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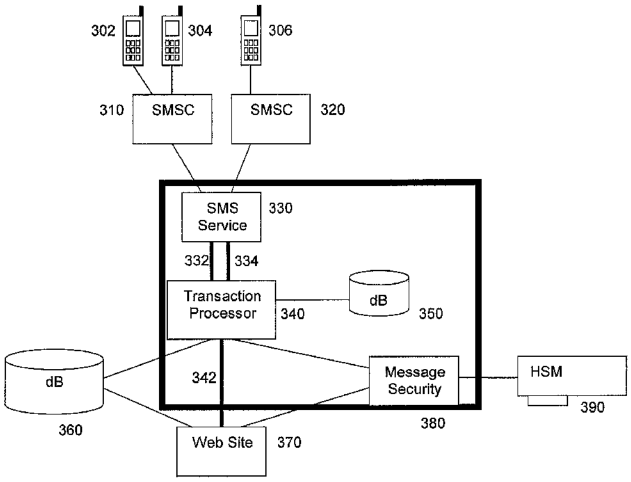

(57) Abstract: In a wireless communications network, a system is provided for securely executing the transfer of rights between holders of accounts. The secure transfer of messages may represent the exchange of title to monetary assets. Each title holder is provided with a SIM card containing a transaction application that can interpret menu messages, accept user inputs and generate transaction messages for processing by the system. Each of the menu and transaction messages is delivered as a short messaging service message. The holder inserts his SIM into a mobile handset, and (after authentication with the system) is permitted to interact with the system to conduct rights transfer transactions. Since the transactions are in the form of simple text messages, the mobile handset need not conform to a high specification (i.e. may not support GPRS).

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Mobile Account Management

The invention relates to the management of secure transactions in a wireless communications network. In particular, the invention relates to the secure transfer of messages representing the exchange of title to monetary assets.

A large proportion of the world's population is not served by conventional banking facilities. There are limited facilities for transferring money between 'enterprises' (e.g. business to business) or between individuals (one location to another). Consequently, cash must often physically change hands. This lack of banking facilities affects small-scale business men and women in emerging markets particularly strongly.

How such small-scale business people access funding, referred to as "microcredit" or "microfinance", is seen as being central to stimulating economic activity in emerging markets.

The availability of financial services (such as microcredit/microfinance) is constrained by the infrastructure in place to deliver it, making existing systems slow, costly and where cash is involved, often insecure.

In many emerging economies, the cellular network provides the platform on which financial services can be delivered, far exceeding the reach of landlines, bank branches and automated teller machines (ATMs) which are largely restricted to urban areas. For this reason, a number of systems have been implemented using the conventional short message functionality (SMS) of cellular networks in an attempt to address customer need – giving access to financial services using the mobile networks and phones as delivery channels.

In one known system, Fundamo Elevator deployed in Zambia as CelPay, targeting high end customers and based on SIM protocol. Registered customers are provided with a CelPay SIM card. The SIM card is programmed to generate a new menu once inserted into a suitable mobile telephone handset. Celpay accounts are credited either via a transfer from a conventional bank account, or by directly depositing cash or cheque into a Celpay partner bank. When the CelPay user wishes to make a payment, he uses the CelPay menu on his handset to input the amount to be paid to the merchant or supplier. He is prompted to authenticate the transaction by inputting a secure Personal Identification Number (PIN). Both payer and payee receive confirmation of the transaction (in the form of an SMS message). Since each transaction has a unique reference number, with full details available online (on the World Wide Web, the "Web"), the merchant or supplier (provided he has access to the Web) has a complete online audit record of who paid what, and when. The merchant or supplier must also have set up a special Celpay-enabled account into which any transfers will be made. Funds can then be swept to the main bank account for the merchant on the merchant's instruction.

Another system, Globe G-Cash in the Philippines, uses SMS notification in relation to conventional “straight money transfer” person to person via outlet agents. A G-Cash account is provided for each registered user. SMS messages requesting payment in G-Cash to recipient accounts are sent to a short code number (a central service) for processing (e.g. to pay a bill or to buy call credit).

Smart Money, also implemented in the Philippines, uses ‘smart credits’ as electronic payments. The Smart Money application makes use of an electronic-wallet card that is linked to a mobile phone account. The card can be used like a debit card. Alternatively, using mobile phones, customers *with bank accounts* can, via SMS, load money onto the card, transfer money between cards, track transactions, pay bills etc.

Another well-known mechanism for money transfer in the absence of banking facilities is the facility to “wire” cash in the form of international remittances, provided by companies such as Western Union.

Existing systems have met with some success. They do however rely on customers having access to a conventional infrastructure such as a bank account, the Web and/or a suitable outlet. This excludes many small businesspeople, for whom access to such basic infrastructure is a considerable burden.

In order to overcome the preceding difficulties, there is provided an account management system for maintaining a plurality of virtual accounts in a cellular communications system, the cellular communications system carrying messages between mobile terminals and each mobile terminal including a data card with a unique identifier, the account management system including:

a messaging means which is adapted to receive incoming transaction messages from mobile terminals using the communications system, the incoming messages including the unique identifier of the originating mobile terminal, and transmitting outgoing transaction messages to mobile terminals in response;

a transaction processing means which is coupled to the messaging means and adapted to interpret incoming transaction messages and to output corresponding transaction instructions;

a message security means, coupled to the transaction processor, which authenticates the incoming transaction messages by comparing the included unique identifier to the entries in a list of valid virtual accounts; and

a transaction data store interface, coupled to the transaction processor, through which the transaction processor communicates with a data store, the interface being adapted to convey instructions to amend data held in one or more valid virtual accounts stored in the data store and to convey transaction complete messages from the data store to the transaction processing means when the amendment is complete;

wherein the transaction processing means is also adapted to interpret transaction complete messages and to output corresponding interpreted transaction complete messages to the messaging means;

wherein each interpreted transaction complete message includes security information generated from unique identifiers of amended virtual accounts, the messaging means directing outgoing messages generated from the interpreted transaction complete messages to corresponding mobile terminals; and

wherein each received outgoing message is in a format which requires the input of a unique key from the data card inserted in the mobile terminal, thereby ensuring that the outgoing message can only be read in the presence of a data card with a unique key that matches the security information in the outgoing message.

The account management system is thus a mobile phone-enabled account management platform. This system has the functionality to allow users to move money at both at a business-to-business level and at a person-to-person level, via mobile terminals (in particular, through the use of widely-available GSM mobile phones). The system makes use of specially developed software running on a mobile phone's SIM card to conduct the conversation with the end user and uses short message service (SMS) to communicate between the SIM card and a central server. This has the advantage of being able to run on low specification mobile phones that do not necessarily support GPRS.

In accordance with a further aspect of the invention, there is provided a method for maintaining a plurality of virtual accounts in a cellular communications system, the cellular communications system carrying messages between mobile terminals and each mobile terminal including a data card with a unique identifier, the method comprising:

receiving incoming transaction messages from mobile terminals using the communications system, the incoming messages including the unique identifier of the originating mobile terminal;

interpreting incoming transaction messages;

authenticating the incoming transaction messages by comparing the included unique identifier to the entries in a list of valid virtual accounts;

where the incoming transaction messages is authentic, outputting corresponding transaction instructions to amend data held in one or more valid virtual accounts stored in a data store;

receiving transaction complete messages from the data store when the amendment is complete; and transmitting outgoing transaction messages to the originating mobile terminals, each interpreted transaction complete message including security information generated from unique identifiers of amended virtual accounts;

wherein each received outgoing message is in a format which requires the input of a unique key from the data card inserted in the mobile terminal, thereby ensuring that the outgoing message can only be read in the presence of a data card with a unique key that matches the security information in the outgoing message.

