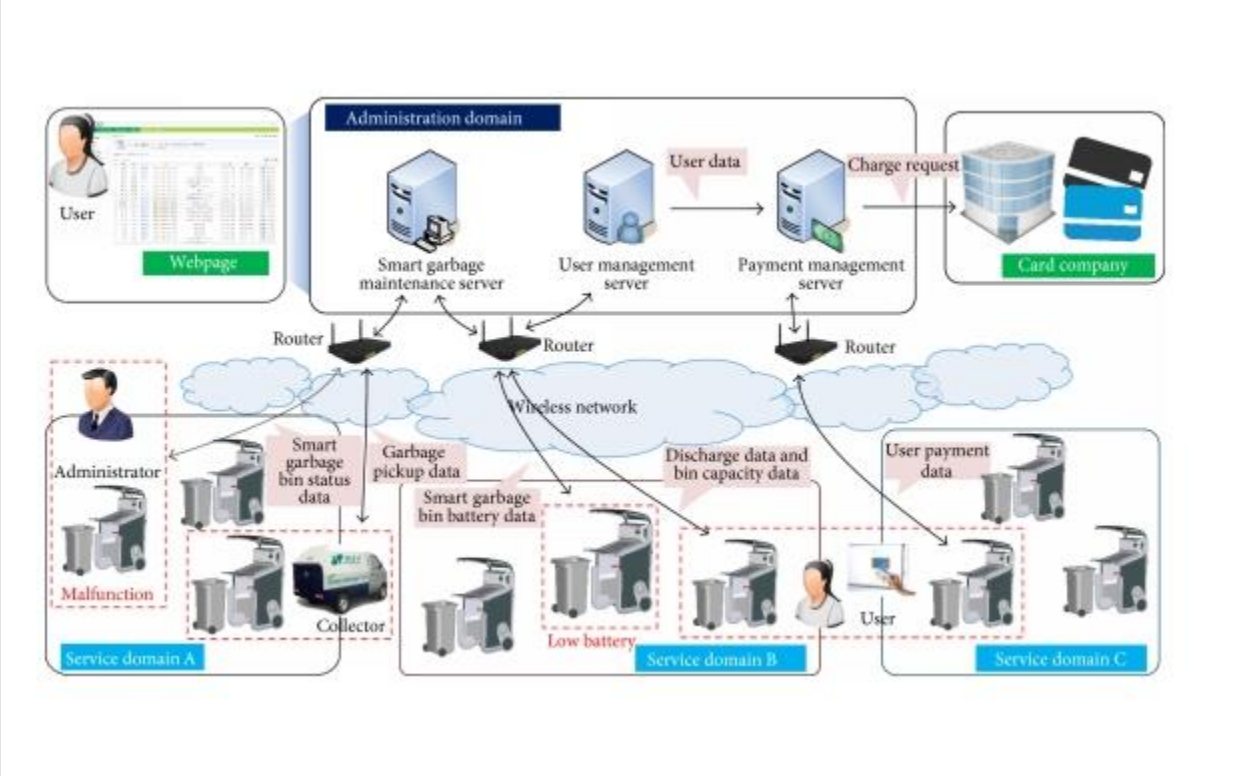
UAT Initiation and Design

3.1. Architecture Overview

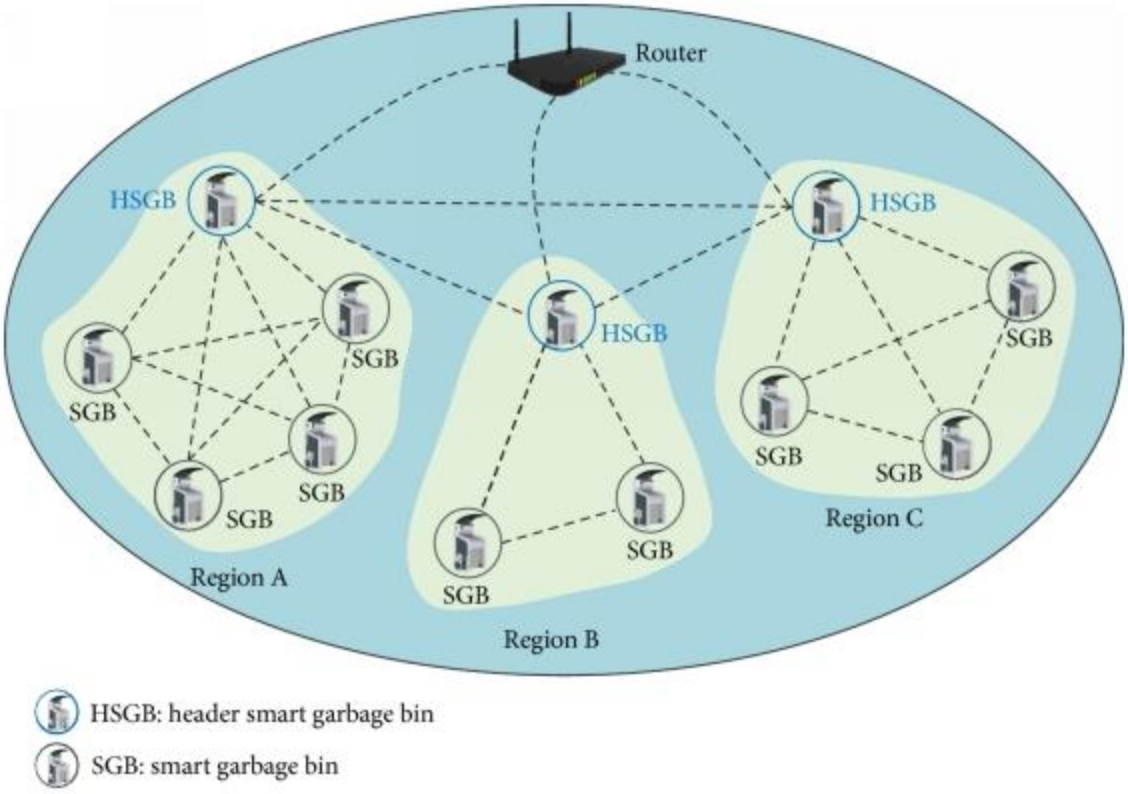
The architecture of the SGS is shown in Figure 1. The SGBs, which are installed near apartment buildings and individual houses, exchange information with each other and send the information to the server through wireless communication. Structurally, the proposed system is divided into two domains: an administration domain and a service domain. In the administration domain, information transferred from a SGB is analyzed and processed. In the service domain, residents throw away their food waste in a SGB, and resident and SGB information is collected and transferred to the administration domain.



