

# **ELECTRONIC SYSTEM AND METHOD FOR ATM CASH WITHDRAWAL**

## **Technical Field**

[0001] The present disclosure generally relates to an electronic system and method for ATM (automated teller machine) cash withdrawal. Particularly, the present disclosure describes various embodiments of an electronic system and method for a user / customer / cardholder to withdraw cash from an ATM.

## **Background**

[0002] ATMs belong to or are operated by financial institutions or banks which issue ATM cards to their users, customers, or cardholders. Each financial institution may be a member of a financial network, e.g. an interbank or ATM network. The financial network, such as Plus® and Cirrus®, enable ATM cardholders to access ATMs belonging to other financial institutions within the same financial network. A host processor or server operative within the financial network facilitates communications between the ATMs and financial institutions within the financial network.

[0003] ATMs can be found at many locations around the world and are typically used by people for cash withdrawals, among other services and functions provided by the ATMs. Currently, when a user attempts withdraw cash from an ATM, he/she may encounter declined transactions such as when the ATM has insufficient cash or when the user's bank account has insufficient balance. The user may need to make several reattempts to withdraw cash, such as by reducing the cash withdrawal amount. These declined or repeated transactions may result in administrative fees charged to the user.

[0004] United States Patent Publication 2012/0278234 describes an ATM with enhanced options that allow users to withdraw cash faster with less input steps at the ATM. However, even though a user may more quickly complete the input steps at the ATM and withdraw the cash, if the ATM has insufficient cash or if the user's bank account has insufficient balance, the user will still face a declined transaction.

The user will need to repeat the input steps in a follow-on transaction, resulting in time wasting and potential unnecessary administrative fees.

[0005] Therefore, in order to address or alleviate at least one of the aforementioned problems and/or disadvantages, there is a need to provide an electronic system and method for ATM cash withdrawal.

## **Summary**

[0006] According to a first aspect of the present disclosure, there is an electronic system, a computerized method, and a non-transitory computer-readable storage medium for a user to withdraw cash from an automated teller machine (ATM) operated by an acquirer financial institution, the user having a financial account with an issuer financial institution. The system comprises an intermediary server communicatively linked to an issuer of the issuer financial institution server and an acquirer server of the acquirer financial institution. The intermediary server is configured for performing steps of the method comprising: communicating, to the issuer server and the acquirer server, a withdrawal request made by the user at the ATM; determining, by the issuer server, an account balance in the financial account; determining, by the issuer server, a withdrawable quantum deductible from the financial account based on the withdrawal request and the account balance; communicating the withdrawable quantum from the issuer server to the acquirer server; determining, by the acquirer server, available cash in the ATM; and determining, by the acquirer server, a cash quantum dispensable from the ATM based on the withdrawable quantum and available cash.

[0007] According to a second aspect of the present disclosure, there is an automated teller machine (ATM) comprising: one or more input devices for generating a withdrawal request made by a user; and a processor operative for performing a transaction process. The transaction process comprises: communicating the withdrawal request to an issuer server of an issuer financial institution and an acquirer server of an acquirer financial institution, the user having a financial account with the issuer financial institution and the ATM operated by the acquirer financial

institution; and receiving, from the acquirer server, details of a cash quantum dispensable from the ATM, wherein the dispensable cash quantum is determined based on available cash in the ATM and a withdrawable quantum deductible from a financial account of the user; and wherein the withdrawable quantum is determined by the issuer server based on the withdrawal request and an account balance in the financial account.

[0008] According to a third aspect of the present disclosure, there is an electronic system, a computerized method, and a non-transitory computer-readable storage medium for a user to withdraw cash from an automated teller machine (ATM) operated by an acquirer financial institution. The system comprises an acquirer server of the acquirer financial institution, the acquirer server configured for performing steps of the method comprising: receiving a withdrawal request made by the user at the ATM; communicating the withdrawal request to an issuer server of an issuer financial institution, the user having a financial account with the issuer financial institution; receiving a withdrawable quantum from the issuer server, the withdrawable quantum deductible from the financial account based on the withdrawal request and an account balance in the financial account; determining, by the acquirer server, available cash in the ATM; and determining a cash quantum dispensable from the ATM based on the withdrawable quantum and the available cash.

[0009] An electronic system and method for ATM cash withdrawal according to the present disclosure is thus disclosed herein. Various features, aspects, and advantages of the present disclosure will become more apparent from the following detailed description of the embodiments of the present disclosure, by way of non-limiting examples only, along with the accompanying drawings.

### **Brief Description of the Drawings**

[0010] FIG. 1 is an illustration of an electronic system for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0011] FIG. 2 is an illustration of various communication scenarios within the electronic system of FIG. 1, in accordance with embodiments of the present disclosure.

[0012] FIG. 3 is an illustration of various components of an issuer server and an acquirer server in the electronic system of FIG. 1, in accordance with embodiments of the present disclosure.

[0013] FIG. 4 is a flowchart illustration of a computerized method for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0014] FIG. 5 is an illustration of a decision diagram of a transaction process for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0015] FIG. 6 is another flowchart illustration of a computerized method for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0016] FIG. 7 is another illustration of a decision diagram of a transaction process for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0017] FIG. 8 is yet another flowchart illustration of a computerized method for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0018] FIG. 9 is yet another illustration of a decision diagram of a transaction process for ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0019] FIG. 10 is an illustration of various tables for determining the ATM cash withdrawal, in accordance with embodiments of the present disclosure.

[0020] FIG. 11 is a block diagram illustration of the technical architecture of a server of the electronic system of FIG. 1, in accordance with embodiments of the present disclosure.

