

A Wireless LAN-Based Solution for Issues Related to Positioning Information is Increasingly Desirable

Technologies for identifying the locations of persons and objects are advancing rapidly, and various means are used for the identification of locations such as GPS, base station-based positioning information, RFID and wireless LAN. The Wireless Positioning System of NEC Networks & System Integration Corp. enables the solution of customer problems using two methods. These are the method for positioning the target according to the difference in the times of receptions of radio waves and the method of detecting if the target is inside the target area according to the strength of the received radio wave. This article introduces the Wireless Positioning System of NEC Networks & System Integration Corp. by focusing on its mechanism and by considering cases of system introductions.

ISHIWATARI Yoshitsugu
Staff,
Services Development Dept.,
Service Solutions Division,
Network Operations Unit,
NEC Networks & System Integration Corporation

HORIGOME Hiroki
Assistant Manager,
Product Planning Dept., Business Planning Office,
Network Operations Unit,
NEC Networks & System Integration Corporation

KOBAYASHI Yusuke
Staff,
Product Planning Dept., Business Planning Office,
Network Operations Unit,
NEC Networks & System Integration Corporation

Introduction

The need for identifying the locations of persons and objects is a long-standing one. Before communications developed, ships were able to arrive at destinations without being lost by identifying their current locations from the positions of stars in the night sky.

After the release of the GPS (Global Positioning System), anyone has now been enabled to use positioning information without special knowledge, and the data is used widely for ship and aircraft route checking as well as for car navigation and mountaineering systems.

More recently, new types of positioning systems have been developed, including a system for positioning cellular phones and PHS terminals based on the positions of their base stations, a system using RFID (Radio Frequency Identification) and a system using radio waves from wireless LAN. Now, the technological foundations for utilizing positioning information anywhere, regardless of it being indoors or outdoors, are being prepared.

The importance of positioning information is now widely recognized and the fields of its application are currently expanding as a result of the obligation from FY2007 for cellular phones to send their positioning information when making emergency calls.

Types of Positioning Systems

At present, the technologies used in positioning systems can be classified roughly into four methods as shown in **Fig. 1**.

(1) GPS (Global Positioning System) Method

The GPS measures the position on the earth of the target using four of a total of 24 satellites distributed around the earth. This method cannot be used indoors where the GPS satellite radio waves cannot reach, but can be used at any outdoor position on the earth. This capability makes this method the currently most widely used method.

(2) Base Station-Based Positioning Method

This method measures the radio-distance between a cellular phone or PHS terminal from a specific base station that it uses based on the phone ID information obtained from the base station and on the strength of the radio wave that the terminal receives from the base station.

(3) RFID Method

This method identifies the position of an object according to the location of the reader that is reading the RFID tag attached to the object. It can measure the tag location when the reader installed in the desired location reads the information from the RFID tag. The coverage range of the reader is as accurate as a few tens of centimeters to some meters, and this method is usually used for indoor positioning.

(4) Wireless LAN Method

This method measures the position of a wireless LAN client based on the arrival time and intensities of radio waves. It

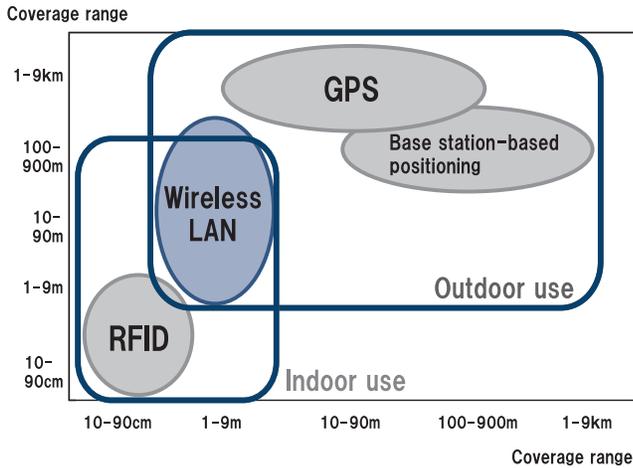


Fig. 1 Main technologies used in positioning.

can be used both indoors and outdoors, and features higher accuracy than the GPS and base station methods and has a wider coverage range than the RFID method.

