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Design of Business Process and Message Interface for Self-Service Terminal System

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Abstract

Nowadays, self-service terminals, which are used widely in banking systems, can be seen everywhere. However, few systems could combine a large number of self-service terminals and a diversified electronic payment platforms for providing convenient financial services. In this paper, we develop such a combined self-service terminal system. We also give details about the design of business process and message interface on four main functional modules of our new developed system, which are uploading transaction logs, registering and configuring new self-service terminals, uploading running status, paying debts, and releasing information. Last, we conduct an experiment to evaluate the performance of our self-service terminals in terms of the packet loss rate. Results show that the design of business process and message interface is effective.

Keywords: *self-service terminal, electronic payment platform, business process, message interface*

1. Introduction

The emergence of electronic payment platforms not only diversifies payment methods but also leads to a much easier life. The combination of self-service terminals, which are referred to terminal devices of many business functions, and electronic payment platforms could cover the shortages, such as the lack of net points for financial services, provide financial services to rural areas, reduce the transaction cost, and provide cheap and convenient social financial services.

As terminal devices of the electronic payment platform, the self-service terminals are supposed to distribute widely in people concentrated areas, such as residential areas, factory dormitory area and rural areas. Benefits by using our self-service terminal system include: (1) users can make payments of public utilities, such as water, electricity, gas and telephone. (2) users can obtain conveniently many financial related services, such as remittance and transfer accounts. (3) users can process many communication value-added services, such as air recharge for mobile phone and custom ring tones. (4) the government can release efficiently some necessary information, such as policies and regulations, notification and public

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information. (5) as one kind of multimedia terminals, the self-service terminals could support the streaming media player to display roundly advertisements during intervals.

In this paper, we firstly give details about the design of business process and message interface on four main functional modules of our new developed self-service terminal system. Then, we conduct an experiment to demonstrate the effectiveness of our system design.

2. Business Process Design

2.1. Uploading Transaction Logs

Self-help terminals create transaction logs documents by days to record transactions and key operating processes for later verifications. It is recommended that these documents could keep transaction logs for at least one month. Figure 1 shows the business process for uploading the transaction logs.

It can be seen from this figure that there are several key steps for uploading the transaction logs, which are: ① Self-service terminals are asked to send messages of uploading the transaction logs according to text messages of administrators or business host computers. ② Self-service terminals send corresponding response messages to business host computers. ③ Self-service terminals send messages of uploading the transaction logs to business host computers. ④ Business host computers write the uploaded messages into local transaction logs documents. ⑤ Business host computers send messages to tell self-service terminals that current transaction logs messages are recorded. ⑥ Self-service terminals decide whether they complete uploading the transaction logs. ⑦ If transaction logs are not uploaded completely, ⑧ then repeat steps of ③ ④ ⑤ ⑥ ⑦ until all needed transaction logs are uploaded.

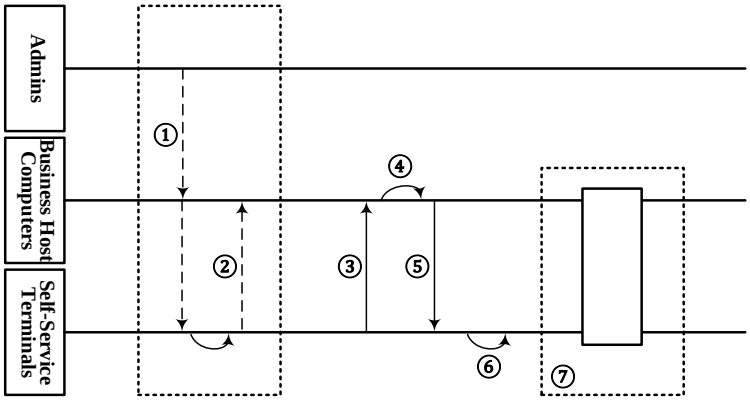

Figure 1. Business Process for Uploading Transaction Logs

2.2. Registering and Configuring New Self-Service Terminals

This business process is required when self-service terminals are installed for the first time or parameters of self-service terminals need corresponding changes or parameters of self-service terminals can't synchronize with that of business host computers due to physical problems. This business process requires cooperation among administers and maintainers. Figure 2 shows the business process for registering and configuring new self-service terminals.