## **Detailed Description**

[0021] In the present disclosure, depiction of a given element or consideration or use of a particular element number in a particular figure or a reference thereto in corresponding descriptive material can encompass the same, an equivalent, or an analogous element or element number identified in another figure or descriptive material associated therewith. The use of “/” in a figure or associated text is understood to mean “and/or” unless otherwise indicated. For purposes of brevity and clarity, descriptions of embodiments of the present disclosure are directed to an electronic system and method for ATM cash withdrawal, in accordance with the drawings. While aspects of the present disclosure will be described in conjunction with the embodiments provided herein, it will be understood that they are not intended to limit the present disclosure to these embodiments. On the contrary, the present disclosure is intended to cover alternatives, modifications and equivalents to the embodiments described herein, which are included within the scope of the present disclosure as defined by the appended claims. Furthermore, in the following detailed description, specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be recognized by an individual having ordinary skill in the art, i.e. a skilled person, that the present disclosure may be practiced without specific details, and/or with multiple details arising from combinations of aspects of particular embodiments. In a number of instances, known systems, methods, procedures, and components have not been described in detail so as to not unnecessarily obscure aspects of the embodiments of the present disclosure.

[0022] As used herein, an ATM is defined as a self-service kiosk such as a cash machine or electronic telecommunications device that enables users to perform financial transactions, particularly cash withdrawal, without the need for a human cashier, clerk or bank teller. An ATM is operated by a financial institution, ATM operator, or a bank, which also issues ATM cards to their customers or users for performing transactions at ATMs. The financial institution is typically a member of a financial network, such as an interbank network, ATM consortium, or ATM network.

Some examples of financial networks include global interbank networks such as Cirrus<sup>®</sup> operated by MasterCard<sup>®</sup> and Plus<sup>®</sup> operated by Visa<sup>®</sup>.

## Overview

[0023] In representative or exemplary embodiments of the present disclosure, there is provided an electronic system 10 for cash withdrawal from an automated teller machine (ATM) 20 as illustrated in a schematic diagram in FIG. 1. The system 10 includes one or more transaction processing entities which include, but are not limited to, an issuer financial institution 30, an acquirer financial institution 40, and an intermediary transaction processing entity 50. The transaction processing entities 30, 40, and 50 are in communication with one another over a communication network 60.

[0024] A representative user 70 interacts with the ATM 20 (owned / operated by the acquirer bank 40) to initiate a transaction process for withdrawing cash therefrom. The intermediary transaction processing entity 50 is operative for processing various steps of the transaction process between the issuer financial institution 30 and acquirer financial institution 40. Notably, the issuer financial institution 30 may be a bank that issued an ATM card to the user 70, and the acquirer financial institution 40 may be a bank that owns / operates the ATM 20. Notably, the user 70 has a financial account with the issuer financial institution 30. The ATM 20 communicates the withdrawal request made by the user 70 at the ATM 20 to the issuer financial institution 30 and acquirer financial institution 40. The withdrawal request may include a requested quantum defined by the user 70.

[0025] In one embodiment, the issuer financial institution 30 first determines an account balance in the financial account and a withdrawable quantum or amount of money that is deductible from the financial account based on the account balance. The withdrawable quantum may be substantially all of the account balance, subject to financial regulations that may require a minimum balance to be maintained in the financial account. The issuer financial institution 30 then communicates the withdrawable quantum to the acquirer financial institution 40, thereby informing the

acquirer financial institution 40 of the maximum amount of money that the user 70 is able to withdraw from his/her financial account.

[0026] The acquirer financial institution 40 determines available cash in the ATM 20. As the ATM 20 is owned / operated by the acquirer financial institution 40, the acquirer financial institution 40 is able to determine the available cash in the ATM 20 and whether the ATM 20 is able to meet the user's withdrawal request. The acquirer financial institution 40 then determines a cash quantum dispensable from the ATM 20 based on the withdrawable quantum and available cash.

[0027] In another embodiment, the acquirer financial institution 40 first receives the withdrawal request with a requested quantum defined by the user 70. The acquirer financial institution 40 determines whether the ATM 20 has sufficient available cash to meet the requested quantum. If not, the requested quantum is updated to the available cash in the ATM 20. The acquirer financial institution 40 then communicates the withdrawal request with the requested quantum to the issuer financial institution 30 which then determines the withdrawable quantum based on the requested quantum and the account balance. The issuer financial institution 30 then communicates the withdrawable quantum to the acquirer financial institution 40, thereby informing the acquirer financial institution 40 that the cash quantum dispensable from the ATM 20 is equal to the withdrawable quantum.

[0028] In one embodiment, the dispensable cash quantum is displayed to the user 70, and if fine with the user 70 then it gets dispensed. If the user 70 indicates that the user 70 does not want the dispensable cash quantum, then the user 70 may decline the transaction and the transaction processing entities 30, 40, and 50 are notified accordingly. In another embodiment, the user 70 accepts the dispensable cash quantum, and the cash is then dispensed along with notifications to transaction processing entities 30, 40, and 50. In yet another embodiment, no display is provided to the user 70 and the dispensable cash quantum is dispensed automatically.

[0029] Advantageously, the user 70 is less likely to face declined transactions which are common in conventional ATM transactions, particularly if the ATM 20 has less

cash than the requested quantum, or if the user 70 is requesting for a higher quantum than what is available in his/her financial account. While the user 70 may not be able to withdraw the requested quantum in full, the user 70 will still be able to withdraw some cash from the ATM 20 as calculated in the dispensable cash quantum. The transaction does not get declined which may help the user 70 to avoid unnecessary administrative fees. If the withdrawn cash is sufficient for the user 70, the user 70 would not need to perform another transaction at the ATM 20, saving time for the user 70 and improving user experience.

