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Enhanced Indoor Positioning Method Using RSSI Log Model Based on IEEE 802.11s Mesh Network

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ABSTRACT

LBS(Location Based Service) is becoming popular. Location determination technologies are a core technology for LBS, because LBS based on a position of each device or user. In outdoor, GPS is used to get a position of device or user. But, in indoor, GPS is not available. Therefore, for 'Indoor LBS', an enhanced indoor localization scheme which produces a similar position accuracy to that of GPS is needed. In case, a wireless network, such as IEEE 802.11 a/b/g is available, a positioning method using RSSI(Received Signal Strength Indicator) from each AP may produce more positioning errors due to the limited number of available APs. In this paper, we will propose an enhanced indoor positioning method using mesh AP from IEEE 802.11s that has mobility and can be changed from MS.

KEYWORDS: LBS, mesh network, RSSI

1. INTRODUCTION

LBS(Localization Based Service) is being magnified as the development of mobile communication technology. LBS has been developed for outdoor environment using GPS (Global Positioning System) [1], however, in indoor environments cannot be carried out effectively by it. In recent years, WLAN (Wireless Local Area Network) is widely used to locate in an indoor environment.

Positioning in WLAN based on IEEE802.11 [2] is considered. Generally, received signal strength indication (RSSI) is used in the WLAN Location Based Server as the location information provider. However, any indoor area cannot positioning. Because the access points is not enough to positioning in these area. APs are set very concentrated. So to overcome this problem, in this paper, an enhanced indoor positioning method based on IEEE 802.11s mesh network is proposed.

The remaining paper is organized as following. In Section 2 we discuss general characteristics of RSSI measurements and Mesh network. Proposed positioning method based on IEEE 802.11s mesh network is stated in Section 3. In Section 4, the result of simulation is described. Finally, in the Section V, we give conclusion of this paper.

2. CHARACTERISTICS RSSI MEASUREMENTS & MESH NETWORK

2.1 RSSI Measurements

The RSSI (Received Signal Strength Indicator) define a measurement of the RF energy and the unit is dBm. The RSSI is decreased exponentially as the distance from AP increased. Because of these characteristics, in this paper we used RSSI attenuation model and is given as [12]:

$$\text{RSSI[dbm]} = -(10\text{n}\log_{10}\text{d} - \text{A}) \quad (6)$$

$$\text{distance[m]} = 10^{\frac{\text{RSSI}-\text{A}}{-10\text{n}}} \quad (7)$$

In (6) the n is the attenuation factor, parameter A is the offset which is the measured RSSI value at 1m point apart from AP. And the d is distance from AP and A. This parameter reflect indoor propagation environment. Because the RSSI is a sensitive parameter, it is can affected by environment significantly. In Figure 1 that shows RSSI attenuation as distance.

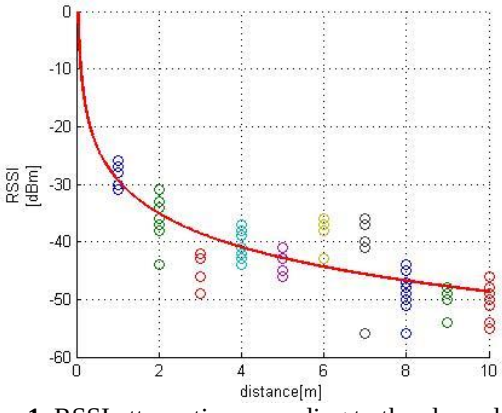

Figure 1. RSSI attenuation according to the elapsed distance

In practical situations, many factors that can affect RSSI value exist such as furniture, walls and person. These factors can produce signal scattering and multi-path effect. It also can result in positioning error. So we are limited available APs.(<7m) In order to reduce positioning error, proper parameter determination is necessary.

2.2 Mesh Network

Mesh Network is a technique proposed in the IEEE 802.11s. Classical IEEE 802.11 network

which don’t apply mesh is like figure 2. APs are connected other APs by wired infrastructure. Also AP and STA(Station) is connected between the wireless

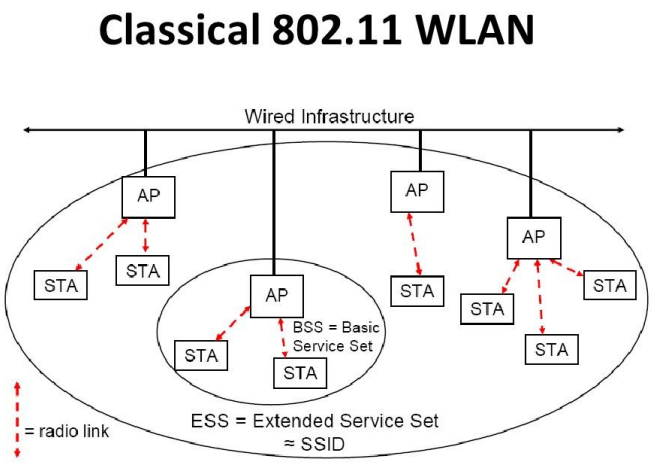

Figure 2. Classical IEEE 802.11 Network configuration

Mesh network have more flexible network than classical network. Because it have multiple wireless connection like figure 3.