By creating a series of virtual accounts within a standard deposit account operated on behalf of individual customers and organisations such as, microfinance institutions (MFI), the platform enables individual users, service providers and agents to move 'allocated funds' between these virtual accounts by instructing the account manager to do so, for example via SMS.

Once an individual has been given a virtual account, money can be allocated to this (for example by a microfinance service provider). Value can be moved between accounts within the virtual account system when instructions are received by SMS, say. For example, an individual can request value to be moved between his virtual account and the corresponding virtual account of a merchant from which he is buying goods or services.

The value represented by the virtual account can be encashed at any suitable registered agent, such as an airtime reseller or any location that has suitable 'cash flow' (shops, petrol stations, etc). These agents are much more widespread and convenient to access than bank outlets. The process is quick and transaction costs should be lowered substantially. In particular, this arrangement also obviates the need for the physical movement (and (re)counting) of 'cash' and so offers security benefits for the user.

Using mobile technology to make financial transactions faster, cheaper, and more secure, facilitates the delivery of financial services in emerging markets where other financial transaction mechanisms are unattractive. The invention also facilitates the wider transfer of money between migrant workers and their families.

Preferably, the platform is provided with a security layer. The security layer may be implemented at each stage of a transaction. This layer is built into the Account Manager to protect against fraudulent use.

The security of the exchange of information between individual users, service providers and agents (i.e. a handset with an appropriate SIM installed), on the one hand, and the account manager, on the other, may be enhanced by requiring encryption of the message (e.g. SMS message) using a key that is shared between both parties. To effect this shared key encryption, the SIM used in the handset may be provided with a SIM Toolkit (STK) application for encrypting and decrypting such messages.

Alternatively, or additionally, security may be provided using other ID and security checks independent of the SIM or handset. Examples of such alternate checks include: Personal Identification Numbers (PINs); username/password combinations; biometric parameters (such as iris scans, fingerprinting, voice pattern recognition etc.). These checks may use existing functionalities on the handset (i.e. key pad and microphone) to obtain data for processing at a secure server: thus, interactive voice response (IVR) or Voice Recognition may be used to obtain secure information from the user. One advantage of this is that a handset and a single SIM can be shared by a whole community of users, similar to a point of sales device: user accounts can be distinguished by requiring the input of further ID and security information.

Preferably, there is also provided a reporting means for providing a reporting functionality that allows movement of value between the virtual accounts to be tracked. The reporting means may further track encashment. The reporting means thereby provides an audit trail as may be required by regulatory authorities.

For a better understanding of the present invention an embodiment will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows schematically a network in which the invention may be used;

Figure 2 is a diagrammatic drawing of a microfinance system incorporating a virtual account management system in accordance with the present invention;

Figure 3 shows the information flow in the system of Figure 2; and

Figure 4 illustrates the some of the microfinance transactions facilitated by present invention; and

Figure 5 illustrates the operation of a message forwarder utility for overcoming firewall restrictions.

Figure 1 shows schematically a network in which the invention may be used. The figure shows a cellular network. However, it should be appreciated that the invention is applicable to any type of network, although it is particularly applicable to a network where at least some of the devices communicate using mobile telecommunications/wireless data transmission. Mobile terminal 1 is registered with GSM/GPRS or UMTS (3G) mobile telecommunications network 3. The mobile terminal 1 may be a handheld mobile telephone, a personal digital assistant (PDA) or a laptop computer equipped with a datacard. The mobile terminal 1 communicates wirelessly with mobile telecommunications network 3 via the radio access network (RAN) of the mobile telecommunications network 3, comprising, in the case of a UMTS network, base station (Node B) 5, and radio network controller (RNC) 7. Communications between the mobile terminal 1 and the mobile telecommunications network 3 are routed from the radio access network via GPRS support nodes (SGSN) 9, which may be connected by a fixed (cable) link to the mobile telecommunications network 3.

In the conventional manner, a multiplicity of other mobile terminals is registered with the mobile telecommunications network 3. These mobile terminals include mobile terminals 11 and 13. The terminals 11 and 13 communicate with the mobile telecommunications network 3 in a similar manner to the terminal 1, that is via an appropriate Node B 5, RNC 7 and SGSN 9.

The mobile telecommunications network 3 includes a gateway GPRS support node (GGSN) 17 which enables IP-based communications with other networks, such as the Internet 19 via an appropriate link 21. A multiplicity of terminals are connected to the Internet (by fixed or wireless links), and a PC terminal 23 and a PDA terminal 25 are shown by way of example.

Each of the mobile terminals 1, 11 and 13 is provided with a respective subscriber identity module (SIM) 15. During the manufacturing process of each SIM, authentication information is stored thereon under the control of the mobile telecommunications network 3. The mobile telecommunications network 3 itself stores details of each of the SIMs issued under its control. In operation of the mobile telecommunications network 3, a terminal 1, 11, 13 is authenticated (for example, when the user activates the terminal in the network with a view to making or receiving calls) by the network sending a challenge to the terminal 1,11,13 incorporating a SIM 15, in response to which the SIM 15 calculates a reply (dependent on the predetermined information held on the SIM - typically an authentication algorithm and a unique key Ki) and transmits it back to the mobile telecommunications network 3. The mobile telecommunications network 3 includes an authentication processor 17 which generates the challenge and which receives the reply from the terminal 1, 11, 13.

Using information pre-stored concerning the content of the relevant SIM 15, the authentication processor calculates the expected value of the reply from the mobile terminal 1, 11, 13. If the reply received matches the expected calculated reply, the SIM 15 and the associated mobile terminal are considered to be authenticated.

It should be understood that such an authentication process can be performed for any terminal provided with a SIM 15 under control of the mobile telecommunications network 3. In the embodiment the terminal communicates wirelessly with the mobile telecommunications network 3 via the network's radio access network, although this is not essential. For example, the terminal may communicate with the network via the fixed telephone network (PSTN), via a UMA "access point" and/or via the Internet. The PC 23 and the PDA 25 may also be provided with a SIM 15 under the control of the network.

The SIM 15 used by the terminal 1,11,13,23,25 may be a SIM of the type defined in the GSM or UMTS standards specifications, or may be a simulation of a SIM - that is, software or hardware that performs a function corresponding to that of the SIM. The SIM may be in accordance with the arrangement described in WO-A-2004 036513.

It should be noted that the authentication process being described does not necessarily authenticate the human identity of the user. For example, mobile telecommunication networks have pre-pay subscribers who are issued with SIMs in return for pre-payment, enabling them to use network services. However, the identity of such pre-pay subscribers may not be known by the network. Nevertheless, such a user cannot make use of the network until the network has authenticated the user's SIM - that is, has confirmed that such user is a particular user who has a particular pre-paid account with a network.

The network shown in Figure 1 comprises both the mobile telecommunications network 3 and the Internet 19 (which itself comprises a multiplicity of other networks).