### Description of Embodiments

[0030] In various embodiments of the present disclosure with reference to FIG. 1, the electronic system 10 includes one or more transaction processing entities, namely the issuer financial institution 30, the acquirer financial institution 40, and the intermediary transaction processing entity 50. The intermediary transaction processing entity 50 operates a server 100 that includes a processor and a data storage device or memory configured to store computer-readable instructions for processing by the server 100. The server 100 may be referred to as an intermediary server 100 or intermediary transaction processor 100.

[0031] The issuer financial institution 30, e.g. issuer bank 30, operates an issuer server 32 and an issuer database 34 communicatively linked thereto. The issuer server 32 includes a processor and a data storage device or memory configured to store computer-readable instructions for processing by the issuer server 32. The issuer server 32 may be referred to as an issuer transaction processor 32. The issuer database 34 stores details of users 70 associated with or are customers of the issuer bank 30, such as identification and financial account details of the users 70 who are customers / cardholders of the issuer bank 30. A user 70 is considered to be a customer / cardholder of the issuer bank 30 if the user 70 has a financial account with the issuer bank 30 and the issuer bank 30 has issued a financial card, e.g. ATM card, credit card, or debit card, to the user 70. It will be appreciated that the issuer database 34 may reside locally on the issuer server 32, or alternatively on a remote server or computer communicatively linked to the issuer server 32.

[0032] The acquirer financial institution 40, e.g. acquirer bank 40, operates an acquirer server 42 and an acquirer database 44 communicatively linked thereto. The acquirer server 42 includes a processor and a data storage device or memory configured to store computer-readable instructions for processing by the acquirer server 42. The acquirer server 42 may be referred to as an acquirer transaction processor 42. The acquirer database 44 stores details of merchants and transaction terminals associated with or operated by the acquirer bank 40. Particularly, the acquirer database 44 stores details of the ATMs 20 owned / operated by the acquirer bank 40. It will be appreciated that the acquirer database 44 may reside locally on the acquirer server 42, or alternatively on a remote server or computer communicatively linked to the acquirer server 42.

[0033] The communication network 60 may be a cellular network via cell tower, broadband network such as Internet, or wireless network via access point. The communication network 60 operates a financial network of entities, including the transaction processing entities 30, 40, and 50. The financial network may also be referred to as an interbank network, ATM consortium, or ATM network. The intermediary server 100, issuer server 32, and acquirer server 42 are thus communicatively linked to one another via the communication network 60. Particularly, the intermediary server 100 facilitates communication between the ATM 20, issuer server 32, and acquirer server 42, via the communication network 60.

[0034] In some embodiments, one financial institution or bank operates as the issuer bank 32 and acquirer bank 42. As an example, the user 70 may use an ATM card at the ATM 20, wherein the ATM card is issued by the same bank that owns / operates the ATM 20. In these embodiments, the issuer server 32, issuer database 34, acquirer server 42, and acquirer database 44 are operated by the same bank, possibly in distinct groups or divisions of the bank. It will be appreciated that communication between among the ATM 20, issuer server 32, acquirer server 42 may still occur via the communication network 60 and facilitated by the intermediary server 100.

[0035] A transaction process is initiated at the ATM 20 for a user 70 to withdraw cash therefrom. The ATM 20 includes a processor 21 for processing data and instructions for the ATM 20, such as for cooperating / coordinating with various other components of the ATM 20. The ATM 20 further includes a data storage device or memory 22 configured to store computer-readable instructions for processing by the processor 21. The ATM 20 further includes a data communication component / module 23, such as a network device, transceiver, or network interface, for facilitating communication incoming to and outgoing from the ATM 20.

[0036] The ATM 20 further includes one or more input devices 24. The input devices 24 include a card receiver or slot for receiving an ATM card inserted by the user 70 thereinto. The input devices 24 further include a keypad, touch screen, or touchpad, etc. for receiving user identification information, user input, user request, etc. from the user 70. For example, the user 70 may input details such as user authentication data, e.g. personal identification number (PIN) and requested cash quantum for withdrawal from the ATM 20, as well as other user request or inputs through the input device 24. The ATM 20 further includes one or more output devices 25 for presenting information to the user 70. The output devices 25 include a screen for displaying a user interface thereon to assist the user 70 in providing user inputs. The output devices 25 further include an audio speaker for providing audio alerts / notifications to the user 70 during his/her interaction with the ATM 20.

[0037] The ATM 20 further includes a number of storage containers or cassettes 26 to collectively hold the available cash in the ATM 20 in various denominations. Each cassette 26 is designated to hold cash bills of one denomination. The ATM 20 further includes a sorting mechanism 27 and a dispensing mechanism 28. The sorting mechanism 27 is operative to retrieve cash bills from the cassettes 26 and sort them out in appropriate denominations. The dispensing mechanism 28 is operative to dispense the sorted cash bills to the user 70.

[0038] The data communication component 23 of the ATM 20 facilitates communication to and from the ATM 20. Particularly, the data communication component 23 facilitates the ATM 20 to transmit data to and receive data from one or

more of the transaction processing entities 30, 40, and 50 via the communication network 60. FIG. 2 illustrates various communication scenarios within the system 10. The user 70 interacts with the ATM 20, which in turn communicates with the intermediary server 100, issuer server 32, and/or acquirer server 42. For example, the ATM 20 may communicate via the intermediary server 100 to the issuer server 32 and acquirer server 42. In another example, the ATM 20 may first communicate with the acquirer server 42 before communicating with the issuer server 32 via the intermediary server 100. In another example, the ATM 20 may first communicate with the issuer server 32 before communicating with the acquirer server 42 via the intermediary server 100. In another example, the ATM 20 may communicate with the issuer server 32 and acquirer server 42 directly without going through the intermediary server 100, such as if the issuer server 32 and acquirer server 42 are operated by the same bank. It will be appreciated that various other communication scenarios involving the intermediary server 100, issuer server 32, and/or acquirer server 42 within the system 10 may be possible.