It can be seen from this figure that there are several key steps for registering and configuring new self-service terminals, which are: ① administrators add new self-service terminals and input corresponding parameters. ② business host computers enter in the

original status. ③ administrators register self-service terminals by sending messages. ④ self-service terminals send response messages. ⑤ self-service terminals ask for registrations. ⑥ business host computers enter in the initial status. ⑦ business host computers send response messages. ⑧ self-service terminals ask for initializations. ⑨ business host computers enter in the status of functional testing. ⑩ business host computers send response messages of functional testing to self-service terminals. ⑪ self-service terminals ask for signing in. ⑫ business host computers enter in the testing procedure. ⑬ business host computers send response messages of testing procedure to self-service terminals. ⑭ self-service terminals enter in the testing procedure. (a) Testing Procedure. (b) if the testing procedure is done, terminals begin to work. ⑮ administrators send messages to trigger settling accounts of self-service terminals. ⑯ self-service terminals send response messages. ⑰ self-service terminals ask for settling accounts. ⑱ business host computers enter in the normal working status. ⑲ business host computers send response messages. ⑳ self-service terminals enter in the normal working status.

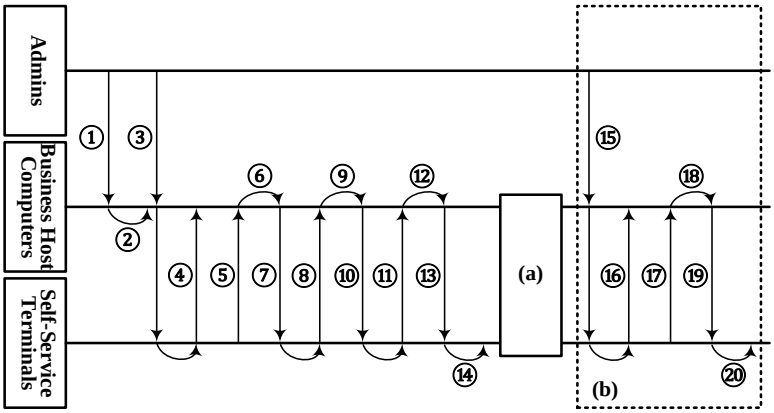

Figure 2. Business Process for Registering and Configuring New Self-service Terminals

2.3. Uploading Running Status

To be on the safe side, running status of self-service terminals is required to be uploaded. Figure 3 shows the business process for uploading running status of self-service terminals.

It can be seen from this figure that there are several key steps for uploading running status, which are: ① Self-service terminals are asked to send messages of uploading the running status according to text messages of administrators or business host computers. ② self-service terminals send response messages to business host computers. ③ self-service terminals send heartbeat messages to business host computers. ④ business host computers perform transaction processing on the received messages. ⑤ business host computers send response messages to self-service terminals. ⑥ self-service terminals perform transaction processing. ⑦ self-service terminals send messages of uploading running status. ⑧ business host computers send response messages of status to self-service terminals.

2.4. Paying Debts

Figure 4 shows the business process for paying debts, which is one of the key businesses of the self-service terminal system. It can be seen from this figure that there are several key steps for paying debts, which are: ① users type their customer identification number into self-

service terminals. ② the transaction process is caught on surveillance video by self-service terminals. ③ self-service terminals ask for debt queries of current users. ④ business host computers obtain results of debt queries. ⑤ business host computers send response messages

