SYSTEMS AND METHODS FOR PROCESSING PAYMENT TRANSACTIONS BETWEEN PREPAID PAYMENT CARD ACCOUNTS

TECHNICAL FIELD

[0001] The present disclosure relates to processing payment transactions and in particular to the processing of payment transactions between prepaid payment card accounts.

BACKGROUND

[0002] Cash remains one of the most prevalent payment means in developing countries. One of the reasons for this is that conventional payment cards such as credit or debit cards require specialized infrastructure that may not be cost effective particularly for small merchants. A second advantage of cash payments is that the receiver can immediately use the proceeds to make another purchase. Prepaid payment cards offer a relatively simple way to provide a form of payment card, however the issues discussed above still persist.

SUMMARY

[0003] In accordance first aspect of the present invention a transaction processing system for processing payments between prepaid payment card accounts is provided. The system comprises: a processor, and a data storage device. The storage device stores computer program instructions operable to cause the processor to: receive a settlement guarantee certificate message from a payment ledger system, the settlement guarantee certificate message comprising an indication of a payment card issuer associated with a payer prepaid payment card, an indication of a payment card issuer associated with a user prepaid payment card, and an indication of a payment amount; receive a settlement guarantee certificate indication from a user device of a user, the settlement guarantee certificate indication comprising an indication of a prepaid payment card account of the user; match the settlement guarantee certificate message and the settlement guarantee certificate indication; and increase a balance associated with the prepaid payment card account of the user by the payment amount.

[0004] In an embodiment the data storage device stores instructions operable to cause the processor to: match the settlement guarantee certificate message and the settlement guarantee certificate indication by identifying that a unique identifier of the settlement guarantee certificate matches a unique identifier of the settlement guarantee certificate indication.

[0005] In an embodiment, the settlement guarantee certificate comprises a digital signature of the ledger system and the data storage device stores instructions operable to cause the processor to: authenticate the digital signature of the ledger system using a public key of the ledger system.

[0006] In an embodiment, the data storage device stores instructions operable to cause the processor to: receive a payment request message from the user device of the user, the payment request message comprising an indication of the prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card; generate payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount; send the payment message to a payment ledger system; receive a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount; decrease the balance associated with the prepaid payment card account of the user by the payment amount; and send the settlement guarantee certificate indication to the user device of the user.

[0007] In an embodiment the data storage device stores instructions operable to cause the processor to: digitally sign the payment message using a private key of the system associated the issuer of the user prepaid payment card.

[0008] According to a second aspect of the present invention, a transaction processing system for processing payments between prepaid payment card accounts is provided. The system comprises a processor, and a data storage device data storage device storing computer program instructions operable to cause the processor to: receive a payment request message from a user device of a user, the payment request message comprising an indication of the prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card; generate payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount; send the payment message to a payment ledger system; receive a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount; decrease the balance associated with the prepaid payment card account of the user by the payment amount; and send the settlement guarantee certificate indication to the user device of the user.

[0009] In an embodiment, wherein the data storage device stores instructions operable to cause the processor to: digitally sign the payment message using a private key of the system associated the issuer of the user prepaid payment card.

[0010] According to a second aspect of the present invention a payment transaction processing method of processing an incoming payment transaction from a payer prepaid payment card account to a user prepaid payment card account, at a system associated with an issuer of the user prepaid payment card is provided. The method comprises: receiving a settlement guarantee certificate message from a payment ledger system, the settlement guarantee certificate message comprising an indication of a payment card issuer associated with the payer prepaid payment card, an indication of a payment card issuer associated with the user prepaid payment card, and an indication of a payment amount; receiving a settlement guarantee certificate indication from a user device of a user, the settlement guarantee certificate indication comprising an indication of a prepaid payment card account of the user; matching the settlement guarantee certificate message and the settlement guarantee certificate indication; and increasing a balance associated with the prepaid payment card account of the user by the payment amount.

[0011] In an embodiment, matching the settlement guarantee certificate message and the settlement guarantee certificate indication comprises identifying that a unique identifier of the settlement guarantee certificate matches a unique identifier of the settlement guarantee certificate indication.

[0012] In an embodiment, the settlement guarantee certificate comprises a digital signature of the ledger system and the method further comprises authenticating the digital signature of the ledger system using a public key of the ledger system.

[0013] According to a fourth aspect of the present invention, a payment transaction processing method of processing an outgoing payment from a user prepaid payment card account to a payee prepaid payment card account, at a system associated with an issuer of the user prepaid payment card is provided. The method comprises: receiving a payment request message from a user device of a user, the payment request message comprising an indication of a prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card; generating a payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount; sending the payment message to a payment ledger system; receiving a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount; decreasing a balance associated with the prepaid payment card account of the user by the payment amount; and sending the settlement guarantee certificate indication to the user device of the user.

[0014] In an embodiment, the method further comprises digitally signing the payment message using a private key of the system associated the issuer of the user prepaid payment card.

[0015] Embodiments of the invention may be provided as a network of communicating devices (i.e. a “computerized network”). Embodiments of the invention may be also provided as a software application downloadable into a computer device to facilitate the method. The software application may be a computer program product, which may be stored on a non-transitory computer-readable medium on a tangible data-storage device (such as a storage device of a server, or one within a user device).