[0039] In some embodiments further with reference to FIG. 3 and FIG. 4, there is a computerized method or transaction process 200 implemented on the system 10. FIG. 3 illustrates various components / modules of the issuer server 32 and acquirer server 42 for performing or facilitating various steps of the transaction process 200. FIG. 4 illustrates a flowchart of the various steps of the transaction process 200 performed or facilitated by one or more of the intermediary server 100, issuer server 32, and acquirer server 42.

[0040] The user 70 interacts with the ATM 20 to initiate the transaction process 200 for withdrawing cash therefrom. At the ATM 20, the user 70 inserts an ATM card into the card receiver / slot of the input devices 24. A financial or bank account of the user 70 is identifiable from the ATM card. The user 70 then inputs details on a keypad or user interface of the input devices 24. The input details include authentication data, e.g. PIN for authenticating the ATM card, as well as a withdrawal input. In one embodiment, the withdrawal input includes a requested quantum or amount of cash as defined by the user 70. In another embodiment, the withdrawal input includes a single function for withdrawing the maximum amount of

money for the user 70, as explained later. This single function may be referred to as an “Access All” function. The processor 21 of the ATM 20 combines these details from the input devices 24 and generates a withdrawal request. In another embodiment, the “Access All” function is automatically included in the withdrawal input as the default option. In addition, the “Access All” function may be automatically included depending on the type of ATM card and/or financial account of the user 70.

[0041] In a step 202 of the method or transaction process 200, the withdrawal request made by the user 70 at the ATM 20 is communicated to the issuer server 32 and the acquirer server 42. Specifically, the data communication component 23 of the ATM 20 communicates the withdrawal request to a data communication component 33 of the issuer server 32 and to a data communication component 43 of the acquirer server 42. In one embodiment, the withdrawal request is communicated to the acquirer server 42 first and subsequently to the issuer server 32 via the intermediary server 100. In another embodiment, the withdrawal request is communicated directly to the acquirer server 42 and issuer server 32.

[0042] In a step 204, an authentication component 31 of the issuer server 32 identifies the user 70 by verifying the authentication data (e.g. PIN) against the issuer database 34. After verification, in a subsequent step 206, a balance determination component 35 of the issuer server 32 determines an account balance in the financial account of the user 70. Details of the financial account are retrievable from the issuer database 34 by a data retrieval component 36 of the issuer server 32. In a step 208, a quantum determination component 37 of the issuer server 32 determines a withdrawable quantum deductible from the financial account based on the account balance and the withdrawal request.

[0043] In one embodiment wherein the user 70 has defined the requested quantum in the withdrawal request, if the requested quantum is \$5,000 and the account balance is \$10,000, the withdrawable quantum is \$5,000 according to the user's request. If the requested quantum is \$6,000 and the account balance is \$4,000, the withdrawable quantum is \$4,000 because the user 70 cannot withdraw more than

the account balance. More generally, the withdrawable quantum is a lower of the requested quantum and the account balance.

[0044] In a step 210, the data communication component 33 of the issuer server 32 communicates the withdrawable quantum to the data communication component 43 of the acquirer server 42. In a step 212, a cash determination component 45 of the acquirer server 42 determines the available cash in the ATM 20. Particularly, the cash determination component 45 determines available denominations of the available cash. Details of the available denominations, including the number of cash bills in each denomination stored in each cassette 26, are communicable from the ATM 20 to the acquirer server 42 and/or retrievable from the acquirer database 44 by a data retrieval component 46 of the acquirer server 42. Accordingly, the available cash is determined as an aggregated quantum of the available denominations in all the cassettes 26.

[0045] In a step 214, a quantum determination component 47 of the acquirer server 42 determines a cash quantum dispensable from the ATM 20 based on the withdrawable quantum and available cash. Generally, the dispensable cash quantum is a lower of the withdrawable quantum and the available cash. Based on the dispensable cash quantum, the sorting mechanism 27 sorts out appropriate quantities of the cash bills in various denominations. The dispensing mechanism 28 then dispenses the dispensable cash quantum to the user 70.

[0046] In one embodiment, the dispensable cash quantum is dispensed in response to a user confirmation input at the ATM 20. For example, details of the dispensable cash quantum are displayed on the ATM 20, particularly on the screen of the output devices 25, to inform the user 70. If the dispensable cash quantum is acceptable to the user 70, the user 70 then inputs, via the keypad of the input devices 24, the user confirmation input to acknowledge that the user 70 intends to withdraw the dispensable cash quantum. Notifications of the withdrawal will be communicated to the issuer server 32 and acquirer server 42. Conversely, if the dispensable cash quantum is not acceptable to the user 70, the user 70 then inputs a declination input to reject withdrawal of the dispensable cash quantum, thereby cancelling the

transaction process 200. Notifications of the withdrawal cancellation will similarly be communicated to the issuer server 32 and acquirer server 42. In another embodiment, details of the dispensable cash quantum are not displayed on the ATM 20 and will be automatically dispensed to the user 70.

