

# RFID 미들웨어 평가 위한 테스트 데이터 생성기의 설계 및 구현\*

장해봉<sup>o</sup> 박종규 류우석 홍봉희  
부산대학교 컴퓨터공학과

[jszhp@pusuan.ac.kr](mailto:jszhp@pusuan.ac.kr), [allan@pusan.ac.kr](mailto:allan@pusan.ac.kr), [wsryu@pusan.ac.kr](mailto:wsryu@pusan.ac.kr), [bhhong@pusan.ac.kr](mailto:bhhong@pusan.ac.kr)

## Design and Implementation of an RFID Middleware Test Data Generator

Haipeng Zhang<sup>o</sup> ChungKyu Park Wooseok Ryu Bonghee Hong  
Department of Computer Science and Engineering, Pusan National University

### 1. Introduction

Recently RFID technology has been widely used in many area and many enterprises have developed their own RFID systems with different features. As an essential element in RFID system, RFID middleware provides not only device independency between readers and applications but also collecting, filtering and grouping functions for RFID streaming data to reply users' requests. To evaluate a RFID system, RFID middleware is a very important factor. However, evaluating a RFID middleware in the real test environments is not easy as constructing test environments makes a high test costs. There are some existing research works that have been made in this field. Various factors of RFID middleware evaluation have been discussed in [1]. Research of RFID middleware performance test is introduced in [2] and virtual data simulation in DSMS field is discussed in [3]. However, most of them consider the performance test rather than other test. To facilitate and reduce the cost of RFID middleware test, we propose and implement a test data generator tool which can automate testing RFID middleware. Using our testing tool, the real RFID environments can be easily simulated. Virtual tags and virtual readers which are same with the real devices can be generated in the testing tool. Testers can deploy and configure these virtual devices by setting different parameters. Test data can be automatically generated under different test environments. In order to satisfy a variety of testing objectives, we define two test data sets which are Semantic Invalid data (SID) and Semantic Valid Data (SVD). SID without having any semantic meaning is used for the performance test. On the other hand, SVD with semantic meaning which can represent the real environments and business processes is used for testing whether RFID middleware can satisfy user applications or not. These two data sets can represent most RFID data features in RFID society.

### 2. Body

In an RFID system, RFID readers are deployed at some stationary places and mobile readers are operated by staffs. RFID tags attached on products are read when they move to reader interrogator zone or tags staying in stationary place are read by mobile readers. So the limitations of building real environments are caused by deploying readers and tags. So we use virtual devices to simulate the real RFID readers and tags. Using virtual devices virtual test environments can be easily constructed. In the virtual environment, virtual readers and virtual tags are the most important components. Various environments can be constructed by deploying different virtual readers and virtual tags. The test data generated from these virtual devices is able to represent the characteristics of the real environments. So designing virtual readers and virtual tags is the most important thing for developing a testing tool. To construct virtual test environments we need to develop three virtual devices which are virtual reader plays the role of real physical reader; virtual tag plays the role of real physical tags; virtual controller controls the movements of tag or readers and controls the operations between reader and tag.

By using these virtual devices, we can build many different test environments which represent different business processes. After deploying the virtual devices, test data set is needed to be generated. In order to easily generate various test data, we need define the flexible parameters of test data generation. To define the

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parameters for generating test data, we need to analyze the features of RFID data. RFID data has both real-time streaming data features and its own features. From [4] and ALE [5], we can get the following special data features: redundancy data, grouped data, tag moving path, noisy data. Other features are same with real-time streaming data's. After getting the data features of RFID data, we can give the general parameters for generating the test data. Table 1 summarizes the defined test parameters.

Table 1. Parameters for Data Generation

Parameters	Description
$N_r$	The number of readers
$R_l$	Reader list of each path
$T_r$	The moving time between two readers
$R_r$	Redundancy ratio
$N_g$	The number of tags in each group
$G_r$	Group ratio
$R_n$	Noisy ratio of each reader

To generate test data, we also define two data sets which are Semantic Invalid Data (SID) and Semantic Valid Data (SVD). SID is the data set which has no semantic meaning. On the contrary, SVD is the data set which has semantic meaning. SID is mainly used for the performance test. SVD having semantic meaning is used for test other features of RFID middleware as SVD can represent the user defined test environments such as conveyor belt and product line. Both of these two data sets can be generated by setting the parameters which are defined in Table 1. In this paper, we use random model to generate these two data sets. Random model consists of Gaussian, uniform and skewed random methods.

We have implemented virtual devices and made an integrated architecture of a test data generator. The test data generator mainly contains four components which are Data Generator, Virtual Tag, Virtual Reader and Controller. After setting the parameters, Data Generator generates SID and SVD data sets by using three random methods. Generated test data is temporarily stored in Test Data Storage. Tag data controller dispatches the test data to different tags and controls tag data to different readers. Reader controller controls reader's operations. Virtual Reader receives tag data, communicates with RFID middleware and sends the generated tag event to middleware. Various test data can be generated by the flexible parameter setting.

### 3. Conclusion

Testing RFID middleware under the real test environments is labor-intensive and expensive. Deploying a lot of real devices to build real test environments spends lots of time, recourse and money. So in this paper, we design and implement a test data generator which can simulate real test environment and automatically generate data for testing RFID middleware. To do this, firstly we analyze the requirements and the concepts for designing virtual test environment. Secondly, we analyze the features of RFID data and define the parameters for generating test data and define two test data sets. At last we implement a test data generator which can test RFID middleware without any real devices.

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