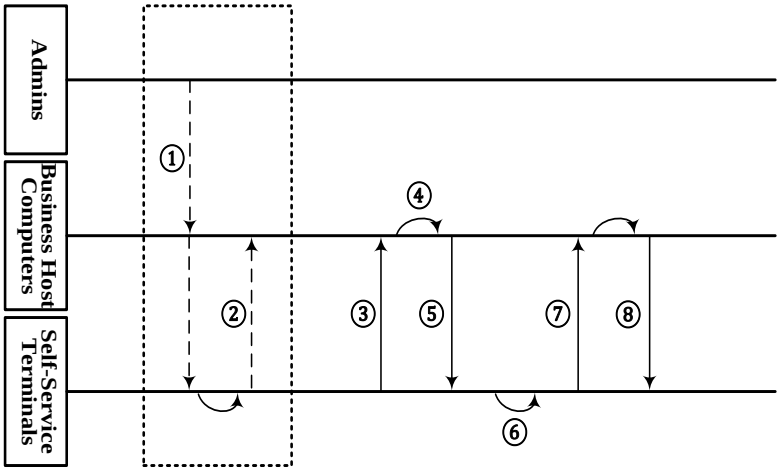

Figure 3. Business Process for Uploading Running Status

to self-service terminals. ⑥ self-service terminals show users the results and end the business process if there is no record of debt queries. ⑦ users select payment items, swipe the card and enter the PIN. ⑧ self-service terminals show users payments platform, transaction amounts and other information. ⑨ self-service terminals ask payments platform for transferring accounts and enter into the business process of reversal if the response of transferring accounts times out. ⑩ payments platform proceed to transfer accounts. ⑪ payments platform send response messages to self-service terminals. ⑫ self-service terminals proceed to charge up locally. ⑬ self-service terminals ask to charge up on business host computers. ⑭ business host computers proceed to deal with the transaction. ⑮ business host computers send response messages to self-service terminals. ⑯ self-service terminals show users payment results, print receipts and stop catching the surveillance video.

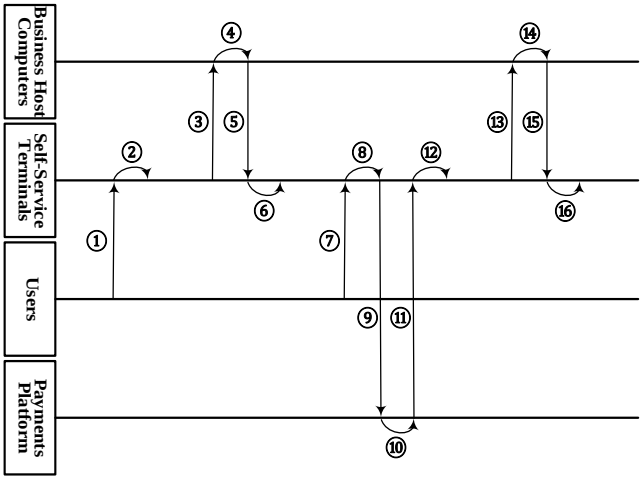

Figure 4. Business Process for Paying Debts

2.5. Releasing Information

The business process of releasing information is designed for specific users, such as government users, as shown in Figure 5. It can be seen from this figure that there are several key steps for releasing information, which are: ① users select target self-service terminals and enter releasing information into the selected terminals manually or automatically. ② administrators audit the releasing information. ③ in emergency circumstance for releasing information, administrators can send text messages to trigger the self-service terminals to ask for releasing information. ④ self-service terminals send respond message to business host computers for releasing emergency information. ⑤ self-service terminals send heartbeats message to business host computers for releasing normal information. ⑥ business host computers obtain the normal releasing information. ⑦ business host computers send response messages to self-service terminals. ⑧ self-service terminals receive the normal releasing information. ⑨ self-service terminals send validation messages to business host computers. ⑩ business host computers mark the normal information that are released, which can guarantee the reliability of the information release and prevent repeats of information release process and messages loss. ⑪ business host computers send validation messages to self-service terminals. ⑫ self-service terminals release formally the target information.