[0047] A decision diagram 300 according to the transaction process 200 is illustrated in FIG. 5. At a node 302, the user 70 interacts with the ATM 20 and makes a withdrawal request with a user-defined requested quantum. At a node 304, the issuer bank 30 determines whether the account balance in the financial account of the user 70 is equal to or more than the requested quantum. If yes, the node 304 leads to a node 306 wherein the withdrawable quantum is the requested quantum. If no, the node 304 leads to a node 308 wherein the withdrawable quantum is substantially all of the account balance. The nodes 306 and 308 converge at a node 310. At the node 310, the acquirer bank 40 determines whether the available cash in the ATM 20 is equal to or more than the withdrawable quantum. If yes, the node 310 leads to a node 312 wherein the dispensable cash quantum is the withdrawable quantum. If no, the node 310 leads to a node 314 wherein the dispensable cash quantum is substantially all of the available cash. Accordingly, the user 70 is always able to withdraw some cash from the ATM 20 with this transaction process 200.

[0048] In some embodiments with reference to FIG. 6, there is a computerized method or transaction process 400 implemented on the system 10. FIG. 6 illustrates a flowchart of the various steps of the transaction process 400 performed or facilitated by one or more of the intermediary server 100, issuer server 32, and acquirer server 42. For purpose of brevity, it will be appreciated that various aspects of the transaction process 200 apply analogously to the transaction process 400.

[0049] In a step 402 of the method or transaction process 400, the withdrawal request made by the user 70 at the ATM 20 is communicated to the acquirer server 42. In a step 404, the cash determination component 45 of the acquirer server 42 determines the available cash in the ATM 20. In a step 406, the quantum determination component 47 of the acquirer server 42 determines whether the available cash is equal to or more than a requested quantum defined in the

withdrawal request by the user 70. In a step 408, the acquirer server 42 updates the requested quantum to the lower of the initial requested quantum and available cash.

[0050] In a step 410, the acquirer server 42 communicates the withdrawal request including the (updated) requested quantum to the issuer server 32 via the intermediary server 100. In a step 412, the authentication component 31 of the issuer server 32 identifies the user 70 by verifying the authentication data against the issuer database 34. After verification, in a subsequent step 414, the balance determination component 35 of the issuer server 32 determines an account balance in the financial account of the user 70. In a step 416, the quantum determination component 37 of the issuer server 32 determines a withdrawable quantum deductible from the financial account based on the account balance and withdrawal request. The withdrawable quantum is a lower of the account balance and the requested quantum in the withdrawal request.

[0051] In a step 418, the issuer server 32 communicates the withdrawable quantum to the acquirer server 42. In a step 420, the quantum determination component 37 determines a cash quantum dispensable from the ATM 20, wherein the dispensable cash quantum is equal to the withdrawable quantum. As the withdrawable quantum is determined based on the requested quantum which is in turn determined based on the available cash in the ATM 20, the dispensable cash quantum is thus determined based on the withdrawal request and the available cash.

[0052] As an example, the user 70 has defined the requested quantum as \$5,000 but the available cash in the ATM 20 is \$4,000. The requested quantum is thus updated to \$4,000 and communicated to the issuer server 32. If the account balance is \$10,000, the withdrawable quantum (and consequently the dispensable cash quantum) is \$4,000 according to the updated requested quantum. If the updated requested quantum is \$4,000 and the account balance is \$3,000, the withdrawable quantum (and consequently the dispensable cash quantum) is \$3,000 because the user 70 cannot withdraw more than the account balance.

[0053] A decision diagram 500 according to the transaction process 400 is illustrated in FIG. 7. At a node 502, the user 70 interacts with the ATM 20 and makes a withdrawal request with a user-defined requested quantum. At a node 504, the acquirer bank 40 determines whether the available cash in the ATM 20 is equal to or more than the requested quantum. If yes, the node 504 leads to a node 506 wherein the requested quantum remains unchanged. If no, the node 504 leads to a node 508 wherein the requested quantum is updated to the available cash, as that is the maximum amount the ATM 20 can dispense. The nodes 506 and 508 converge at a node 510. At the node 510, the issuer bank 30 determines whether the account balance in the financial account of the user 70 is equal to or more than the requested quantum. If yes, the node 510 leads to a node 512 wherein the withdrawable quantum is the requested quantum. If no, the node 510 leads to a node 514 wherein the withdrawable quantum is substantially all of the account balance. The nodes 512 and 514 converge at a node 516 wherein the dispensable cash quantum is the withdrawable quantum. Accordingly, the user 70 is always able to withdraw some cash from the ATM 20 with this transaction process 400.

[0054] In some embodiments with reference to FIG. 8, the user 70 has selected the "Access All" function, such that the withdrawable quantum is substantially all of the account balance, subject to financial regulations that may require a minimum balance to be maintained in the financial account. More generally, the withdrawal request does not require the user 70 to define the requested quantum but instead includes an automatic request for substantially expending or depleting the financial account. As shown in FIG. 8, there is a computerized method for transaction process 600 implemented on the system 10. For purpose of brevity, it will be appreciated that various aspects of the transaction process 200 / 400 apply analogously to the transaction process 600.

[0055] In a step 602 of the method or transaction process 600, the withdrawal request made by the user 70 at the ATM 20 is communicated to the issuer server 32 and the acquirer server 42. In a step 604, the issuer server 32 identifies the user 70 by verifying the authentication data against the issuer database 34. After verification, in a subsequent step 606, the issuer server 32 determines an account balance in the

financial account of the user 70. In a step 608, the issuer server 32 determines a withdrawable quantum deductible from the financial account based on the account balance and the withdrawal request. Notably, the withdrawable quantum is substantially all of the account balance, subject to financial regulations on the financial account.