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the following, embodiments of the present invention will be described as non-limiting examples with reference to the accompanying drawings in which:

FIG.1 is a block diagram showing system for processing payment transactions between prepaid payment card accounts according to an embodiment of the present invention;

FIG.2 shows message flows in a method of processing a payment from a customer to a merchant according to an embodiment of the present invention;

FIG.3A to FIG.3F show example screen displays of a customer device in a method of processing a payment according to an embodiment of the present invention;

FIG.4 is a block diagram showing the data of a settlement guarantee certificate (SGC) used in embodiments of the present invention;

FIG.5 is a block diagram showing the data of a settlement guarantee certificate (SGC) indication used in embodiments of the present invention;

FIG.6A to FIG.6C show example screen displays of a merchant device in a method of processing a payment according to an embodiment of the present invention;

FIG.7 shows message flows in a method of processing a payment from a merchant to a supplier according to an embodiment of the present invention;

FIG.8A to FIG.8E show example screen displays of a merchant device in a method of processing a payment according to an embodiment of the present invention;

FIG.9 is a block diagram showing functional modules of a prepaid payment card issuer institution system for processing transactions between prepaid payment card accounts according to an embodiment of the present invention;

FIG.10 is a flowchart showing a method of processing an incoming payment transaction from a payer prepaid payment card to a user prepaid payment card according to an embodiment of the present invention;

FIG.11 is a flowchart showing a method of processing an outgoing from a user prepaid payment card to a payee prepaid payment card according to an embodiment of the present invention; and

FIG.12 is a block diagram showing a technical architecture of a transaction processing system for processing transactions between prepaid payment cards according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0017] As used herein, the term “payment card” refers to any cashless payment device associated with a payment account, such as a credit card, a debit card, a prepaid card, a charge card, a membership card, a promotional card, a frequent flyer card, an identification card, a prepaid card, a gift card, and/or any other device that may hold payment account information, such as mobile phones, Smartphones, personal digital assistants (PDAs), key fobs, transponder devices, NFC-enabled devices, and/or computers. In addition, the “payment card” may exist as application-based stored value accounts associated with an electronic wallet service provider tied in with an issuer institution.

[0018] The term “institution” is used in a sense which is not necessarily limited to organizations which are legally constituted as banks, since in some jurisdictions other organizations may be permitted to maintain financial accounts such as a payment card account. An institution may be one of the following: a bank, a financial technology company, a telecommunication company or a financial institution.

[0019] As used in this disclosure, the terms “component,” “module,” “system,” “apparatus,” “interface,” or the like are generally intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component or a module may be, but is not limited to being, a process running on a processor, a processor, an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a controller and the controller can be a component or a module. One or more components/modules may reside within a process and/or thread of execution and a component may be localized on one computer and/or distributed between two or more computers.

[0020] Furthermore, the claimed subject matter may be implemented as a method, apparatus, or article of manufacture using standard programming and/or engineering techniques to

produce software, firmware, hardware, or any combination thereof to control a computer to implement the disclosed subject matter. For instance, the claimed subject matter may be implemented as a computer-readable medium embedded with a computer executable program, which encompasses a computer program accessible from any computer-readable storage device or storage media. For example, computer readable media can include but are not limited to magnetic storage devices (e.g., hard disk, floppy disk, magnetic strips . . .), optical disks (e.g., compact disk (CD), digital versatile disk (DVD) . . .), smart cards, and flash memory devices (e.g., card, stick, key drive . . .).

[0021] FIG.1 is a block diagram showing system for processing payment transactions between prepaid payment card accounts according to an embodiment of the present invention. The system enables a customer 112 to make payments from a customer prepaid payment card 114 to a merchant prepaid payment card 124 of a merchant 122. The payment amount is credited to the merchant prepaid payment card 124 without the requirement to wait until clearing of the payment has taken place. This enables the merchant 122 to utilize the funds from the payment, for example to make a payment to a supplier 132. This payment can be made from the merchant prepaid payment card 124 to a supplier prepaid payment card 134.

[0022] The system 100 comprises a customer device 110 which is associated with the customer 112, a merchant device 120 which is associated with the merchant 122 and a supplier device 130 which is associated with the supplier 132. The customer device 110, the merchant device 120 and the supplier device 130 are each portable computing devices such as smartphones or tablet computer devices. The customer device stores details of the customer prepaid payment card 114. The merchant device 120 stores details of the merchant prepaid payment card 124. The supplier device 130 stores details of a supplier prepaid payment card 134. The customer prepaid payment card 114 is issued by a customer issuer institution 142 which operates a customer issuer institution system 140. The customer issuer institution system 140 stores details of the customer prepaid payment card 114 such as a balance associated with the customer prepaid payment card 114. The merchant prepaid payment card 124 is issued by a merchant issuer institution 152 which operates a merchant issuer institution system 150. The merchant issuer institution system 150 stores details of the merchant prepaid payment card 124 such as a balance associated with the merchant prepaid payment card 124. The supplier prepaid payment card 134 is issued by a supplier issuer institution 162 which operates a supplier issuer institution system 160. The supplier issuer institution system 160 stores details of the supplier prepaid payment card 134 such as a balance associated with the supplier prepaid payment card 134.

[0023] As shown in FIG.1, the system 100 further comprises a ledger system 170 which is communicatively coupled to the customer issuer institution system 140, the merchant issuer institution system 150 and the supplier issuer institution system 160. The ledger system 170 functions to issue electronic settlement guarantee certificates (SGCs) which guarantee settlement payments between the customer issuer institution 142, the merchant issuer institution 152 and the supplier issuer institution 162. Based on an SGC the respective issuer institutions can credit prepaid payment card accounts immediately after a transaction is carried out without the need to wait until settlement of a transaction is completed. This allows the funds from the transaction to be available for the payee to use in another transaction. So, for example if the customer 112 makes a purchase at the merchant 122 and uses the customer prepaid payment card 114 to make a payment to the merchant prepaid payment card 124, the funds will immediately be available for use by the merchant 122. The merchant 122 may then use the funds to pay the supplier 132 using the merchant prepaid payment card 124. The message flows in processing such a payment are described below with reference to FIG.2.