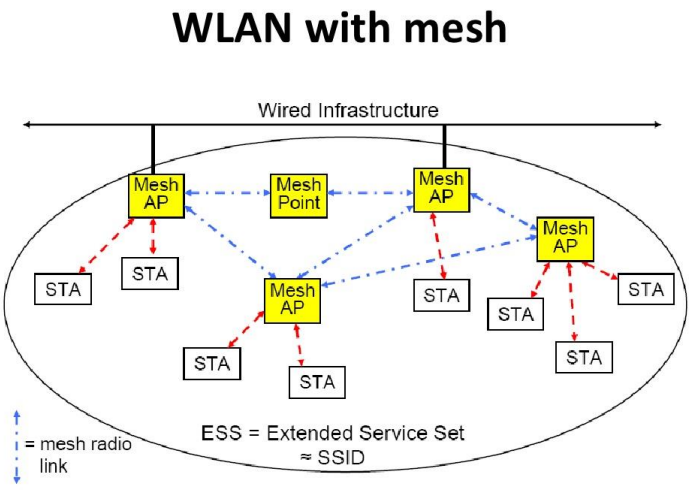

Figure 3. Classical IEEE 802.11 Network configuration

In Figure 3, there is a different configuration from classical network. Mesh point has only relay function. It works between Mesh APs using wireless communication. Classical AP has to connect wired infrastructure. However Mesh AP also can works wireless condition. Mesh AP has more mobility. So we can make up positioning error that happen APs lack.

3. PROPOSED POSITIONING METHOD

First of all, we should find position of Mesh AP. Mesh AP looks like MS. But Mesh AP is supported MIMO. So we can get AOA(Angle of Arrival). If we can get angle and distance from APs, it is sufficient for positioning. Next we update DB about position of mesh AP. Finally we

use mesh AP for positioning.

The algorithm of method is shown as follows:

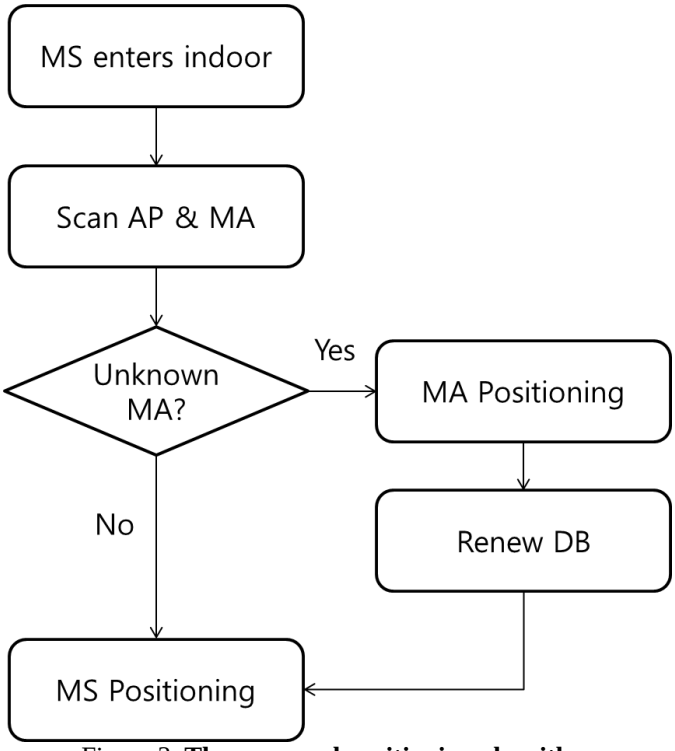

Figure 3. **The proposed positioning algorithm**

4. SIMULATION RESULT

We simulate in a 14m x 14m indoor environment. This is modeled the Kyungpook National University IT-1 building. And attenuation factor *n* is 2.9, offset A is -28dBm. The error of AOA is 10°. MS is located (7m,7m). APs is existed in a whole simulation environment.

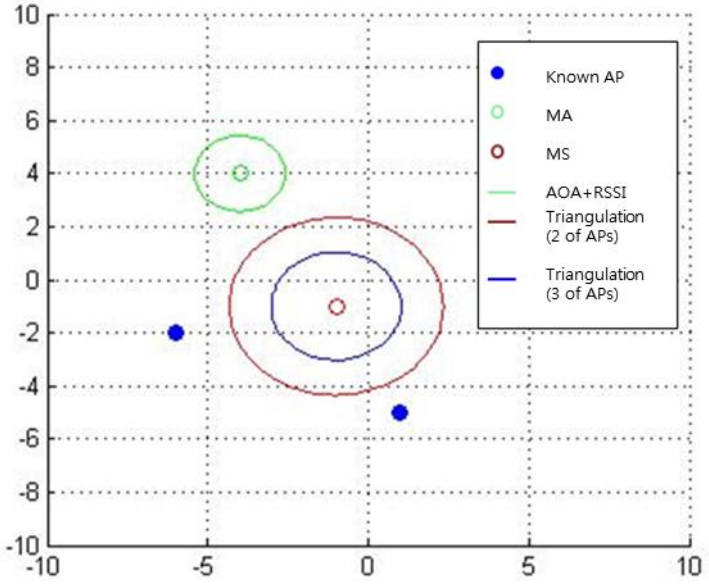

Figure 3. **Average error of positioning**

Figure 3 is shown Average error of positioning. Red line is displayed error of triangulation only using 2 of APs. And Blue line is error of triangulation using 2 of known AP and MA. As shown as Table 3, the positioning err of proposed method is less than that of existing method by 1.6m. The existing method using RSSI attenuation model in WLAN environment.

	Existing Method	Proposed Method
Average error	3.3368m	2.0257m
Error Variance	1.3425	1.1205

Table 3. Simulation result

5. CONCLUSION

This paper explains a method for indoor positioning using the RSSI attenuation model in Mesh network. It can use more APs and more accuracy. Proposed method can raise accuracy in indoor environment about lack of APs. The experimental result shows that the positioning error of proposed method is less than that of existing method by 1.3m.
In the future, it is necessary integrated model to apply penetration as well as diffraction. And positioning error occur RSSI error. So filter for correcting RSSI error should be developed.

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