The procedure for transmission of "short messages" is different. The term "short messages" or "SMS messages" as used in relation to the embodiments means short messages as defined in the GSM or 3G standard specifications. Such messages are commonly in the form of text messages of limited maximum length, but they can have other forms, such as in the form of binary data, or may contain configuration data for changing the functional parameters of a mobile. The invention is not limited to the transmission of messages of this "short message" type.

Short messages may be sent to or from mobiles such as the mobiles 1,11,13 and the others belonging to the network 3. However, in addition, short messages may be sent to or from "short message entities" (SMEs) such as shown at 20,20A,20B. These SMEs may be in the form of terminals of various sorts such as fixed terminals for sending short messages of various types to mobiles and for receiving short messages from mobiles. For example, the SMEs may be in the form of terminals associated with banking computers or computers of other types generating information (commercial information, for example) for transmission to mobiles and for receiving short messages in response from mobiles, but may be of many other types, such as application servers of various types.

The network 3 has a short message service centre (SMSC) 26 associated with it. The SMEs 20,20A,20B are connected to the SMSC 26 by fixed networks 30 of suitable type. When a mobile wishes to send a short message, it will do this via the SMSC 26 of its network 3. Thus, for example, if the mobile 1 wishes to send a short message to mobile 11, the short message is automatically addressed by the mobile 11 to SMSC 26, which then delivers the short message to mobile 11 (after registering the necessary details to enable a charge to be made to mobile 1). Each short message therefore carries the address of the local SMSC (this address is automatically generated by the sender), together with the address of the intended destination of the short message. When the local SMSC receives the short message, it then reads the address (the MSISDN or Mobile Station ISDN number or telephone number of the intended destination) and despatches the short message accordingly.

The SMS messages may be secured and authenticated in accordance with the arrangement described in co-pending patent application publication No. GB-A-2415574 which is fully incorporated herein by reference.

In a basic embodiment, the invention allows the straightforward transfer of value between customers, where each customer has a respective virtual account provided on the platform. In accordance with the invention, account transactions are conducted wholly over a telecommunications network (for instance a GSM network). An exchange of SMS transaction messages causes the transfer of funds between one customer account and another customer account, each account being managed by the account management system, thereby allowing money to be sent home or up country without the security risks normally involved with such activities. Furthermore, the customers only require a SIM card to be able to operate such virtual accounts, the SIM card being inserted in a suitable terminal (generally a mobile phone handset) in order to connect to the telecommunication network.

Figure 2 illustrates the interactions between "actors" in a microfinance system. A virtual account management system in accordance with the present invention may be installed in the Data Centre such that customers and operators can access the facilities either through mobile telephone handsets or over a network link (either leased line or internet).

Each customer's virtual account has an associated SIM inbox within which recent transactions are preferably stored, thereby representing the current balance of the virtual account.

Provision is made for the administration of the switched network environment, for customer support and for the maintenance of the data stored in the data centre. Where necessary, a virtual private network (VPN) is established using a VPN concentrator (for example the Cisco 3000). The VPN concentrator allows the creation of a VPN tunnel for the development and administration of the data stored on the data centre remotely. In particular, the provision of a VPN facilitates access by individual organisational partners/customers (eg. microfinance institutions (MFIs), Airtime Dealerships acting as Agents) to their core accounts using an internet connection.

As an alternative to the direction of transaction SMS messages to a SMSC coupled to the wired network, SMS transaction messages may also be directed to an SMSC bureau which routes SMS messages as packets through the internet (as, for example, e-mail under the SNMP, Simple Network Mail protocol).

In addition or as an alternative to the provision of a mobile handset SMS-based interface, the virtual account management system may optionally be accessed via one or more channels within a range of complimentary channels including the Web, GPRS, Unstructured Supplementary Service Data (USSD), and Voice.

In addition to transfer of value between virtual accounts, SMS transaction messages are used to withdraw and deposit cash in a process facilitated by the provision of an Agent account. Approved agents of the account management system, such as telephone credit resellers (or shop owners), are provided with further menu facilities to allow them to verify the withdrawal and/or deposition of physical cash with the agent.

Alternatively, or additionally, the client may buy goods directly without the use of physical cash by transferring funds to a Merchant account. Again the merchant account is a virtual account management system account provided to merchants to allow the sale of goods and services in return for fund transfer from a client account to the merchant.

A typical transaction may be illustrated by referring to the elements of Figure 3. A mobile phone user initiates the transaction by navigating through menus displayed on the screen of his mobile phone 302 to a funds transaction application on the SIM card (installed in the phone 302). Similarly, other users also carry out transactions on the system using their mobile phones 304,306. The user then chooses the appropriate transaction from a funds transaction application menu and enters the requested information such as destination account, amount, PIN, etc. The information is packaged into an encrypted message and then sent via SMS to a Transaction Processor 340. To get to the Transaction Processor 340, the encrypted message must first pass through the network operator's short message service centre – SMSC, 310 and an SMS service module 330. The connection from the mobile phones to the SMSC is made over the mobile network.

The thick lines in Fig 3 represent Message Queues (MQ). MQs can work across computers and allows the two entities at either end to work independently. One entity submits a message, without waiting for a reply, and the other receives and processes it at a later time. For example, the SMS service module 330 can continue to receive SMS messages and relay them to a queue while the Transaction Processor 340 is temporarily turned off for maintenance.

The Transaction Processor 340 is triggered by events such as the arrival of an incoming message or delivery notification, notification of SMSC acceptance of an outgoing message, timer expiration or external request. It determines the correct response to the event and carries it out.

As Figure 3 illustrates, the Transaction Processor 340 can connect simultaneously to more than one SMSC 310,320. This allows for differences in the functionality of different SMSCs. The architecture also allows for multiple SMS Services 330, potentially spread across a plurality of host computers 300, with each SMS Service 330 connected to one or more SMSCs. It also allows for multiple Transaction Processors 340 for scalability.

The Transaction Processor 340 is responsible for accepting incoming requests of different types and handling them through to completion. Each incoming request initiates a new transaction. Before completing, the new transaction may involve one or more steps over a period of time (in some cases, as long as 45 minutes). Consider, for example, a customer initiating a Send Money transaction. When the Transaction Processor 340 receives the request message the Processor verifies the message, queries the main database 350 and, if successful, sends a reply to the customer's mobile phone 302 confirming that the transaction has taken place. Some seconds or minutes later the Transaction Processor 340 receives confirmation of delivery of the reply, confirms the transaction to the transaction database 350 and sends a notification to the recipient.

Often multiple events are grouped together into a single transaction. For example, when a funds transaction-capable SIM is first activated, an SMS message is sent from the SIM to the Transaction Processor 340. The Transaction Processor 340 decrypts and decodes the incoming message to discover that it is an activation request and that it includes the correct PIN for that phone number.

It passes the request on to the Accounting Database 360 and if it approves the activation, passes back an initial menu in several SMS messages, via the SMSC 310 and SMS service module 330. This is delivered as a binary SMS to the SIM Application itself. When successful delivery acknowledgements have arrived for all the SMS messages, the Transaction Processor 340 sends a further, text SMS message to the phone 302 containing the, now activated, SIM telling the user that activation was successful. All these events – the initial message, the notification from the SMSC 310 of the acceptance of the initial menu messages and each of the delivery notifications are grouped together by the Transaction Processor 340 as a single application-level transaction.