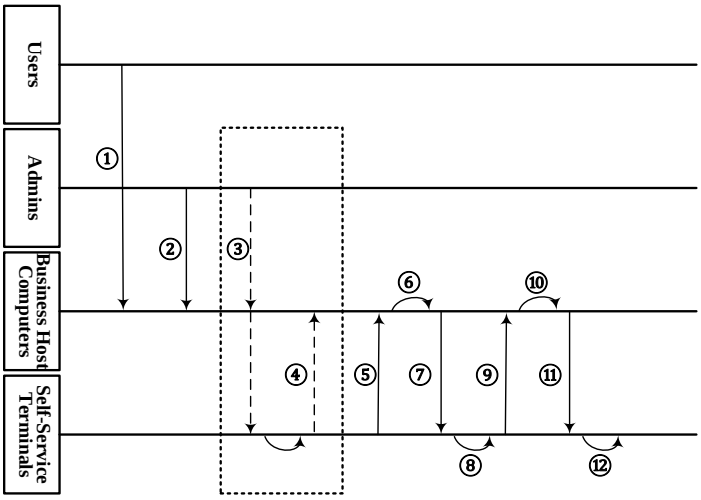

Figure 5. Business Process for Releasing Information

3. Message Interface Design

3.1. ISO8583 Message Format

The ISO8583 message format, which is commonly used by the banking and financial services sectors to exchange financial transaction messages, is defined by the International Standards Organization (ISO) [1-3]. It has three parts, as shown in Figure 6, which are the type identifier, the bitmap and the data element sequence that is in the same order as bitmap.

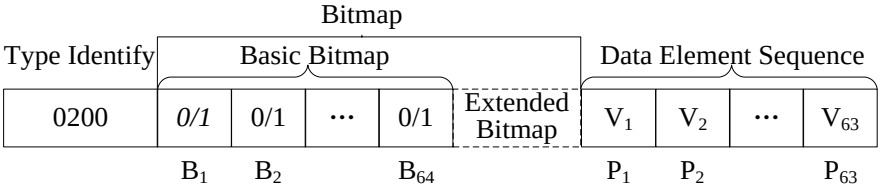

Figure 6. ISO8583 Message Format

(1) The type identifier, which is also called the information code, is the first part of an ISO8583 message. It is stored in format of BCD code which has a fixed length of 4 bit, and is configured by the message initiator to define the type of a message. For example, BCD code 0100 is used to denote an authorization transaction message, BCD code 0110 is used to denote a response message to an authorization transaction, and BCD code 0200 is used to denote a financial transaction message.

(2) The bitmap, which is represented by binary numbers, is the second part of an ISO8583 message. If $B_i = 1$ and $2 \leq i \leq 64$, then the data element B_{i-1} is used. If $B_1 = 0$, only the basic bitmap is used as the bitmap, otherwise both basic bitmap and extended bitmap are used as the bitmap. In this paper, we use only the basic bitmap for our self-service terminal system.

(3) The data element sequence is the third part of an ISO8583 message. Each domain of the data element sequence is defined uniformly. For example, the name of domain P_2 is processing code, which corresponds to B_3 of the basic bitmap. The data attribute is n6, where 6 refers to the length of the domain P_2 and n means that the domain P_2 contains only numeric data, such as 31A000.

3.2. Uploading Transaction Logs

The main message for uploading transaction logs is the uploading transaction logs message. The interface of this message is designed as shown in Table 1, where the terminal running number, as shown in Bit 11, is used to decide whether to send the current message for the second time, and the log message, as shown in Bit 56, is a quadruple which is defined as <position, content, format, illustrations>.

Table 1. Message Interface of Uploading Transaction Logs

Bit	Content	Type	Length	Request	Response
	Information code	BCD	n 4		
	Bitmap	BIN	b 64	M	M
3	Processing code	BCD	n 6	M	R
6	Terminal serial number	BCD	n 12	M	R
10	Message authentication code	BCD	n 8	C	
11	Terminal running number	BCD	n 6	M	R
27	The initiator of the conversation	BCD	n 1	M	
39	Response code	ASCII	an 2		M
42	Merno	ASCII	n 15	M	
56	Log message	ASCII	ans..999	M	
57	Date of log	ASCII	n 6	M	
60	Operator number	ASCII	n 2	M	
64	Message authentication code	BIN	b 64	M	M

3.3. Registering and Configuring New Self-Service Terminals

The message interface for registering and configuring new self-service terminals is designed as shown in Table 2, where the heartbeat interval, as shown in Bit 14, takes minute as units and 30 minutes as default value, the information of transaction processors, as shown in Bit 56, has a format of <bank codes, IP of transaction processors, port>, and the information of FTP servers, as shown in Bit 58, has a format of <server IP, port, user name, password, program main path>.