[0024] FIG.2 shows message flows in a method of processing a payment from a customer to a merchant according to an embodiment of the present invention.

[0025] The customer 112 visits the merchant 152 to make a purchase. In order to pay for the purchase, the customer 112 logs into a payment application running on the customer device 110.

[0026] FIG.3A shows an example login screen of the payment application. As shown in FIG.3A, the log in screen 310 has an identifier field 312 for the customer 112 to enter her username or identifier which in this example is a telephone number, and a password field 314 for the customer to enter her password.

[0027] FIG.3B shows an example home screen of the payment application. As shown in FIG.3B, the home screen 320 includes an indication 322 of the prepaid payment card 114, a card balance indication 324 indicating the account balance of the prepaid payment card 114, a transaction listing 326 showing recent transactions, a pay button 328 and a receive button 329. In order to make a payment, the user selects the pay button 328 and in order to receive a payment the user selects the receive button 329.

[0028] Following the example shown in FIG.2, the customer 112 selects the pay button 328 in order to make a payment to the merchant 122. The payment application then displays a payment screen as shown in FIG.3C. As shown in FIG.3C, the payment screen 330 has a payment currency box 331 and a payment amount box 332 in which the user enters the payment currency and payment amount. The payment currency may be automatically

determined by the payment application using the location of the customer device 110. The payment screen 330 has an equivalent amount indicator 334 which indicates the payment amount entered in the payment amount box 332 in the home currency of the prepaid payment card 114. In the example shown in FIG.3C, the payment currency is Thai Bhat (THB) and the home currency of the prepaid payment card 114 is Singapore Dollars (SGD).

[0029] The payment screen 330 has a payee issuer field 336 in which the user inputs an indication of the issuing institution of the payee. In this example, this is the merchant issuer institution 152. The customer 112 may be told this information by the merchant 122 so that it can be input into the payment application. The payment screen 330 has a submit button 338 which the user selects once all of the information has been input.

[0030] Once the submit button 338 of the payment screen 330 is selected, the payment application moves to a payment confirmation screen which is shown in FIG.3D. As shown in FIG.3D, the payment confirmation screen 340 shows a payment amount indication 342 which shows the payment amount and currency, an equivalent amount indication 344 which shows the payment amount in the home currency of the prepaid payment card 114, and a payee issuer indication 346 which indicates the issuer institution of the payee. The payment confirmation screen 340 has a confirm button 348 which the user selects to confirm that the information displayed is correct.

[0031] Returning now to FIG.2, in response to the customer 112 selecting the confirm button 348, the user device 110 generates a payment request 210 which is sent to the customer issuer institution system 140. The payment request 210 comprises an identifier of the prepaid payment card, an indication of the payment currency, an indication of the payment amount, and an indication of the issuer institution of the payee. Thus, in the example shown in FIG.2, the payment request 210 comprises an identifier of the customer prepaid payment card 114, an indication of the payment currency (Thai Bhat), an indication of the payment amount 200 THB, and an indication of the merchant issuer institution.

[0032] In response to receiving the payment request 210, the customer issuer institution system 140 generates a payment message 220 which is sent to the ledger system 170. The payment message 220 comprises an identifier of the prepaid payment card, an indication of the payment currency, an indication of the payment amount, an indication of the customer issuer and an indication of the issuer institution of the payee. In some embodiments, the payment message 220 is digitally signed by the customer issuer institution system 140 using a private key of the customer issuer institution system 140. The payment message 220 is a request from the customer issuer institution 140 for the ledger system 170 to generates a settlement guarantee certificate (SGC). The SGC will act as a guarantee that the customer issuer institution 142 will pay the merchant issuer

institution 152 the payment amount. Based on this guarantee, the merchant issuer institution 152 can make the payment amount available on the merchant prepaid payment card before the payment clearance processing is completed.

[0033] In response to receiving the payment message 220, the ledger system 170 generates a settlement guarantee certificate (SGC) 230. This process may comprise the ledger system 170 authenticating the digital signature of the customer issuer institution system 140 on the payment message 220 using a public key of the customer issuer institution system 140. After generating the SGC, the ledger system 170 sends the SGC 240 to the merchant issuer institution system 150 and sends an SGC indication 250 to the customer issuer institution system 140. The SGC 240 may be digitally signed by the ledger system 170 using a private key of the ledger system 170.

[0034] The SGC 240 and the SGC indication 250 are both electronic messages containing information. The information contained in the messages will now be described with reference to FIG.4 and FIG.5.

[0035] FIG.4 is a block diagram showing the data of a settlement guarantee certificate (SGC) used in embodiments of the present invention. As shown in FIG.4, the settlement guarantee certificate 240 comprises a unique transaction identifier 241, an indication of the transaction amount 242, an indication of the payer primary account number (PAN) 243, an indication of the transaction currency 244, an issuing entity indication 245 and a receiving entity indication 246. The unique transaction identifier 241 is also included in the settlement guarantee certification indication 250 and allows matching of the settlement guarantee certificate and the settlement guarantee certificate indication 250.
The indication of the payer PAN 243 is a unique identifier of the payment card account of the payer. In the example described with reference to FIG.2, the indication of the payer PAN 243 indicates the customer prepaid payment card 114. The issuing entity indication 245 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.2, the issuing entity indication 245 indicates the customer issuing institution 142. The receiving entity indication 246 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.2, the receiving entity indication 246 indicates the merchant issuer institution 152.