In a preferred implementation, the Transaction Processor 340 makes extensive use of the Microsoft [RTM] Enterprise Library, the transactions being MS-DTC level transactions and the incoming events being communicated by means of MSMQ messages. In this case, the Transaction Processor 340 is arranged to ensure that everything from reading a message from a queue, the resulting database processing and any sent messages are all covered by a single, respective, MS-DTC transaction. Therefore, should any error occur during processing, all the work is undone by a single rollback and can be re-started: as a result this implementation is able to cope with database deadlocks.

The Transaction Processor 340 is preferably adapted to nest transactions: using an outer transaction to obtain the next event and an inner transaction to process it. If the inner transaction fails the outer one is preferably allowed to proceed on the grounds that having it fail merely causes the event to be read again and the same error to occur. Only if the inner transaction results in a retryable error does the outer one fail. There is a mechanism for limiting the number of such retries.

The Message Security component 380 is responsible for encrypting and decrypting messages sent between the SIM application (not shown, resident on the user's mobile phone 302) and the Transaction Processor 340. As part of the decoding PINs (and passwords) is verified and new PINs are encrypted in such a way that unencrypted PINs and keys are not exposed outside the Message Security component 380. Each SIM uses a different key for encrypting and decrypting messages. Verification that the appropriate key was used is taken as proof that a message originated on a particular mobile phone 302.

Messages are preferably delivered to the user's mobile phone SIM application as (binary) message programs. This provides a totally secured two-way communication channel, robust against such security threats as "spoofing" of the Account Manager Servers. However, in some cases, SIM card applications are prevented from receiving such SMS messages while menus are being displayed on the screen of the mobile phone 302. In such cases, the system can be configured such that messages sent from the server are sent to SIMs as plain text messages.

In one embodiment, the Message Security component 380 is a COM+ component running as a standalone COM+ server application. In addition to decrypting and decoding messages received from the SIM application and encrypting messages to be sent to the SIM application, the component 380 provides methods for obtaining date and generation information associated with an encrypted PIN; obtaining date and purpose information associated with an encrypted item; encrypting master keys; generating a SIM specific key according to a predefined master key algorithm; encrypting passwords; and verifying passwords against encrypted passwords.

The component 380 uses COM+ role security to limit particular interface methods to particular users. For example, only the service operator can decrypt and encrypt messages for the funds transaction SIM application but the web account user 370 can create PINs.

The particular encryption scheme adopted is selected in accordance with the capabilities of the SIMs used. It is however preferred that all SIMs share a single public key (provided the SIMs support public key encryption). Where this is not possible a SIM specific key may instead be generated from a single shared symmetric key and ID information unique to the SIM. In the latter case, the reliability of the security depends upon the secrecy of the shared symmetric key.

As an example of the inherent flexibility of the Account Manager solution,the inventive system has been configured to support the operation of a microfinance institution, MFI. Figure 4 illustrates the stages in the operation of this embodiment of the invention. The MFI maintains a core virtual account in the Data Centre. In addition, virtual accounts are provided for different roles within a microfinance scheme: field officers, who distribute small loans within communities; clients, virtual account holders who receive loans from the MFI; and group treasurers, whose job it is to verify that loans are being repaid correctly.

When the MFI approves the release of funds for distribution as loans by a field officer, a suitable SMS transaction message is sent. The SMS transaction message effects transfer of funds to the field officer's account. The field officer in turn disperses loans within a group of client accounts. The client accounts are credited with an approved sum, again using an SMS transaction message.

Clients of a particular MFI agree to repay their loan by transferring funds at a pre-determined rate to the account of the group treasurer. This activity is also effected by exchange of secure SMS messages. Finally the group treasurer, once he is satisfied that the correct repayments have been made, transfers the appropriate sum back to the core account of the MFI.

The system of the invention provides two-way secure communication to the SIM via SMS transaction messages. A unique key is provided for each SIM. The system therefore provides complete transparency in terms of which SIM initiates which transaction, facilitating audit and other regulatory functions.

The interface operating on each enabled handset includes an "interpreter". The interpreter is an application similar to a browser. In the above embodiments, each SMS transaction message requesting an account management transaction is constructed through the use of a dialog menu presented by the interpreter, in which the customer is asked to indicate: the target account, the value to be transferred (or withdrawn), the date of transfer and to input security data for authentication. The interpreter is fully customisable over the air. Menus, even the language displayed, can be changed remotely. Each menu item action is effected by a respective mini-programme (for example, Java script running on the browser or an applet). The interface is, furthermore, responsive to server driven events.

The system provides for the different requirements of users of the system. Depending upon the role of the user (e.g. user, agent, treasurer, field officer), the system can be customised with appropriate menus and options. Such updates are conveniently effected by over-the-air updates.

Once generated and sent, the text message is received at a first short message service centre (SMSC), the SMSC is coupled to the switched network environment by means of an SMSC gateway. The SMS transaction message is then transferred by the SMS service across the switched network environment to a transaction processor which interprets the SMS transaction message and, once the SMS has been authenticated, alters the data representing each account affected by the SMS transaction message accordingly, the data being stored in a data centre.

Using the interpreter (with this optional feature enabled), the user is presented with an account inbox, separate from the conventional SMS inbox, whereby he can maintain a transaction history. The account inbox is only accessible through the authentication functionality of the SIM inserted in the handset, so the integrity of the transaction history is assured by SIM authentication.

To confirm the completion of a given transaction, a corresponding transaction completed message is then generated for each account affected by the transaction and the transaction completed message is then encapsulated in an encrypted message which can only be opened correctly by a mobile terminal having a SIM card with the correct decryption key. Effectively the transaction completed message is electronically signed with a key specific to the SIM. The encrypted messages are formatted as SMS messages and delivered via the SMS service to the transaction requesting party and the account owner of the affected account. These SMS messages are delivered to the account inboxes for the respective accounts, so that only the verified user of the SIM can view the transaction status.

In the case where more than one user has access to the handset and a single SIM is shared, further ID and security information may be required. Access provided is then limited to a corresponding account inbox, inaccessible to other users but stored on the SIM nonetheless.

Preferably, Short Message Service Centres (SMSC) upon which the account manager operates, are customisable, in particular in terms of the duration of delay in forwarding any SMS. The service is expandable (supporting multiple SMSCs) and scaleable (storing different phone numbers on the same SMSC, thereby allowing more than one microfinance institution).

The service is preferably also implemented so that it is agnostic with respect to the network infrastructure bearing the transaction messages. A significant capability for the implementation is the ability to remotely host the Servers.

In some implementations, firewall restrictions limit the number of network locations where simultaneous access can be obtained to more than one SMSC. This short-coming can be addressed by implementing a utility application, a message forwarder (see Fig 5), for forwarding MQ messages from a message queue on one computer to the message queue on another computer using protocols that are adapted to cross such firewalls. Since communication between the Transaction Processor 340 and the SMSC 310,320 starts with MQ messages, this utility enables the system to be located elsewhere. Consider the situation when a first data network only allows outgoing connections. In order that the Transaction Processor may be hosted outside the first data network (but still having access to the SMSC of that first data network), the message forwarder must be capable of sending and receiving MQ messages across the firewall preventing incoming connections.