[0056] In a step 610, the issuer server 32 communicates the withdrawable quantum to the acquirer server 42. In a step 612, the acquirer server 42 determines the available cash in the ATM 20. In a step 614, the acquirer server 42 determines a cash quantum dispensable from the ATM 20 based on the withdrawable quantum and available cash, wherein the dispensable cash quantum is a lower of the withdrawable quantum and the available cash. Accordingly, the transaction process 600 allows the user 70 to withdraw substantially all of his/her account balance without defining a specific requested quantum in the withdrawal request.

[0057] A decision diagram 700 according to the transaction process 600 is illustrated in FIG. 9. At a node 702, the user 70 interacts with the ATM 20 and makes a withdrawal request without defining any requested quantum, i.e. the "Access All" function is selected (or automatically included as a default option). At a node 704, the issuer bank 30 determines the account balance in the financial account of the user 70. At a node 706, the issuer bank 30 determines the withdrawable quantum to be substantially all of the account balance. At a node 708, the acquirer bank 40 determines whether the available cash in the ATM 20 is equal to or more than the withdrawable quantum. If yes, the node 708 leads to a node 710 wherein the dispensable cash quantum is the withdrawable quantum. If no, the node 708 leads to a node 712 wherein the dispensable cash quantum is substantially all of the available cash. Accordingly, the user 70 is always able to withdraw some cash from the ATM 20 with this transaction process 600.

[0058] As described above in the transaction processes 200, 400, and 600, various parameters including the requested quantum, account balance, and available cash in the ATM 20 are assessed in order to determine the dispensable cash quantum. For example, in the transaction process 200, the requested quantum is first compared

against the account balance by the issuer bank 30 to determine a withdrawable quantum. The withdrawable quantum is compared against the available cash by the acquirer bank 40. In the transaction process 400, the requested quantum is first compared against the available cash by the acquirer bank 40 to determine whether the available cash is sufficient to meet the requested quantum. The issuer bank 30 then compares the requested quantum against the account balance. It will be appreciated that there will be other variations to the assessing the various parameters in determining the dispensable cash quantum, and that the assessment of the parameters may be performed by any one or more of the issuer server 32, acquirer server 42, and intermediary server 100. Some examples of such other variations are described below.

[0059] In one example, the issuer server 32 receives details of the requested quantum and available cash in the ATM 20 from the acquirer server 42. The issuer server 32 then compares them against the account balance of the user 70, and determines the withdrawable quantum. The withdrawable quantum is equal to the dispensable cash quantum, and this information is communicated to the acquirer server 42. In another example, the issuer server 32 communicates details of the account balance to the acquirer server 42. The acquirer server 42 then compares it against the requested quantum and available cash to determine the withdrawable quantum, which is equal to the dispensable cash quantum. In another example, the intermediary server 100 receives details of the requested quantum, available cash, and account balance from the issuer server 32 and acquirer server 42. The intermediary server 100 compares these details and determines the withdrawable quantum. The withdrawable quantum is equal to the dispensable cash quantum, and this information is communicated to the issuer server 32 and acquirer server 42.

[0060] In some embodiments, the user 70 has defined the requested quantum in the withdrawal request. In one example, the requested quantum is \$5,000, the account balance is \$10,000, the withdrawable quantum is determined to be \$5,000, and the available cash in the ATM 20 is \$8,000. The dispensable cash quantum is determined to be \$5,000 as the ATM 20 cannot dispense more than the withdrawable quantum. However, if the available cash in the ATM 20 is lower at

\$3,000, the dispensable cash quantum is determined to be \$3,000 as the ATM 20 cannot dispense more than the available cash. Table 1 in FIG. 10 illustrates various examples of the dispensable cash quantum based on variations in the requested quantum in the withdrawal request, withdrawable quantum, and available cash.

[0061] In some embodiments, the user 70 has selected the "Access All" function in the withdrawal request, i.e. without defining any requested quantum. The withdrawable quantum is thus substantially all of the account balance. In one example, the withdrawable quantum is \$10,000 and the available cash in the ATM 20 is \$8,000. The dispensable cash quantum is determined to be \$8,000 as the ATM 20 cannot dispense more than the available cash. However, if the available cash in the ATM 20 is higher at \$20,000, the dispensable cash quantum is determined to be \$10,000 as the ATM 20 cannot dispense more than the account balance / withdrawable quantum. Table 2 in FIG. 10 illustrates various examples of the dispensable cash quantum based on variations in the withdrawable quantum and available cash.

[0062] Thus, each of the transaction processes 200, 400, and 600 allows the user 70 to be able to always withdraw some cash from the ATM 20, even though there may be situations wherein the ATM 20 has less cash than the requested quantum, the user 70 is requesting for a higher quantum than the account balance, or the ATM 20 has insufficient cash to meet the requested quantum. The transaction process 200 does not get declined which may help the user 70 to avoid unnecessary administrative fees. Without declined transactions, the user 70 spends less time at the ATM 20 and user experience is improved.