[0036] FIG.5 is a block diagram showing the data of a settlement guarantee certificate (SGC) indication used in embodiments of the present invention. As shown in FIG.5, the settlement guarantee certificate indication 250 comprises a unique transaction identifier 251, an indication of the transaction amount 252, an indication of the payer primary account number (PAN), an indication of the transaction currency 254, an issuing entity indication 255, a receiving entity indication 256, an indication of the payee PAN 257 and a status

indication 258. The unique transaction identifier 251 corresponds to the unique transaction identifier 241 of the settlement guarantee certificate 240 and as mentioned above allows matching of the settlement guarantee certificate 240 and the settlement guarantee certificate indication 250. The indication of the transaction amount 252, the indication of the payer PAN, the indication of the transaction currency 254, the issuing entity indication 255 and the receiving entity indication 256 each correspond to the respective entry of the settlement guarantee certificate 240. The indication of the payee PAN 257 indicates the prepaid payment card of the payee. In the example described with reference to FIG.2, the indication of the payee PAN 257 is a unique identifier of the merchant prepaid payment card 124. As is described in more detail below, the indication of the payee PAN is added to the settlement guarantee certificate indication 250 by the merchant device 120 during the processing of the payment transaction and initially the indication of the payee PAN 257 does not store any information. The status indication 258 indicates the status of the settlement guarantee certificate and the payment transaction. Initially, the status is set to “initiated”, then to “processing”, then to “verifying” and finally to “done”.

[0037] When the settlement guarantee certificate indication is generated by the ledger system 170, the indication of the payee PAN 257 is empty and the status 258 is set to “initiated”.

[0038] In response to receiving the settlement guarantee certificate indication 250, the customer issuer institution server 140 debits the account balance associated with the customer prepaid payment card 114 and sends the settlement guarantee certificate indication 250 to the customer device 110.

[0039] In response to receiving the settlement guarantee certificate indication 250, the customer device 110 displays the settlement guarantee certificate indication as a QR code 270. FIG.3E shows an example generated SGC screen of the payment application displaying the QR code 270. As shown in FIG.3E the generated SGC screen 350 displays a QR code 270 which includes the data of the settlement guarantee certificate indication. The generated SGC screen also includes an indication of the payment amount 352 and a “done” button 254. The customer 112 provides the settlement guarantee certificate indication 250 to the merchant 122 by allowing the merchant 122 to scan the QR code 270 with the merchant device 124. The status indication 258 of the settlement guarantee certification indication 250 is updated from “initiated” to “processing” by the customer device 110 when the customer 112 shows the QR code 270 to the merchant 122.

[0040] After the customer 112 has displayed the QR code 270 to the merchant 122 and the merchant device 124 has captured the QR code 270, the display of the customer device 114 returns to the home screen as shown in FIG.3F. As shown in FIG.3F, the home screen

360 displays an updated balance in the card balance indication 324 and the new transaction is added to the transaction listing 326.

[0041] In order to receive the payment, the merchant 122 logs into the payment application on the merchant device 120. FIG.6A shows an example login screen of the payment application. As shown in FIG.6A, the log in screen 610 has an identifier field 612 for the merchant 122 to enter his username or identifier which in this example is a telephone number, and a password field 614 for the customer to enter his password.

[0042] FIG.6B shows an example home screen of the payment application. As shown in FIG.6B, the home screen 620 includes an indication 622 of the merchant prepaid payment card 124, a card balance indication 624 indicating the account balance of the prepaid payment card 124, a transaction listing 626 showing recent transactions, a pay button 528 and a receive button 629. In order to receive the payment, the user selects the receive button 629.

[0043] The payment application then displays a scan SGC screen as shown in FIG.6C. As shown in FIG.6C, the scan SGC screen 630 displays the camera output 632 of a camera of the merchant device 120 which is used to capture the QR code 270 displayed on the customer device 110.

[0044] The process described above allows the settlement guarantee certificate indication 250 to be transferred to the merchant device 120. Returning now to FIG.2, in response to the merchant device 120 receiving the settlement guarantee certificate indication 250, the status of in the status indication 258 of the settlement guarantee certification indication 250 is updated from “processing” to “verifying” by the merchant device 120. The merchant device 120 adds the primary account number (PAN) of the merchant prepaid payment card 124 to the indication of the payee PAN 257 of the settlement guarantee certificate indication 250.

[0045] The merchant device 120 sends the settlement guarantee certificate indication 250 to the merchant issuer institution system 150. After receiving the settlement guarantee certificate indication 250, the merchant issuer institution system 150 performs a matching and account crediting action 280. In the matching and crediting action 280, the merchant issuer institution system 150 matches the received settlement guarantee certificate indication 250 with the received settlement guarantee certificate 240 and if a match is found, the merchant issuer institution system 150 credits the account balance of the merchant prepaid payment card 124 with the payment amount. The matching process may comprise determining that the unique transaction identifier 241 of the settlement guarantee certificate 240 and the unique transaction identifier 251 of the settlement guarantee

certificate indication 250 match. After crediting the account balance of the merchant prepaid credit card with the transaction amount, the merchant issuer institution system 150 updates the status indication 258 of the settlement guarantee certificate indication 250 from “verifying” to “done”.

[0046] In some embodiments, after receiving the settlement guarantee certificate 240 from the ledger system 170 and prior to crediting the account balance of the merchant prepaid payment card 124 with the payment amount the merchant issuer institution system 150 may validate the digital signature of the ledger system 170 which is included in the settlement guarantee certificate 240 using the public key of the ledger system 170.

[0047] In the method described above with reference to FIG.2, a payment is made from the customer prepaid payment card 114 to the merchant prepaid payment card 124 and the balance from this payment is available to the merchant 122 to use in transactions without the need for a clearing process to take place. Thus, the merchant can immediately use the balance to make a further payment, for example to a supplier. FIG.7 shows an example of such a method.