The Message Forwarder consists of two parts, a web service and a client implemented as, for example, a Windows NT Service. The client runs on the computer within the firewall (Computer A) and initiates all calls to the web service running on Computer B. Since web service calls use HTTP, this is allowed. Figure 5 shows how the parts interconnect.

Conveniently, the system is capable of imposing cost-based routing policies ensuring that SMS transaction messages are routed according to predetermined criteria, such as lowest financial cost, shortest distance, or fastest service. In preferred embodiments, the system imposes policies that are updated dynamically, thereby ensuring that the operator can provide the service at least cost. Often, a local mobile service provider will be used for Inbound SMS messages. Primarily, this permits the provision of SMS services that are cost-free for the user. This does also keep costs of SMS traffic low.

Clearly, where price of SMS traffic is less important, there is little restriction on the geographical location: the platform could be implemented and run from anywhere in the world. Roaming access to such services may be provided, where costs are not prohibitive.

For international applications, the database and logic of the virtual account manager are preferably provided with extension applications to cater for currency conversions, language and regulatory differences (e.g. anti-fraud measures).

The architecture of the system means that one-to-many transactions are relatively simple to implement: thus, for example, a single agent transaction can be used to top up three separate virtual accounts.

It is preferred that the Transaction Processor is provided with an SMS multiplexer facility that determines which of several possible SMSCs should be used to deliver any given SMS message.

In addition to facility for handling transaction request from user SIMs and from website access, the Transaction Manager also conveniently has a facility for handling requests for airtime from prepay customers (either for the user himself or on behalf of another user and/or phone). Such requests could originate from within the transaction application menu or from access to a suitable webpage.

In a further enhancement of the invention, the system may request or infer the physical location of the user. With this location information (e.g. the Cell ID), the system can ensure that information provided to the user is relevant to that user's physical context. This allows handsets to be used as a community building tool – advertising locally available resources, etc.

CLAIMS

1. An account management system for maintaining a plurality of virtual accounts in a cellular communications system, the cellular communications system carrying messages between mobile terminals and each mobile terminal including a data card with a unique identifier, the account management system including:

a messaging means which is adapted to receive incoming transaction messages from mobile terminals using the communications system, the incoming messages including the unique identifier of the originating mobile terminal, and transmitting outgoing transaction messages to mobile terminals in response;

a transaction processing means which is coupled to the messaging means and adapted to interpret incoming transaction messages and to output corresponding transaction instructions;

a message security means, coupled to the transaction processor, which authenticates the incoming transaction messages by comparing the included unique identifier to the entries in a list of valid virtual accounts; and

a transaction data store interface, coupled to the transaction processor, through which the transaction processor communicates with a data store, the interface being adapted to convey instructions to amend data held in one or more valid virtual accounts stored in the data store and to convey transaction complete messages from the data store to the transaction processing means when the amendment is complete;

wherein the transaction processing means is also adapted to interpret transaction complete messages and to output corresponding interpreted transaction complete messages to the messaging means;

wherein each interpreted transaction complete message includes security information generated from unique identifiers of amended virtual accounts, the messaging means directing outgoing messages generated from the interpreted transaction complete messages to corresponding mobile terminals; and

wherein each received outgoing message is in a format which requires the input of a unique key from the data card inserted in the mobile terminal, thereby ensuring that the outgoing message can only be read in the presence of a data card with a unique key that matches the security information in the outgoing message.

2. A system as claimed in claim 1, wherein the transaction processing means further includes a reporting component for providing a reporting functionality such that movement of value between the virtual accounts is tracked.

3. A system as claimed in claim 1 or claim 2, wherein the transaction processing means provides a plurality of virtual accounts, each account representing one of a number of distinct roles within a microfinance scheme.

4. A system as claimed in any one of claims 1 to 3, wherein the transaction processing means has additional functionality and wherein remote access to the additional functionality is further protected by requiring the establishment of a virtual private network (VPN).

5. A system as claimed in any one of claims 1 to 4, wherein the messaging means receives incoming transaction messages directly from an SMSC component of the communications system.

6. A system as claimed in any one of claims 1 to 4, wherein the messaging means receives incoming transaction messages from a short message entity, which intercepts incoming transaction messages from the cellular communications system and delivers the incoming transaction messages over an internet interface.

7. A system as claimed in either of claims 5 or 6, wherein the route taken by each incoming transaction messages is determined on a cost-basis in accordance with a predetermined set of cost criteria.

8. A system as claimed in claim 7, wherein the criteria are updated dynamically in response to changes in cost.

9. A method for operating a mobile phone handset suitable for interacting with the system as claimed in any one of the preceding claims, the method including:

providing an interpreter application;

using the interpreter application to render menus for display on the mobile phone;

accepting input transaction information via the menus;

generating incoming transaction messages in accordance with the input transaction information;

transmitting the incoming transaction messages to the system;

receiving outgoing transaction messages from the system; and

displaying confirmation of the completion of transaction on the mobile handset.

10. A method as claimed in claim 9, wherein the step of rendering a menu for display includes the step of receiving a menu message and adapting the menu in response to the contents of the menu message, thereby customising the menu for the different requirements of users of the system.

11. A method as claimed in claim 10, wherein the menu message is received as an over-the-air update.

12. A method as claimed in either of claim 10 or claim 11, further comprising determining the physical location of the handset and generating location based information, wherein the menu message includes location based information appropriate to the physical location of the handset.

13. A method as claimed in any one of claims 9 to 12, wherein the step of accepting input transaction information, includes:

presenting a dialog menu to the user;

prompting the user to input transaction information; and

storing the input transaction information in a format suitable for processing into a transaction message.

14. A method as claimed in claim 13, wherein the input transaction information includes information identifying one or more of the following parameters: the target account; the value to be transferred; the date of transfer; the value to be withdrawn; the date of withdrawal; and security data for authentication.

15. A method as claimed in any one of claims 9 to 14, wherein the step of accepting input transaction information includes a preliminary step of authenticating the attempt to access a given account inbox by means of the authentication functionality of the data card inserted in the mobile telephone handset, whereby the integrity of the transaction history is assured by SIM authentication.

16. A method as claimed in claim 15, wherein the authentication step includes: prompting the user to speak into a microphone provided on the handset; recording a voice input; and comparing the voice input with a verified user voice sample; and confirming the voice as that of the user, thereby authenticating the user with voice recognition.