(i) Administration Domain. In this domain, registered resident information, payment information, and status information, such as the battery life, memory, and any malfunctions of the SGBs, are collected. To achieve this, three servers are used: a smart garbage maintenance server, a user management server, and a payment management server. The user management server manages food waste discharge information and the personal information of the registered residents who are registered in the user management server through an administrator. Furthermore, information on the discharge amount of food waste is stored and classified based on region, resident, and bin in the user management server. The charge management server conducts the payment process based on the weight of the

food waste with the resident's card company. When a resident uses an RFID card to discharge his food waste, his personal card information registered on the RFID card is transferred to the charge management server, which then requests the card company to process the payment. The smart garbage maintenance server plays a role in managing all information related to the SGBs such as the amount of food waste each SGB has, the amount of food waste a collection company has gathered, and the status information of the SGBs. Thus, if a malfunction is detected in a SGB after analyzing the status information, an administrator is sent to check the problem, and the smart garbage maintenance server induces residents to use a nearby SGB. All information managed in the administration domain is also provided through a Web-based service, through which the administrators can determine the state of the system and residents can check the amount of food waste they have thrown away and for how much they have paid.

(ii) Service Domain. This domain is where the residents throw away their food waste. When a resident's RFID card touches the RFID reader of a SGB, the SGB authenticates the resident and opens the lid. The resident then throws away his food waste, and the SGB measures its weight. After the discharge process, the SGB sends the collected information on the resident and the weight of his food waste to the administration domain. Based on the collected information, a garbage collector collects the food waste from the SGB, an administrator inspects or repairs the bin, and a cleaner cleans the bin as necessary. Figure 2 illustrates the network topology of SGBs located in the service domain. The SGBs exchange information such as their capacity, battery life, and resident information through a WMN. Therefore, service continuity is guaranteed even when the same residents use different garbage bins. A header smart garbage bin (HSGB), located within each region, analyzes and manages the other SGBs within its region after collecting their information. The HSGB also exchanges this information with other HSGBs through the WMN, allowing the service continuity to be secured. Furthermore, for network reliability, if a communication problem occurs in a HSGB, header authority is delegated to the most appropriate SGB within the same region.



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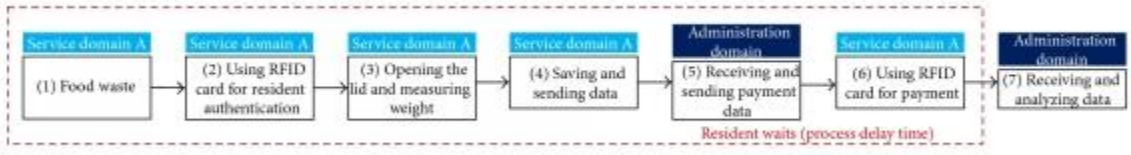
3.2. Discharge Process of Smart Garbage System

As mentioned above, the proposed system uses a new discharge process to minimize the delay caused by the payment and data transmission processes. Figure 3 shows a comparison between an existing RFID-based garbage collection system and the proposed system. In the existing RFID-based garbage collection system, a resident touches his RFID card to the garbage bin twice. The first touch is for resident authentication, and the second touch is for his payment. Because a data transmission between a garbage bin and a server is required

before payment, the process delay incurred from the moment the food waste is weighed until the fee is paid may be lengthy, and residents may be inconvenienced. In the proposed system, however, food waste disposal and the payment process are conducted by touching an RFID card to the SGB only once, thereby reducing the process delay of existing RFID-based garbage collection systems. After the resident authentication and weighing process, the balance of the RFID card is shown on an LCD screen of the SGB using the payment data previously received from the server and the present weight of the food waste. This marks the end of the discharge process requiring the residents to wait. Then, if no other residents are waiting to use the SGB, the SGB then sends the payment data to the server through a router each time it receives a request message from the router, and the server processes the payment data of all residents and charges their fees through their credit card company. Using this discharge process, an additional RFID card touch for payment is unnecessary, which reduces the process delay.



(a) The existing RFID-based garbage collection system