[0048] FIG.7 shows message flows in a method of processing a payment from a merchant to a supplier according to an embodiment of the present invention. In order to make the payment to the supplier 132, the merchant 122 logs into the payment application running on the merchant device 120.

[0049] FIG.8A shows an example login screen of the payment application. As shown in FIG.8A, the log in screen 810 has an identifier field 312 for the merchant 122 to enter his username or identifier which in this example is a telephone number, and a password field 314 for the merchant 122 to enter his password.

[0050] FIG.8B shows an example home screen of the payment application. As shown in FIG.8B, the home screen 820 includes an indication 822 of the prepaid payment card 124, a card balance indication 324 indicating the account balance of the prepaid payment card 124, a transaction listing 326 showing recent transactions, a pay button 328 and a receive button 329. In order to make a payment, the user selects the pay button 328 and in order to receive a payment the user selects the receive button 329.

[0051] In the example shown FIG.7, the merchant 122 selects the pay button 328 in order to make a payment to the supplier 132. The payment application then displays a payment screen as shown in FIG.8C. As shown in FIG.8C, the payment screen 830 has a payment currency box 331 and a payment amount box 332 in which the user enters the payment currency and payment amount. The payment currency may be automatically determined by the payment application using the location of the merchant device 120. The payment

screen 330 has an equivalent amount indicator 334 which indicates the payment amount entered in the payment amount box 332 in the home currency of the prepaid payment card 124. In the example shown in FIG.3C, the payment currency is Thai Bhat (THB) and the home currency of the prepaid payment card 124 is also Thai Bhat (THB).

[0052] The payment screen 330 has a payee issuer field 336 in which the user inputs an indication of the issuing institution of the payee. In this example, this is the supplier issuer institution 162. The merchant 122 may be told this information by the supplier 132 so that it can be input into the payment application. The payment screen 330 has a submit button 338 which the user selects once all of the information has been input.

[0053] Once the submit button 338 of the payment screen 330 is selected, the payment application moves to a payment confirmation screen which is shown in FIG.8D. As shown in FIG.3D, the payment confirmation screen 340 shows a payment amount indication 342 which shows the payment amount and currency, an equivalent amount indication 344 which shows the payment amount in the home currency of the prepaid payment card 124, and a payee issuer indication 346 which indicates the issuer institution of the payee. The payment confirmation screen 340 has a confirm button 348 which the user selects to confirm that the information displayed is correct.

[0054] Returning now to FIG.7, in response to the merchant 122 selecting the confirm button 348, the merchant device 120 generates a payment request 710 which is sent to the merchant issuer institution system 150. The payment request 710 comprises an identifier of the prepaid payment card, an indication of the payment currency, an indication of the payment amount, and an indication of the issuer institution of the payee. Thus, in the example shown in FIG.7, the payment request 710 comprises an identifier of the merchant prepaid payment card 124, an indication of the payment currency (Thai Bhat), an indication of the payment amount 200 THB, and an indication of the supplier issuer institution 160.

[0055] In response to receiving the payment request 710, the merchant issuer institution system 150 generates a payment message 720 which is sent to the ledger system 170. The payment message 720 comprises an identifier of the prepaid payment card, an indication of the payment currency, an indication of the payment amount, an indication of the customer issuer and an indication of the issuer institution of the payee. In some embodiments, the payment message 720 is digitally signed by the merchant issuer institution system 150 using a private key of the merchant issuer institution system 150. The payment message 720 is a request from the merchant issuer institution 150 for the ledger system 170 to generates a settlement guarantee certificate (SGC). The SGC will act as a guarantee that the merchant issuer institution 152 will pay the supplier issuer institution 162 the payment amount. Based on this guarantee, the supplier issuer institution

162 can make the payment amount available on the supplier prepaid payment card before the payment clearance processing is completed.

[0056] In response to receiving the payment message 720, the ledger system 170 generates a settlement guarantee certificate (SGC) 730. This process may comprise the ledger system 170 authenticating the digital signature of the merchant issuer institution system 150 on the payment message 720 using a public key of the merchant issuer institution system 150. After generating the SGC, the ledger system 170 sends the SGC 740 to the supplier issuer institution system 160 and sends an SGC indication 750 to the merchant issuer institution system 150. The SGC 740 may be digitally signed by the ledger system 170 using a private key of the ledger system 170.

[0057] The SGC 740 and the SGC indication 750 are both electronic messages containing information which has a form as described above with reference to FIG.4 and FIG.5. In the example described with reference to FIG.7, in the SGC 740, the indication of the payer PAN 243 indicates the merchant prepaid payment card 124. The issuing entity indication 245 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.7, the issuing entity indication 245 indicates the merchant issuing institution 152. The receiving entity indication 246 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.8, the receiving entity indication 246 indicates the supplier issuer institution 162.

[0058] In the SGC indication 760, the indication of the payer PAN 243 indicates the merchant prepaid payment card 124. The issuing entity indication 245 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.7, the issuing entity indication 255 indicates the merchant issuing institution 152. The receiving entity indication 256 indicates the issuer institution of the payee payment card. In the example described with reference to FIG.8, the receiving entity indication 246 indicates the supplier issuer institution 162. The payee PAN 257, which is added by the supplier device 130 during the processing, indicates the supplier prepaid payment card 134.

[0059] When the settlement guarantee certificate indication is generated by the ledger system 170, the indication of the payee PAN 257 is empty and the status 258 is set to “initiated”.

[0060] In response to receiving the settlement guarantee certificate indication 750, the merchant issuer institution server 150 debits the account balance associated with the merchant prepaid payment card 124 and sends the settlement guarantee certificate indication 750 to the merchant device 120.