Outline of Wireless Positioning System

The wireless LAN-based positioning system identifies the location of the terminal using the IEEE802.11b radio wave that is used generally in public wireless LAN systems, private businesses and by individuals. This system was first introduced in Japan in 2003.

The Wireless Positioning System proposed by NEC Networks & System Integration Corp. is composed of the following components.

- 1) Wi-Fi tag (**Photo 1**) (or an IEEE802.11b compatible device): to be carried by the position identification target.
- 2) Location receiver (LR, which is a positioning-dedicated antenna) (**Photo 2**): Receives data from the tag and transfers



Photo 1 (Left) Wi-Fi tag, (Right) Wi-Fi tag with button.



Photo 2 Location receiver.

data to the server.

3) Position search engine: Computes data received from the LR and identifies the position of the tag.

4) Positioning platform: Originally developed by NEC Networks & System Integration Corp. It can be used for the easy development of various systems that make use of positioning information.

(1) Positioning Methods

Positioning is performed using two methods, the TDOA (Time Difference of Arrival) method with a highly accurate positioning capability and the RSSI (Received Signal Strength Indicator) method for simplified positioning.

1) TDOA Method

With this method, four*¹ LRs receive the radio wave from the tag (or an IEEE802.11b compliant device) and the position search engine calculates the distance between the tag and each LR based on the difference in the radio wave arrival time at each station as shown in **Fig. 2**. It is capable of positioning with high accuracy and is applicable over a wide range of applications including the target tracking and navigation.

2) RSSI Method

This method detects the target based on the strength of the radio wave from the Wi-Fi tag, in the same way as the base station-based positioning system, as shown in **Fig. 3**. It detects the presence of the target terminal within the coverage range (within approx. 60 meters*²) of the LR. It is applicable to position detection in a narrow area where the TDOA method is difficult to apply, and is applicable when using only a single LR.

*¹ Positioning is also possible with only three LRs. However, the use of four or more LRs is recommended in consideration of possible radio wave blocking, etc.

*² This is the reference range for indoor installation. This value varies depending on the environment.

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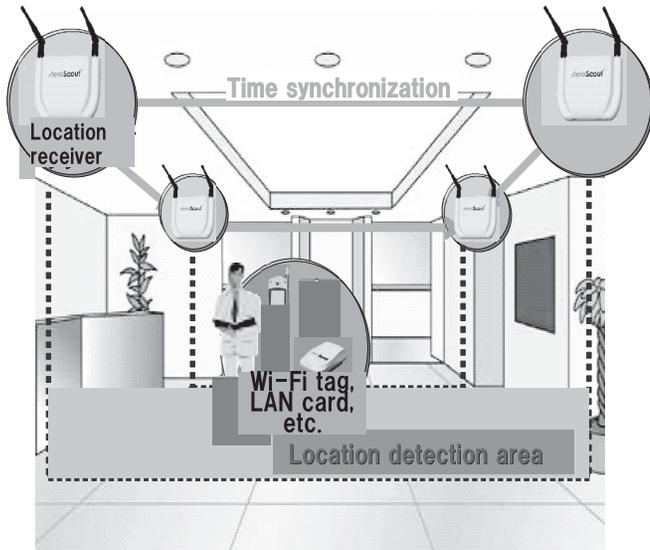


Fig. 2 Image of TDOA system.

