO is also evolving to meet the needs of all customers by improving its functions according to the new standards for wireless LAN. All of us at NEC Fielding are working to create networks with high security and reliability by offering total support. The coverage extends from initial proposals and construction to maintenance, administration and management, thus eliminating the sources of customer anxieties, one by one.

FOCUS POINT

RADIOSCAPE-PRO adopts the ray launching method, which is a kind of ray-tracing technique).

This technique considers radio waves emitted from an antenna as a group of radio wave rays. The techniques for predicting the propagation characteristics of radio waves include both 'statistical' and 'deterministic' techniques, and the ray tracing technique belongs to the deterministic techniques. Each ray is propagated by repeating reflections and transmittances of furniture and walls, and the ray tracing can be categorized according to the chosen method of propagation path tracing into the imaging method or its improved version called the ray launching method.

The ray launching method features a significant reduction in the propagation path search time because the propagation path is obtained as an approximation. With the ray launching method, the rays are radiated at discrete angle intervals from a transmitting point regardless of the location of the receiving point, and the rays passing close to the receiving point after repeated reflections and transmittances are regarded as rays reaching the receiving point. This process can reduce the search time because it does not need to define the receiving point in advance and it does not need to search the path that passes exactly through the receiving point.

However, when an accurate analysis is required, the ray launching method also necessitates a large number of rays and associated computations. To deal with this problem, the ray launching method of RADIOSCAPE-PRO has been improved into the 'parallel ray launching method,' which consists of a parallel processing of ray launching methods. The parallel ray launching method divides the spaces adjacent to the transmitting and receiving points into multiple areas that expand radially from the receiving point, assigns a ray to the center of each area. It then allocates the assigned rays to the server groups for processing the parallel ray launching data and obtains the radio wave conditions from the search results of the rays, and displays it on a location plan.

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