[0061] In response to receiving the settlement guarantee certificate indication 750, the merchant device 120 displays the settlement guarantee certificate indication as a QR code

770. FIG.8E shows an example generated SGC screen of the payment application displaying the QR code 770. As shown in FIG.8E the generated SGC screen 850 displays a QR code 770 which includes the data of the settlement guarantee certificate indication. The generated SGC screen also includes an indication of the payment amount 352 and a “done” button 254. The merchant 122 provides the settlement guarantee certificate indication 750 to the supplier 132 by allowing the supplier 132 to scan the QR code 770 with the supplier device 134. The status indication 258 of the settlement guarantee certification indication 750 is updated from “initiated” to “processing” by the merchant device 120 when the merchant 122 shows the QR code 770 to the supplier 122.

[0062] The supplier 132 logs onto the payment application on the supplier device 130 and scans the QR code 770 to obtain the settlement guarantee certificate indication 750. In response to the supplier device 130 receiving the settlement guarantee certificate indication 750, the status of in the status indication 258 of the settlement guarantee certification indication 750 is updated from “processing” to “verifying” by the supplier device 130. The supplier device 130 adds the primary account number (PAN) of the supplier prepaid payment card 134 to the indication of the payee PAN 257 of the settlement guarantee certificate indication 750.

[0063] The supplier device 130 sends the settlement guarantee certificate indication 750 to the supplier issuer institution system 160. After receiving the settlement guarantee certificate indication 750, the supplier issuer institution system 160 performs a matching and account crediting action 780. In the matching and crediting action 780, the supplier issuer institution system 160 matches the received settlement guarantee certificate indication 750 with the received settlement guarantee certificate 740 and if a match is found, the supplier issuer institution system 160 credits the account balance of the supplier prepaid payment card 134 with the payment amount. The matching process may comprise determining that the unique transaction identifier 241 of the settlement guarantee certificate 740 and the unique transaction identifier 251 of the settlement guarantee certificate indication 750 match. After crediting the account balance of the supplier prepaid payment card account with the transaction amount, the supplier issuer institution system 160 updates the status indication 258 of the settlement guarantee certificate indication 750 from “verifying” to “done”.

[0064] In some embodiments, after receiving the settlement guarantee certificate 740 from the ledger system 170 and prior to crediting the account balance of the supplier prepaid payment card 134 with the payment amount the supplier issuer institution system 160 may validate the digital signature of the ledger system 170 which is included in the settlement guarantee certificate 740 using the public key of the ledger system 170.

[0065] As described in the example above, the merchant 122 pays the supplier 132 using the payment processing method described herein. This method allows a payment to be made between prepaid payment cards without the requirement for equipment such a point of sale device (POS) to be provided by either the merchant 122 to accept the payment from the customer 112 or by the supplier 132 to accept the payment from the merchant 122. It would be possible, however for the merchant 122 to receive a payment from the customer 112 using the methods described herein and then to make a payment to the supplier 132 using a POS device provided by the supplier. Such a series of payment transactions would still allow the merchant 122 to make the payment to the supplier 132 immediately after receiving the payment from the customer 112 without having to wait a number of days for the payment to clear.

[0066] FIG.9 is a block diagram showing functional modules of a prepaid payment card issuer institution system for processing transactions between prepaid payment cards according to an embodiment of the present invention. The prepaid payment card issuer institution system 900 may receive incoming payments on a prepaid payment card (for example to act as the merchant issuer institution system 150 in the scenario of FIG.2, or the supplier issuer institution system 160 in the scenario of FIG.7) and/or may make outgoing payments from a prepaid payment card (for example to act as the customer issuer institution system 140 in the scenario of FIG.2, or the merchant issuer institution system 150 in the scenario of FIG.7).

[0067] As shown in FIG.9, the prepaid payment card issuer institution system 900 comprises a user device interaction module 902, an outgoing payment processing module 904, an incoming payment processing module 906 and an account balance update module 908. Each of the modules shown in FIG.8 may be implemented as hardware, software or a combination of hardware and software. An example of a technical architecture of the prepaid payment card issuer institution system 900 is described in detail below with reference to FIG.12. The user device interaction module 902 is operable to interact with a user device. The user device interaction module is operable to communicate via a network such as the internet with the payment application running on a user device such as the customer device 110, the merchant device 120 or the supplier device 130. The outgoing payment processing module 904 is operable to process outgoing payments and communicates with the ledger system 170 send a payment message and receive settlement guarantee certificate indication. The incoming payment processing module 906 is operable to communicate with the ledger system 170 and receive a settlement guarantee certificate. The account balance update module 908 is operable to update the account balance of prepaid payment cards to either increase the balance when receiving a payment or decrease the balance when making a payment.

[0068] FIG.10 is a flowchart showing a method of processing an incoming payment transaction from a payer prepaid payment card account to a user prepaid payment card account according to an embodiment of the present invention. The method 1000 shown in FIG.10 is carried out by the prepaid payment card issuer institution system 900 shown in FIG.9.

[0069] In step 1002, the incoming payment processing module 906 of the prepaid payment card issuer institution system 900 receives a settlement guarantee certificate 240 from the ledger system 170. The settlement guarantee certificate 240 comprises the data as shown in FIG.4. In some embodiments, the settlement guarantee certificate 240 is digitally signed by the ledger system 170 and the prepaid payment card issuer institution system 900 may authenticate the digital signature using a public key of the ledger system 170.