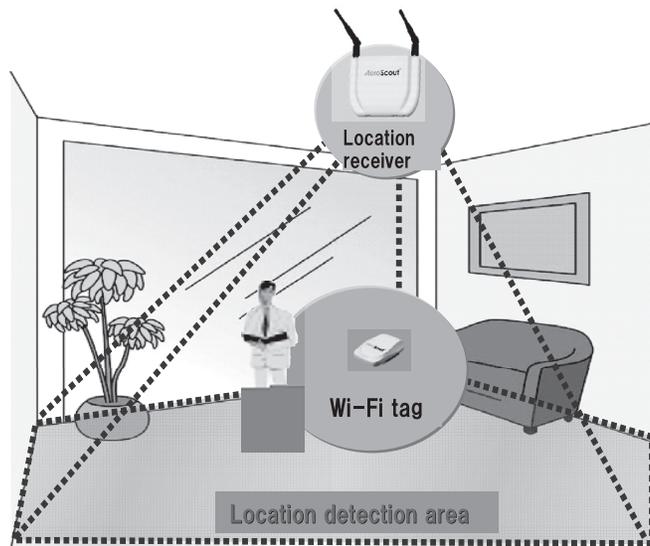


Fig. 3 Image of RSSI system.

(2) Positioning Platform

Development of a system utilizing the positioning information usually requires complicated settings and operations of the positioning engine and the technical support of highly skilled development personnel.

The positioning platform of NEC Networks & System Integration Corp. has been developed to reduce the burden of complicated settings and to facilitate an expansion of the services that use positioning information.

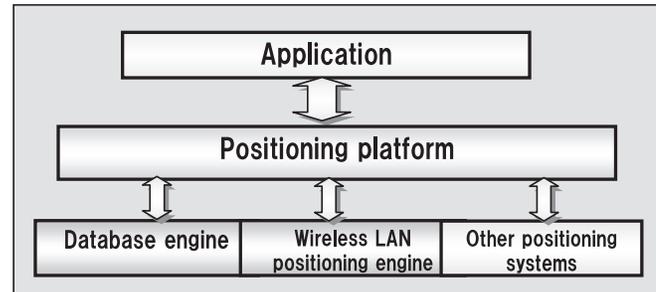


Fig. 4 Image of positioning platform.

As shown in Fig. 4, the functions of the positioning platform can roughly be divided into two. One is the function for acquiring the tag position information identified with the positioning engine and storing it in the database and the other is the function of providing the positioning information in the database to an application upon request.

These functions make it possible to link the positioning information with other applications used in different jobs. We are also planning to extend the functions to enable easy linkage with other advanced systems that use positioning information.

(3) Notes on System Introduction

The following points should be noted when introducing the Wireless Positioning System.

1) Local Radio Wave Environment

Since IEEE802.11b used by the Wireless Positioning System is a radio wave in the 2.4GHz band that does not require permission to be used, it might be interfered with by radio waves and noise from other systems. This makes it necessary to measure the local radio wave environment before system introduction, adjust the antenna installation locations and set the wireless LAN channels properly.

2) Terminal Power Consumption

A wireless LAN terminal consumes more power than a cellular phone or PHS terminals. If it is set to transmit radio waves permanently for real-time acquisition of positioning information, its battery would be exhausted in a very short period. To avoid this, it is important to judge the required extent of the real-time characteristics for introducing a Wireless Positioning System and to perform the optimum setup procedures.

Development of Wireless Positioning Systems

(1) Case of Introduction in an Amusement Facility

NEC Networks & System Integration Corp. provided the

Wireless Positioning System for the “Namco Aso-Base,” a time-based charged facility for children that opened in June 2006 by Namco., Ltd. The “Namco Aso-Base” was established with the concept of “offering relaxation to parents caring for children,” and features a rich lineup of adult-oriented items such as massage chairs, Internet and magazines as well as the playing facilities for children.

The Parent Zone is located at the center of the premises and the children Zone is placed around it in order to improve safety and security. To allow the parents to check the locations of their children easily, a positioning system based on the Wireless Positioning System was developed jointly with NEC Networks & System Integration Corp. and Namco and this was introduced in order to improve security.