[0063] In some embodiments, the withdrawable quantum is lower than the available cash in the ATM 20. However, the ATM 20 may not be able to dispense exactly the withdrawable quantum because of lack of available denominations of the available cash. For example, the withdrawable quantum is \$90 and the available cash is \$10,000, but this \$10,000 is only available in large denominations of \$50, \$100, and/or \$1,000. Conventionally, the user 70 may be asked to amend the requested quantum or the transaction may be declined, resulting in poor user experience. In the

transaction process 200, the acquirer server 42 may determine a combination of the available denominations such that an aggregated quantum of the combination is maximized towards the withdrawable quantum, wherein the dispensable cash quantum is the aggregated quantum. In the same example, the best combination is one \$50 cash bill wherein the aggregated quantum of \$50 is maximized towards or is closest to the withdrawable quantum of \$90. The dispensable cash quantum is thus the aggregated quantum of \$50. Even though the user may have requested for \$90, the user 70 will be able to withdraw \$50 without having to amend the withdrawal request or perform another transaction at the ATM 20. Table 3 in FIG. 10 illustrates an example of the dispensable cash quantum based on the available denominations of the available cash.

### Technical Architecture

[0064] The following is a description of the technical architecture of a server, such as the intermediary server 100, with reference to FIG. 11. It will be appreciated that the issuer server 32 and acquirer server 42 may have similar technical architecture as well.

[0065] The technical architecture of the server 100 includes a processor 102 (also referred to as a central processor unit or CPU) that is in communication with memory devices including secondary storage 104 (such as disk drives or memory cards), read only memory (ROM) 106, and random access memory (RAM) 108. The processor 102 may be implemented as one or more CPU chips. Various modules or components for performing various operations or steps of the method / transaction process 200 are configured as part of the processor 102 and such operations or steps are performed in response to non-transitory instructions operative or executed by the processor 102.

[0066] The technical architecture further includes input/output (I/O) devices 110, and network connectivity devices 112. The secondary storage 104 typically includes a memory card or other storage device and is used for non-volatile storage of data and as an over-flow data storage device if RAM 108 is not large enough to hold all

working data. Secondary storage 104 may be used to store programs which are loaded into RAM 108 when such programs are selected for execution.

[0067] The secondary storage 104 has a processing component 114, including non-transitory instructions operative by the processor 102 to perform various operations or steps of the method 200 according to various embodiments of the present disclosure. The ROM 106 is used to store instructions and perhaps data which are read during program execution. The secondary storage 104, the ROM 106, and/or the RAM 108 may be referred to in some contexts as computer-readable storage media and/or non-transitory computer-readable media. Non-transitory computer-readable media include all computer-readable media, with the sole exception being a transitory propagating signal per se.

[0068] The I/O devices 110 may include printers, video monitors, liquid crystal displays (LCDs), plasma displays, touch screen displays, keyboards, keypads, switches, dials, mice, track balls, voice recognizers, card readers, paper tape readers, and/or other known input devices.

[0069] The network connectivity devices 112 may take the form of modems, modem banks, Ethernet cards, universal serial bus (USB) interface cards, serial interfaces, token ring cards, fibre distributed data interface (FDDI) cards, wireless local area network (WLAN) cards, radio transceiver cards that promote radio communications using protocols such as code division multiple access (CDMA), global system for mobile communications (GSM), long-term evolution (LTE), worldwide interoperability for microwave access (WiMAX), near field communication (NFC), radio frequency identity (RFID), and/or other air interface protocol radio transceiver cards, and other known network devices. These network connectivity devices 112 may enable the processor 102 to communicate with the Internet or one or more intranets. With such a network connection, it is contemplated that the processor 102 might receive information from the network, or might output information to the network in the course of performing the operations or steps of the method 200. Such information, which is often represented as a sequence of instructions to be executed using

processor 102, may be received from and outputted to the network, for example, in the form of a computer data signal embodied in a carrier wave.

[0070] The processor 102 executes instructions, codes, computer programs, scripts which it accesses from hard disk, floppy disk, optical disk (these various disk based systems may all be considered secondary storage 104), flash drive, ROM 106, RAM 108, or the network connectivity devices 112. While only one processor 102 is shown, multiple processors may be present. Thus, while instructions may be discussed as executed by a processor, the instructions may be executed simultaneously, serially, or otherwise executed by one or multiple processors.

[0071] It will be appreciated that the technical architecture of the server 100 may be formed by one computer, or multiple computers in communication with each other that collaborate to perform a task. For example, but not by way of limitation, an application may be partitioned in such a way as to permit concurrent and/or parallel processing of the instructions of the application. Alternatively, the data processed by the application may be partitioned in such a way as to permit concurrent and/or parallel processing of different portions of a data set by the multiple computers. In an embodiment, virtualization software may be employed by the technical architecture to provide the functionality of a number of servers that is not directly bound to the number of computers in the technical architecture. In an embodiment, the functionality disclosed above may be provided by executing the application and/or applications in a cloud computing environment. Cloud computing may include providing computing services via a network connection using dynamically scalable computing resources. A cloud computing environment may be established by an enterprise and/or may be hired on an as-needed basis from a third party provider.

[0072] It is understood that by programming and/or loading executable instructions onto the technical architecture of the server 100, at least one of the CPU 102, the ROM 106, and the RAM 108 are changed, transforming the technical architecture in part into a specific purpose machine or apparatus having the functionality as taught by various embodiments of the present disclosure. It is fundamental to the electrical engineering and software engineering arts that functionality that can be implemented

by loading executable software into a computer can be converted to a hardware implementation by known design rules.

[0073] In the foregoing detailed description, embodiments of the present disclosure in relation to an electronic system and method for ATM cash withdrawal are described with reference to the provided figures. The description of the various embodiments herein is not intended to call out or be limited only to specific or particular representations of the present disclosure, but merely to illustrate non-limiting examples of the present disclosure. The present disclosure serves to address at least one of the mentioned problems and issues associated with the prior art. Although only some embodiments of the present disclosure are disclosed herein, it will be apparent to a person having ordinary skill in the art in view of this disclosure that a variety of changes and/or modifications can be made to the disclosed embodiments without departing from the scope of the present disclosure. Therefore, the scope of the disclosure as well as the scope of the following claims is not limited to embodiments described herein.