17. A method for maintaining a plurality of virtual accounts in a cellular communications system, the cellular communications system carrying messages between mobile terminals and each mobile terminal including a data card with a unique identifier, the method comprising:

receiving incoming transaction messages from mobile terminals using the communications system, the incoming messages including the unique identifier of the originating mobile terminal;

interpreting incoming transaction messages;

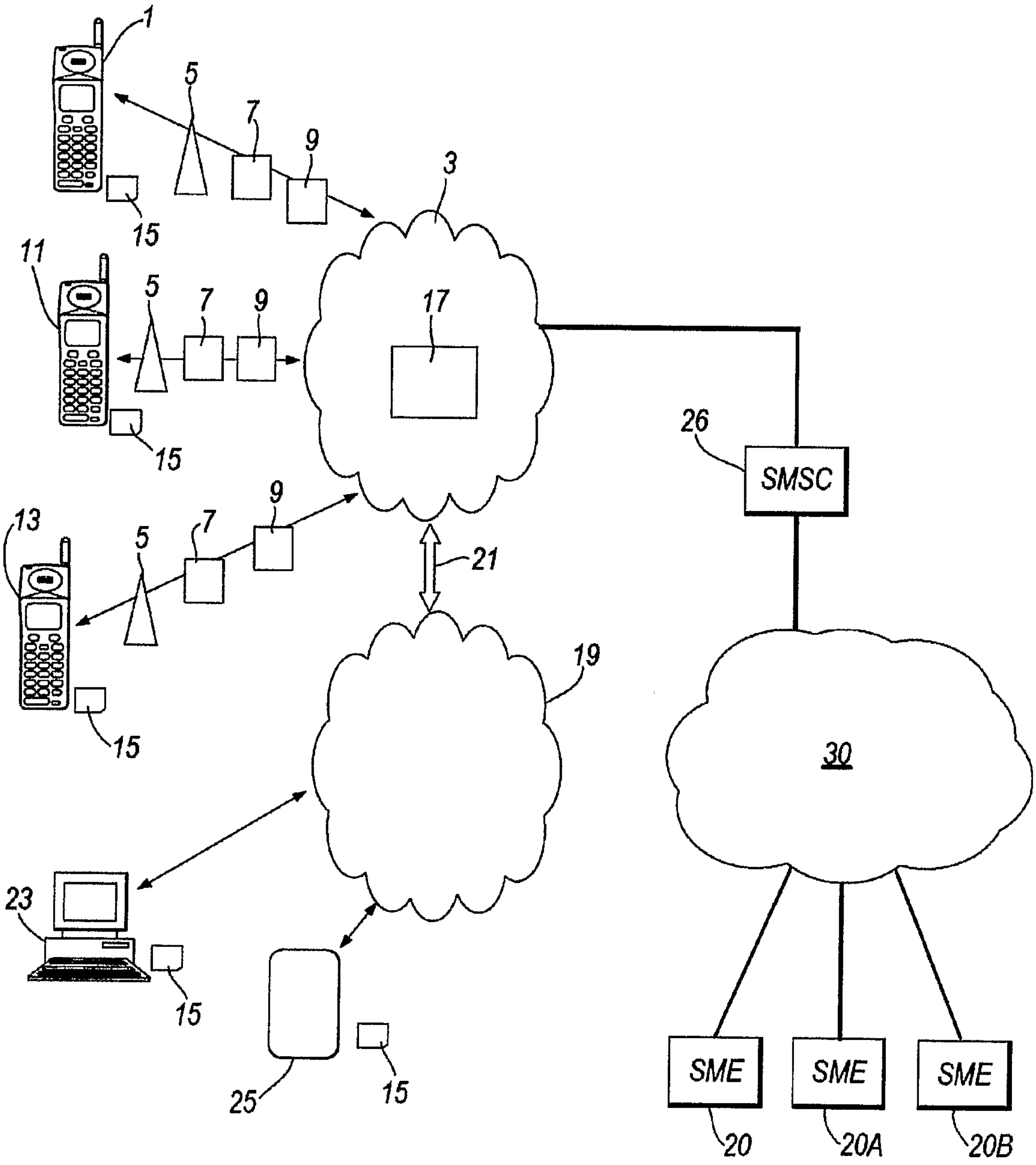
authenticating the incoming transaction messages by comparing the included unique identifier to the entries in a list of valid virtual accounts;

where the incoming transaction messages is authentic, outputting corresponding transaction instructions to amend data held in one or more valid virtual accounts stored in a data store;

receiving transaction complete messages from the data store when the amendment is complete; and

transmitting outgoing transaction messages to the originating mobile terminals, each interpreted transaction complete message including security information generated from unique identifiers of amended virtual accounts;

wherein each received outgoing message is in a format which requires the input of a unique key from the data card inserted in the mobile terminal, thereby ensuring that the outgoing message can only be read in the presence of a data card with a unique key that matches the security information in the outgoing message.


1
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7
9
3
15
11
5
7
9
17
15
26
SMSC
13
5
7
9
21
19
15
30
23
15
25
15
SME
SME
SME
20
20A
20B

Figure 1

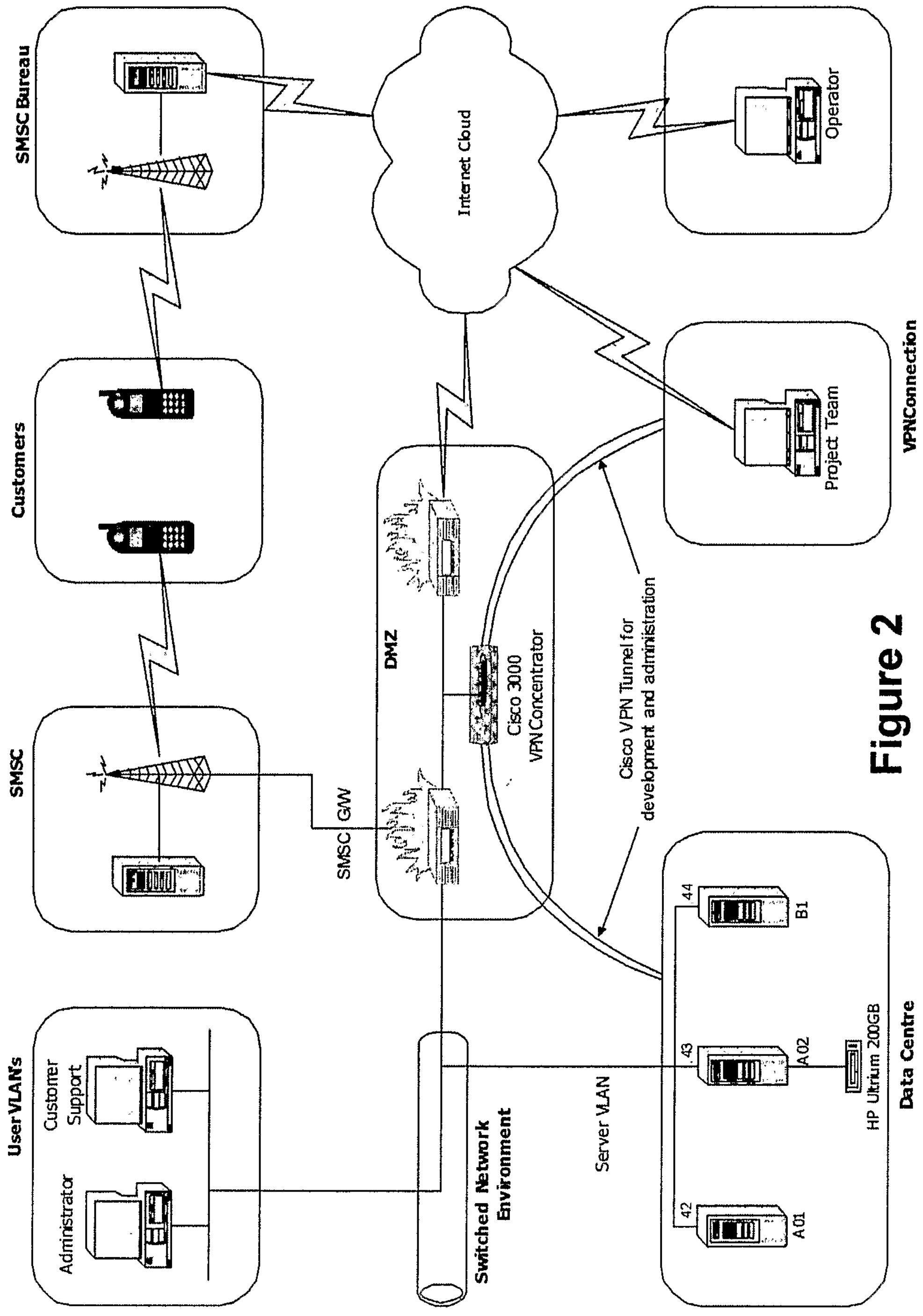
SMSC Bureau
Internet Cloud
Operator
Customers
VPNConnection
Project Team
DMZ
Cisco 3000
VPN Concentrator
Cisco VPN Tunnel for
development and administration
SMSC
SMSC G/W
User VLAN's
Customer
Support
Administrator
Switched Network
Environment
Server VLAN
Data Centre
42
A01
43
A02
44
B1
HP Ultrium 200GB