In the “Namco Aso-Base,” the location of each child can be checked by simply entering the number of the wireless LAN tag the child carries into one of the touch-panel monitors in the facility as shown in the image in Fig. 5. This can provide a feeling of safety for the parents as they can conveniently identify the positions of their children while effectively utilizing their own time. The tag is as light as 35 grams and can be worn like a wristband as shown in the image in Fig. 5, so the children can carry it without a sense of incongruity. Here, the positioning system is not only used a child position identification service, but it can also be used as a marketing tool capable of visitor flow line control and visitor

analyses as well as in the development of entertaining game-like contents that can be enjoyed by the children who use them.

(2) Examples of Wireless Positioning System Applications

A Wireless Positioning System can be applied widely by attaching the tags to either persons or objects.

1) Goods Management in Factories and Warehouses

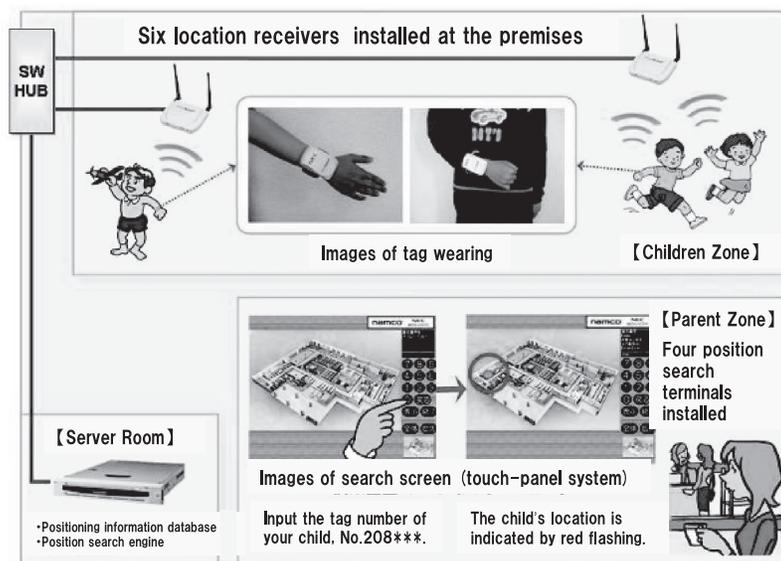
When tags with reference codes allocated by management are attached to goods that move around the premises, the positions and codes of the goods can be displayed and confirmed on a PDA type terminal by simply entering such codes.

2) Sales Promotion at Retailers

When wireless LAN tags are attached to shopping carts, navigation information for moving from the shopper’s current position to the counter of the desired merchandise and real-time advertising to match the position of the shopper can be displayed on the guidance panels installed on the shopping carts. The shopper flow line information obtained from the shopping carts can also be used for analyses aiming at sales promotion.

3) School Commuting Management

When LR’s are installed on the commuting routes and a pupil wearing a tag enters the coverage area of a Location Receiver (LR), the passage information of the pupil is sent to the positioning management terminal at the school and to



“Namco Aso-Base” About 2,450m²

Fig. 5 “Namco Aso-Base” system outline.

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the cellular phone or other terminal of the parents. If the pupil carries a tag with a button that can transmit alarm information when the button is pressed, the parents can thus be informed of an emergency at the moment this occurs.

Conclusion

It is expected that the need for positioning information will grow further and be used in various places both indoors and outdoors. Also, the need will increase rapidly for an environment in which various positioning systems such as GPS and RFID are linked mutually to allow anyone to use the positioning information easily without being concerned about the differences in the locations or the type of communication technologies that are used. At NEC Networks & System Integration Corp. we are continuing development aiming at responding to these needs by enhancing the linkage of our Wireless Positioning System with GPS, the base station-based positioning information system and the RFID system, etc.

We will also extend the platform toward ASP so that the positioning information services are easily available via the Internet, at the same time as adding new values based on positioning capability; e.g. by providing wireless LAN tags with vibration sensor or temperature sensor functions.

Please also visit the Wireless Positioning System page of the NEC Networks & System Integration Corp. website at the following address.

<http://www.nesic.co.jp/solution/bbnw/wps.html>