[0070] In step 1004, the user device interaction module 902 of the prepaid payment card issuer institution system 900 receives a settlement guarantee certificate indication 250 from a user device. As described above, the payee receives the settlement guarantee certificate indication on their device from the payer. The settlement guarantee certificate indication 250 comprises the data shown in FIG.5. The indication of the payee PAN field has been added by the payee device.

[0071] In step 1006, the incoming payment processing module 906 of the prepaid payment card issuer institution system 900 matches the received settlement guarantee certificate 240 and the received settlement guarantee certificate indication 250. The matching comprises matching the unique transaction identifier 241 of the settlement guarantee certificate 240 with the unique transaction identifier 251 of the settlement guarantee certificate indication 250.

[0072] In step 1008, the account balance update module 908 of the prepaid payment card issuer institution system 900 updates the balance of the payee prepaid payment card account by increasing the balance by the transaction amount indicated in the settlement guarantee certificate 240 and the settlement guarantee certificate indication 250.

[0073] FIG.11 is a flowchart showing a method of processing an outgoing from a user prepaid payment card to a payee prepaid payment card according to an embodiment of the present invention. The method 1100 shown in FIG.11 is carried out by the prepaid payment card issuer institution system 900 shown in FIG.9.

[0074] In step 1102, the user device interaction module 902 of the prepaid payment card issuer institution system 900 receives a payment request message from a user device. The payment request message comprises an identifier of the prepaid payment card from which

the payment will be made, an indication of the payment currency, an indication of the payment amount, and an indication of the issuer institution of the payee.

[0075] In step 1104, the outgoing payment processing module 904 of the prepaid payment card issuer institution system 900 generates a payment message. The payment message comprises an identifier of the prepaid payment card, an indication of the payment currency, an indication of the payment amount, an indication of the issuer of the prepaid payment card and an indication of the issuer institution of the payee. In some embodiments, the prepaid payment card issuer institution system 900 digitally signs the payment message using a private key of the prepaid payment card issuer institution system 900 to generate a digital signature.

[0076] In step 1106, the outgoing payment processing module 904 of the prepaid payment card issuer institution system 900 sends the payment message to the ledger system 170.

[0077] As described above, the ledger system 170 then generates the settlement guarantee certificate 240 and the settlement guarantee certificate indication 250.

[0078] In step 1108, the outgoing payment processing module 904 of the prepaid payment card issuer institution system 900 receives the settlement guarantee indication 250 from the ledger system 170.

[0079] In step 1110, the account balance update module 908 of the prepaid payment card issuer institution system 900 updates the balance of the user prepaid payment card account to debit the payment amount from the balance.

[0080] In step 1112, the user device interaction module 902 of the prepaid payment card issuer institution system 900 sends the settlement guarantee certificate indication 250 to the user device.

[0081] Then, as described above, the user provides the settlement guarantee certificate indication to the payee and the processing is continued by the system of the issuer institution of the payee.

[0082] FIG.12 is a block diagram showing a technical architecture 1200 of a prepaid payment card issuer institution system 900 for performing steps of exemplary methods described above. Typically, the methods are implemented by a number of computers each having a data-processing unit. The block diagram as shown in FIG.12 illustrates a technical architecture 1200 of a computer which is suitable for implementing one or more embodiments herein.

[0083] The technical architecture 1200 includes a processor 922 (which may be referred to as a central processor unit or CPU) that is in communication with memory devices including secondary storage 924 (such as disk drives), read only memory (ROM) 926, random access memory (RAM) 928. The processor 922 may be implemented as one or more CPU chips. The technical architecture 920 may further comprise input/output (I/O) devices 930, and network connectivity devices 932.

[0084] The secondary storage 924 is typically comprised of one or more disk drives or tape drives and is used for non-volatile storage of data and as an over-flow data storage device if RAM 928 is not large enough to hold all working data. Secondary storage 924 may be used to store programs which are loaded into RAM 928 when such programs are selected for execution. In this embodiment, the secondary storage 924 has a user device interaction module 902, an incoming payment processing module 904, an outgoing payment processing module 906 and an account balance update module 908, comprising non-transitory instructions operative by the processor 922 to perform various operations of the method of the present disclosure. As depicted in FIG.12, the modules 902-908 are distinct modules which perform respective functions implemented by the prepaid payment card issuer institution system 900. It will be appreciated that the boundaries between these modules are exemplary only, and that alternative embodiments may merge modules or impose an alternative decomposition of functionality of modules. For example, the modules discussed herein may be decomposed into sub-modules to be executed as multiple computer processes, and, optionally, on multiple computers. Moreover, alternative embodiments may combine multiple instances of a particular module or sub-module. It will also be appreciated that, while a software implementation of the modules 902-908 is described herein, these may alternatively be implemented as one or more hardware modules (such as field-programmable gate array(s) or application-specific integrated circuit(s)) comprising circuitry which implements equivalent functionality to that implemented in software. The ROM 926 is used to store instructions and perhaps data which are read during program execution. The secondary storage 924, the RAM 928, and/or the ROM 926 may be referred to in some contexts as computer readable storage media and/or non-transitory computer readable media.

[0085] The I/O devices 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, or other well-known input devices.

[0086] The network connectivity devices 932 may take the form of modems, modem banks, Ethernet cards, universal serial bus (USB) interface cards, serial interfaces, token ring

cards, fiber 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 communications (NFC), radio frequency identity (RFID), and/or other air interface protocol radio transceiver cards, and other well-known network devices. These network connectivity devices 932 may enable the processor 922 to communicate with the Internet or one or more intranets. With such a network connection, it is contemplated that the processor 922 might receive information from the network, or might output information to the network in the course of performing the method operations described herein. Such information, which is often represented as a sequence of instructions to be executed using processor 922, may be received from and outputted to the network, for example, in the form of a computer data signal embodied in a carrier wave.