Table 2. Message Interface of Registering and Configuring New Self-service Terminals

Bit	Content	Type	Length	Request	Response
	Information code	BCD	n 4	0800	0810
	Bitmap	BIN	b 64	M	M
3	Processing code	BCD	n 6	M	R
4	Leisure time	BCD	n 12		M
6	Terminal serial number	BCD	n 12	M	R
7	Response timeout limit	BCD	n 10		M
8	Terminal hardware version number	BCD	n 8	M	
9	Terminal software version number	BCD	n 8	M	
10	Message authentication code	BCD	n 8	C	
12	Current time	BCD	n 6		M
13	Current date	BCD	n 6		M
14	Heartbeat interval	BCD	n 4		M
15	Whether restart it automatically	BCD	n 4		M
22	The maximum number of reversal	BCD	n 3		M
24	Initiated method of reversal	BCD	n 3		M
27	The initiator of the conversation	BCD	n 1	M	
39	Response code	ASCII	an 2		M
42	Merno	ASCII	n 15		M
55	Information of the network	ASCII	ans..50		M
56	Information of transaction processors	ASCII	ans..500		M
57	Information of business hosts	ASCII	ans..50		M
58	Information of FTP servers	ASCII	ans..50		M
60	Operator number	ASCII	n 2	M	

3.4. Uploading Running Status

The message of uploading running status is designed to deal with abnormal conditions which would influence the normal transactions and to response to administers for specific requirements. The interface of this message is shown in Table 3, where the status details, as shown in Bit 56, is used to record details about required items of current self-service terminals, such as statuses of memory, storage space, log file, database, camera, invoice printer, IC card reader, magnetic card reader, and touch screen.

3.5. Paying Debts

The message interface for paying debts is designed as shown in Table 4, where the

Table 3. Message Interface of Uploading Running Status

Bit	Content	Type	Length	Request	Response
	Information code	BCD	n 4		
	Bitmap	BIN	b 64	M	M
3	Processing code	BCD	n 6	M	R
6	Terminal serial number	BCD	n 12	M	R
8	Terminal hardware version number	BCD	n 8	M	
9	Terminal software version number	BCD	n 8	M	
10	Message authentication code	BCD	n 8	C	
12	Current time	BCD	n 6	M	M
13	Current date	BCD	n 6	M	M
27	The initiator of conversations	BCD	n 1	M	
39	Response code	ASCII	an 2		M
42	Merno	ASCII	n 15	M	
56	Status details	ASCII	ans..500	M	
57	Running status	ASCII	n 1	M	
60	Operator number	ASCII	n 2	M	
64	Message authentication code	BIN	b 64	O	O

arrearage information, as shown in Bit 56, has a format of <cost code, chargeable time, sum of arrearage, illustrations>, and the customer identification number, as shown in Bit 63, considers only effective certificate number of the current user.

Table 4. Message Interface of Paying Debts

Bit	Content	Type	Length	Request	Response
	Information code	BCD	n 4		
	Bitmap	BIN	b 64	M	M
3	Processing code	BCD	n 6	M	R
6	Terminal serial number	BCD	n 12	M	R
11	Terminal running number	BCD	n 6	M	R
12	Current time	BCD	n 6		M
13	Current date	BCD	n 6		M
37	System reference number	ASCII	an 12		O
39	Response code	ASCII	an 2		M
42	Merno	ASCII	n 15	M	
52	Cipher texts of personal ID	BIN	b 64	O	
56	Arrearage information	ASCII	ans..500		C
60	Operator number	ASCII	n 2	M	
63	Customer identification number	ASCII	ans..20	M	
64	Message authentication code	BIN	b 64	M	M

3.6. Releasing Information

The message interface for releasing information is designed as shown in Table 5, where the government information, as shown in Bit 56, is adopted to response to new released information and to requirements of administrators, which means deleting all information of current self-service terminal when the value is 0 or renewing the government affairs information when the value is 1, and the message authentication code, as shown in Bit 64, is required for verifying the Bit 56.