## Claims

1. An electronic system for a user to withdraw cash from an automated teller machine (ATM) operated by an acquirer financial institution, the user having a financial account with an issuer financial institution, the system comprising an intermediary server communicatively linked to an issuer server of the issuer financial institution and an acquirer server of the acquirer financial institution, the intermediary server configured for performing a transaction process comprising:

communicating, to the issuer server and the acquirer server, a withdrawal request made by the user at the ATM;

determining, by the issuer server, an account balance in the financial account;

determining, by the issuer server, a withdrawable quantum deductible from the financial account based on the withdrawal request and the account balance;

communicating the withdrawable quantum from the issuer server to the acquirer server;

determining, by the acquirer server, available cash in the ATM; and

determining, by the acquirer server, a cash quantum dispensable from the ATM based on the withdrawable quantum and available cash.

2. The system according to claim 1, wherein the withdrawal request comprises a requested quantum defined by the user.

3. The system according to claim 2, wherein the withdrawable quantum is a lower of the requested quantum and the account balance.

4. The system according to claims 2 or 3, wherein the requested quantum is updatable based on the available cash before communicating the withdrawal request to the issuer server.

5. The system according to claim 1, wherein the withdrawal request comprises an automatic request for substantially expending the financial account, such that the withdrawable quantum is substantially all of the account balance.

6. The system according to any one of claims 1 to 5, wherein the dispensable cash quantum is a lower of the withdrawable quantum and the available cash.

7. The system according to any one of claims 1 to 5, the transaction process further comprising determining, by the acquirer server, available denominations of the available cash, wherein the withdrawable quantum is lower than the available cash.

8. The system according to claim 7, the transaction process further comprising determining, by the acquirer server, a combination of the available denominations such that an aggregated quantum of the combination is maximized towards the withdrawable quantum, wherein the dispensable cash quantum is the aggregated quantum.

9. The system according to any one of claims 1 to 8, the transaction process further comprising dispensing the dispensable cash quantum in response to a user confirmation input at the ATM.

10. A computerized method for a user to withdraw cash from an automated teller machine (ATM) operated by an acquirer financial institution, the user having a financial account with an issuer financial institution, the method performed by an intermediary server, the method comprising:

communicating a withdrawal request made by the user at the ATM to an issuer server of an issuer financial institution and an acquirer server of an acquirer financial institution, the user having a financial account with the issuer financial institution and the ATM operated by the acquirer financial institution;

determining, by the issuer server, an account balance in the financial account;

determining, by the issuer server, a withdrawable quantum deductible from the financial account based on the withdrawal request and the account balance;

communicating the withdrawable quantum from the issuer server to the acquirer server;

determining, by the acquirer server, available cash in the ATM; and

determining, by the acquirer server, a cash quantum dispensable from the ATM based on the withdrawable quantum and available cash.

11. The method according to claim 10, wherein the withdrawal request comprises an automatic request for substantially expending the financial account, such that the withdrawable quantum is substantially all of the account balance.

12. The method according to claims 10 or 11, further comprising determining, by the acquirer server, available denominations of the available cash, wherein the withdrawable quantum is lower than the available cash.

13. The method according to claim 12, further comprising determining, by the acquirer server, a combination of the available denominations such that an aggregated quantum of the combination is maximized towards the withdrawable quantum, wherein the dispensable cash quantum is the aggregated quantum.

14. An automated teller machine (ATM) comprising:

one or more input devices for generating a withdrawal request made by a user; and

a processor operative for performing a transaction process comprising:

communicating the withdrawal request to an issuer server of an issuer financial institution and an acquirer server of an acquirer financial institution, the user having a financial account with the issuer financial institution and the ATM operated by the acquirer financial institution; and

receiving, from the acquirer server, details of a cash quantum dispensable from the ATM,

wherein the dispensable cash quantum is determined based on available cash in the ATM and a withdrawable quantum deductible from a financial account of the user; and

wherein the withdrawable quantum is determined by the issuer server based on the withdrawal request and an account balance in the financial account.

15. The ATM according to claim 14, wherein the processor is further operative for automatically generating a request for substantially expending the financial account, such that the withdrawable quantum is substantially all of the account balance.

16. The ATM according to claims 14 or 15, further comprising a screen for displaying details of the dispensable cash quantum.

17. The ATM according to any one of claims 14 to 16, further comprising a dispensing mechanism for dispensing the dispensable cash quantum in response to a user confirmation input with the input devices.

18. The ATM according to any one of claims 14 to 17, wherein the processor is further operative for communicating, to the acquirer server, details of available denominations of the available cash.

19. The ATM according to claim 18, wherein the dispensable cash quantum is dispensable in a combination of the available denominations such that an aggregated quantum of the combination is maximized towards the withdrawable quantum, wherein the dispensable cash quantum is the aggregated quantum.

20. An electronic system for a user to withdraw cash from an automated teller machine (ATM) operated by an acquirer financial institution, the system comprising an acquirer server of the acquirer financial institution, the acquirer server configured for performing a transaction process comprising:

receiving a withdrawal request made by the user at the ATM;

communicating the withdrawal request to an issuer server of an issuer financial institution, the user having a financial account with the issuer financial institution;

receiving a withdrawable quantum from the issuer server, the withdrawable quantum deductible from the financial account based on the withdrawal request and an account balance in the financial account;

determining, by the acquirer server, available cash in the ATM; and

determining a cash quantum dispensable from the ATM based on the withdrawable quantum and the available cash.