Figure 2

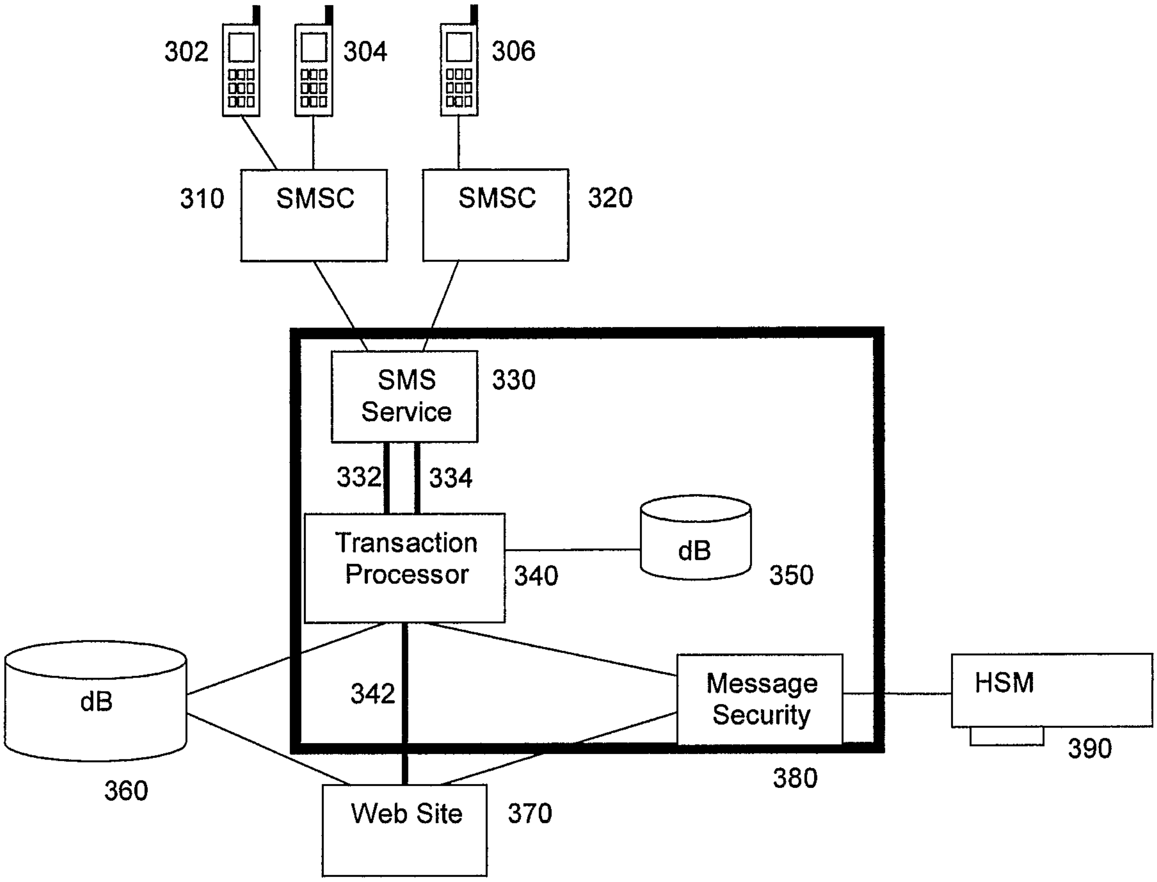
302
304
306
310
SMSC
SMSC
320
SMS Service
330
332
334
Transaction Processor
340
dB
350
dB
360
342
Message Security
380
HSM
390
Web Site
370

Figure 3

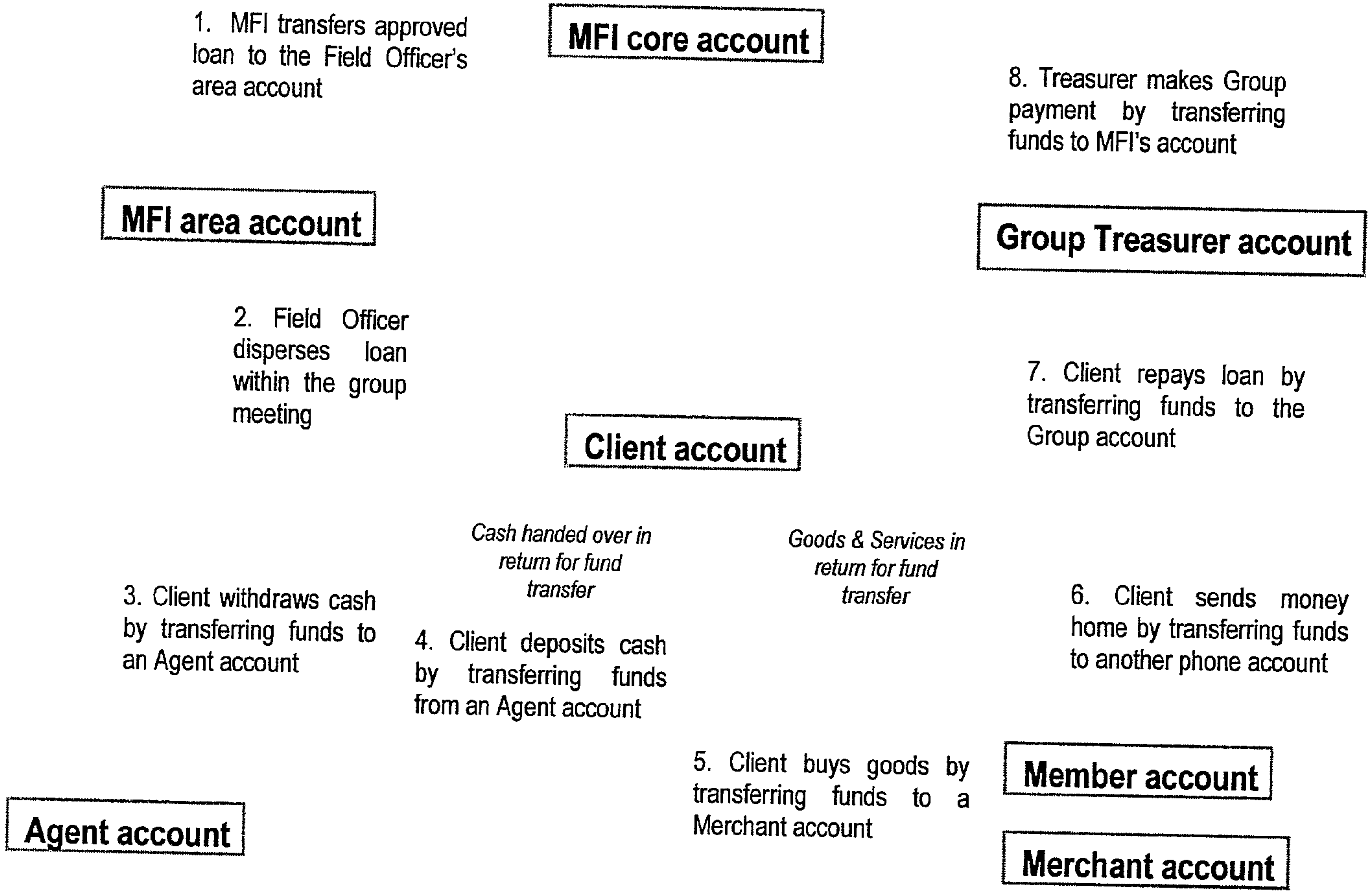
1. MFI transfers approved loan to the Field Officer's area account
MFI core account
8. Treasurer makes Group payment by transferring funds to MFI's account
MFI area account
Group Treasurer account
2. Field Officer disperses loan within the group meeting
7. Client repays loan by transferring funds to the Group account
Client account
Cash handed over in return for fund transfer
Goods & Services in return for fund transfer
3. Client withdraws cash by transferring funds to an Agent account
4. Client deposits cash by transferring funds from an Agent account
6. Client sends money home by transferring funds to another phone account
5. Client buys goods by transferring funds to a Merchant account
Member account
Agent account
Merchant account