[0087] The processor 922 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 924), flash drive, ROM 926, RAM 928, or the network connectivity devices 932. While only one processor 922 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.

[0088] It is understood that by programming and/or loading executable instructions onto the technical architecture 1200, at least one of the CPU 922, the RAM 928, and the ROM 926 are changed, transforming the technical architecture 1200 in part into a specific purpose machine or apparatus having the novel functionality taught by 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 well-known design rules.

[0089] Whilst the foregoing description has described exemplary embodiments, it will be understood by those skilled in the art that many variations of the embodiments can be made within the scope of the invention as defined by the claims. Moreover, features of one or more embodiments may be mixed and matched with features of one or more other embodiments.

CLAIMS

1. A transaction processing system for processing payments between prepaid payment card accounts, the system comprising: a processor, and a data storage device, data storage device storing computer program instructions operable to cause the processor to:

receive a settlement guarantee certificate message from a payment ledger system, the settlement guarantee certificate message comprising an indication of a payment card issuer associated with a payer prepaid payment card, an indication of a payment card issuer associated with a user prepaid payment card, and an indication of a payment amount;

receive a settlement guarantee certificate indication from a user device of a user, the settlement guarantee certificate indication comprising an indication of a prepaid payment card account of the user;

match the settlement guarantee certificate message and the settlement guarantee certificate indication; and

increase a balance associated with the prepaid payment card account of the user by the payment amount.

2. A transaction processing system according to claim 1, wherein the data storage device stores instructions operable to cause the processor to: match the settlement guarantee certificate message and the settlement guarantee certificate indication by identifying that a unique identifier of the settlement guarantee certificate matches a unique identifier of the settlement guarantee certificate indication.

3. A transaction processing system according to claim 1 or claim 2, wherein the settlement guarantee certificate comprises a digital signature of the ledger system and the data storage device stores instructions operable to cause the processor to: authenticate the digital signature of the ledger system using a public key of the ledger system.

4. A transaction processing system according to claim any one of claims 1 to 3, wherein the data storage device stores instructions operable to cause the processor to:

receive a payment request message from the user device of the user, the payment request message comprising an indication of the prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card;

generate payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the

payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount;

send the payment message to a payment ledger system;

receive a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount;

decrease the balance associated with the prepaid payment card account of the user by the payment amount; and

send the settlement guarantee certificate indication to the user device of the user.

5. A transaction processing system according to claim 4, wherein the data storage device stores instructions operable to cause the processor to: digitally sign the payment message using a private key of the system associated the issuer of the user prepaid payment card.

6. A transaction processing system for processing payments between prepaid payment card accounts, the system comprising: a processor, and a data storage device, data storage device storing computer program instructions operable to cause the processor to:

receive a payment request message from a user device of a user, the payment request message comprising an indication of the prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card;

generate payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount;

send the payment message to a payment ledger system;

receive a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount;

decrease the balance associated with the prepaid payment card account of the user by the payment amount; and

send the settlement guarantee certificate indication to the user device of the user.

7. A transaction processing system according to claim 6, wherein the data storage device stores instructions operable to cause the processor to: digitally sign the payment message using a private key of the system associated the issuer of the user prepaid payment card.

8. A payment transaction processing method of processing an incoming payment transaction from a payer prepaid payment card account to a user prepaid payment card account, at a system associated with an issuer of the user prepaid payment card, the method comprising:

receiving a settlement guarantee certificate message from a payment ledger system, the settlement guarantee certificate message comprising an indication of a payment card issuer associated with the payer prepaid payment card, an indication of a payment card issuer associated with the user prepaid payment card, and an indication of a payment amount;

receiving a settlement guarantee certificate indication from a user device of a user, the settlement guarantee certificate indication comprising an indication of a prepaid payment card account of the user;

matching the settlement guarantee certificate message and the settlement guarantee certificate indication; and

increasing a balance associated with the prepaid payment card account of the user by the payment amount.

9. A method according to claim 8, wherein matching the settlement guarantee certificate message and the settlement guarantee certificate indication comprises identifying that a unique identifier of the settlement guarantee certificate matches a unique identifier of the settlement guarantee certificate indication.

10. A method according to claim 8 or claim 9, wherein the settlement guarantee certificate comprises a digital signature of the ledger system and the method further comprises authenticating the digital signature of the ledger system using a public key of the ledger system.

11. A payment transaction processing method of processing an outgoing payment from a user prepaid payment card account to a payee prepaid payment card account, at a system associated with an issuer of a user prepaid payment card, the method comprising:

receiving a payment request message from a user device of a user, the payment request message comprising an indication of a prepaid payment card of the user, an indication of a payment amount, and an indication of a payment card issuer associated with a payee prepaid payment card;

generating a payment message, the payment message comprising an indication of the issuer of the user prepaid payment card, an indication the payment card issuer of the

payee prepaid payment card, an indication of the prepaid payment card account of the user and an indication of the payment amount;

sending the payment message to a payment ledger system;

receiving a settlement guarantee certificate indication from the payment ledger system, the settlement guarantee certificate indication comprising an indication of the issuer of the user prepaid payment card, an indication of the issuer of the payee prepaid payment card; and an indication of the payment amount;

decreasing a balance associated with the prepaid payment card account of the user by the payment amount; and

sending the settlement guarantee certificate indication to the user device of the user.

12. A method according to claim 11, further comprising digitally signing the payment message using a private key of the system associated the issuer of the user prepaid payment card.

13. A non-transitory computer readable medium carrying computer executable instructions which when executed on at least one processor cause the at least one processor to carry out a method according to any one of claims 8 to 12.