Table 5. Message Interface of Releasing Information

Bit	Content	Type	Length	Request	Response
	Information code	BCD	n 4		
	Bitmap	BIN	b 64	M	M
3	Processing code	BCD	n 6	M	R
6	Terminal serial number	BCD	n 12	M	R
10	Message authentication code	BCD	n 8	C	
27	The initiator of conversations	BCD	n 1	M	
39	Response code	ASCII	an 2		M
42	Merno	ASCII	n 15	M	
56	Government information	ASCII	ans..500		O
60	Operator number	ASCII	n 2	M	
64	Message authentication code	BIN	b 64	O	C

4. Experiments

For experiments, we use the Microsoft Windows operating system for the business host computers and the tailored Linux operating system for self-service terminals. To simplify the test, we design an ISO8583 message monitor, which is deployed on the business host computers, to test the packet loss rate performance of our self-service terminal system. We tune the message sending rate of this monitor to be from {100,200,300,400,500} packets per second and the number of self-service terminals to be from {20,50,100}. We run our experiments three times with each time for one week at Dongguan City, Guangdong China and report the average results.

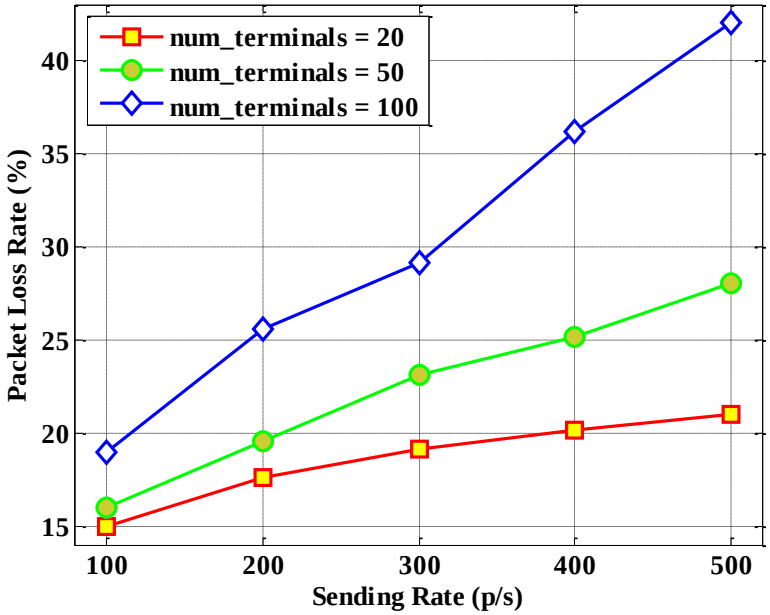

Figure 7. Packet Loss Rate with Respect to Sending Rate, under a Different Number of Terminals

Figure 7 shows the experimental results. Note that a lower packet loss rate indicates a better performance. It can be seen from this figure that: (1) In all case, the packet loss rate increases simultaneously, when the message sending rate varies from 100 packets per second to 500 packets per second, indicating that a lower packet loss rate would be obtained when the message rate is below 300 packets per second. (2) The packet loss rate increases also simultaneously, when the number of self-service terminals varies from 20 to 100, indicating our system could support a moderate number of self-service terminals. In the real situation for every use, the message sending rate is always lower than 300 packets per second. Thus, the experimental results demonstrate the effectiveness of proposed approach.

5. Conclusion

In this paper, we describe and evaluate an implementation scheme for our self-service terminal system, from aspects of business process design and ISO8583 message interface design. At present, this implementation scheme has a favorable effect in practical applications. It is worthwhile to note that we should consider many other issues, such as system cost and system efficiency, in order for a more wide application of our new developed system. So, appropriate tailoring and extending approaches should be further considered to meet the increasingly complex application requirements.

Acknowledgments

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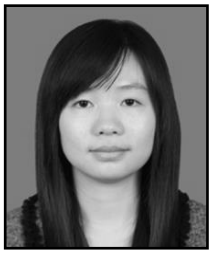

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