Figure 4

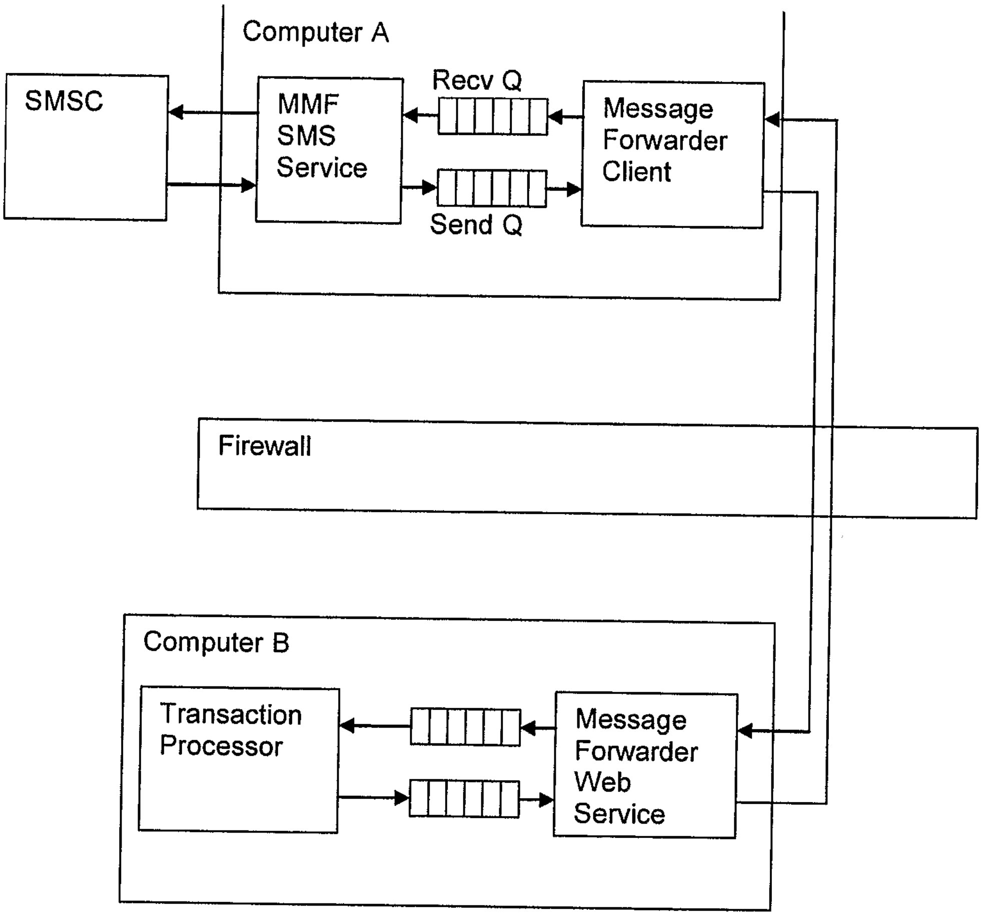
Computer A
SMSC
MMF SMS Service
Recv Q
Send Q
Message Forwarder Client
Firewall
Computer B
Transaction Processor
Message Forwarder Web Service

Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002997

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q20/00 H04M15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 00/67177 A2 (X COM CORP [US]) 9 November 2000 (2000-11-09) page 6, line 20 - page 16, line 30 page 21, line 5 - page 24, line 15 figures 1-3 -----	1-17
Y	WO 2005/004069 A (MOBIPAY INTERNATIONAL S A [ES]; GARCIA RUANO LUCIA [ES]; SANCHEZ SANTO) 13 January 2005 (2005-01-13) page 72, lines 16-25 page 115, line 20 - page 120, line 25 page 141, line 6 - page 148, line 18 claim 1; figures 1,8 -----	1-17
A	EP 1 510 983 A (SIEMENS AG [DE]) 2 March 2005 (2005-03-02) column 4, line 12 - column 10, line 15 figures 1-4 ----- -/--	1-17

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search 3 November 2006	Date of mailing of the international search report 14/11/2006
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Authorized officer Kanlis, Angelos

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002997

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	GB 2 372 615 A (MACNAMEE ROBERT JOSEPH GERARD [GB]) 28 August 2002 (2002-08-28) abstract Sections 1.1.5, 2.1, 2.2.1, 2.2.2, 2.2.3 figures 1,2,4-6 -----	1-17
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A	LAWTON G: "BIOMETRICS: A NEW ERA IN SECURITY" COMPUTER, IEEE SERVICE CENTER, LOS ALAMITOS, CA, US, vol. 31, no. 8, August 1998 (1998-08), pages 16-18, XP000780511 ISSN: 0018-9162 Section "Voice authentication" -----	16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/002997

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			AU	2003282212	A1	04-05-2004
			EP	1552444	A1	13-07-2005
			EP	1552661	A1	13-07-2005
			EP	1552484	A1	13-07-2005
			WO	2004036467	A1	29-04-2004
			WO	2004036866	A1	29-04-2004
			JP	2006506755	T	23-02-2006
			JP	2006505074	T	09-02-2006
			JP	2006506756	T	23-02-2006
			US	2006107037	A1	18-05-2006
			US	2006112275	A1	25-05-2006