DYNAMIC CURRENCY CONVERSION SYSTEM AND METHOD

BACKGROUND

The present invention relates to a card-based system that can offer a user (e.g. a payment card holder) an alternative currency for payment.

A typical transaction terminal system, for example an automatic teller machine, a point of sale terminal, a workstation of the like, will offer transactions in a currency local to the transaction terminal system. However, sometimes users would wish to make a transaction in an alternative currency.

There is a need automatically to identify payments for which a user may wish to make a payment in a currency other than the currency local to the transaction terminal system. Some approaches to provide for the automatic determination of a currency for Dynamic Currency Conversion (DCC) have been proposed.

On regular basis, DCC service providers receive card account range update files from Card Schemes via their respective DCC acquirers, e.g., an Account Billing Currency File from VISA and Account Range File (GCMS Table IP0040T1) from MASTERCARD. Such card account range update files contain information to assist DCC Acquirers and their respective DCC service providers to correctly determine the cardholder's billing currency such as:

- Account Range – Low
- Account Range – High
- Bank Identification Number (BIN) or Issuer Identification Number (IIN)
- Cardholder Billing Currency Code.

It is known to use this information at two stages of the DCC service process:

The first stage is DCC service eligibility detection. This is a step in a process when it is determined whether the card holder of a card is eligible to benefit from a DCC service, that is, if the card of the cardholder issued in a currency other than the local currency for a front-end payment acceptance device, such as Point-of-Sale (POS) terminal or payment web-page for e-Commerce transactions.

At this stage, when a payment card is presented at the front-end payment acceptance device, the card number can be validated with this information to confirm if the card is eligible for DCC service.

To reduce the time required to download the Local Currency Table to the front-end payment acceptance device, it is known to download only the first 6-digits of the Account Range (Low) number or the BIN instead of the whole range. In this regard, it is to be noted that the certain card range may be issued in a country in a currency different from the currency normally associated with a given country or the country's default national currency. For example, a corporate card may be issued in one country in a currency different from the default national currency for that country.

If an approach of downloading only the first 6 digits or BIN is adopted, then a typical Local Currency Table downloaded to front-end payment acceptance device may look like one presented below.

516000

516310

516319

516323

516326

The second stage is DCC billing currency code look-up stage. At this stage, one known approach is to use a portion of the card number to perform a look up for the corresponding Billing Currency Code, and to determine an appropriate exchange rate to be offered for the DCC service. Instead of maintaining the full range for look-up, WO/01/04846 discloses an approach that includes identifying an issuer identifier code from a payment card number and comparing this to entries in a table containing issuer identifier codes and a corresponding currency code to determine an operating currency for association with a card transaction.

With the exponential growth of payment cards issued in the past 10 years, the number of records in the card account range file has grown substantially. Such growth introduces the following technical problems to the DCC service providers:

As the numbers of records in the card account ranges increases, larger local currency tables need to be downloaded to a front-end payment acceptance device. For example, six digits may not be sufficient uniquely to identify the billing currency of a

payment card. Despite the advancement in POS terminal technology and communication infrastructure, memory storage constraints at a POS terminal and telecommunication bottle-necks (in particular for a POS terminal connected to a packet switched telephone networks (PSTNs)) are continuing to be significant problem in payment industry. There is a need to minimise the size of the local currency table to avoid a long download time and a high storage requirement at the front-end payment acceptance device.

Similarly, as the number of records in the card account ranges increases, larger account range file are needed for currency code look-up. As mentioned above, six digits may not be sufficient uniquely to identify the billing currency of a payment card. Although this stage is typically conducted on a DCC provider's host system, and advancement in hardware and database technology can mitigate time loss due to longer look-up, there is still a need to optimize account range files to improve the response times and as a result a shorter waiting time for the cardholder.

SUMMARY

One aspect of the invention provides a transaction terminal system. The transaction terminal system comprises an input interface to receive payment carrier data for a payment carrier, including at least a payment carrier number for the payment carrier. A communications interface is provided to connect to a remote host system. Range storage defines payment carrier number ranges, wherein the payment carrier number ranges define at least one of: a plurality of first consolidated payment carrier number ranges for which an assigned billing currency is a reference currency for the transaction terminal system, or a plurality of second consolidated payment carrier number ranges for which an assigned billing currency is not the reference currency for the transaction terminal system. At least one consolidated payment carrier number range is defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers associated with a given currency to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers associated with the given currency. Transaction terminal system processing means is operable to compare at least part of an input payment carrier number and the first and/or second payment carrier number ranges to determine whether an input payment carrier number falls within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system or within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system. Where the transaction terminal system processing means determines that the input payment carrier number does not fall within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system, and/or where it is determined input payment carrier number falls within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system, the processing means transmits a rate request message that identifies at least part of the payment carrier number to the host system to identify a billing currency for the payment carrier and a billing currency conversion rate; and receives a rate response message from the host system identifying the payment carrier billing currency and the billing currency conversion rate.

Another aspect of the invention provides a host system. The host system comprises a host communications interface to connect to a transaction terminal system. Billing

currency storage defines, for each of a plurality of billing currencies, a plurality of consolidated payment carrier number ranges for which an assigned currency is the billing currency, wherein at least one consolidated payment carrier number range is defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers associated with the billing currency to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers associated with the given currency. Currency conversion rate storage identifying conversion rates between currencies. Host system processing means is responsive to receipt of a rate request message from the transaction terminal system identifying at least part of a received payment carrier number. The processing means compares at least part of the input payment carrier number to the payment carrier number ranges defined in the billing currency storage to identify in which payment carrier number range the received payment carrier number lies, identifies a billing currency associated with that received payment carrier number and identifies a currency conversion rate between a reference currency for the transaction terminal system that sent the rate request message and an identified billing currency for the payment carrier number. The processing means generates a rate response message to be sent to the transaction terminal system identifying the payment carrier billing currency and the billing currency conversion rate.

A dynamic currency conversion system can include at least one such transaction terminal system and at least one such host system.

A further aspect of the invention provides a computer system operable to generate consolidated payment carrier number ranges for such a transaction terminal system and/or such a host system. The computer system comprises storage for received payment carrier number ranges, each payment carrier number range being defined by a range of consecutive payment carrier numbers extending from a lowest payment carrier number for the payment carrier number range to a highest payment carrier number for the payment carrier number range. Processing means is operable to consolidate received payment carrier number ranges to generate a consolidated payment carrier range, in order to generate at least one consolidated payment carrier number range defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers. Storage is provided for the consolidated payment carrier number ranges.

A method of operating such a transaction terminal system can comprise: an input interface receiving payment carrier data for a payment carrier, including at least a payment carrier number for the payment carrier and transaction terminal system processing means comparing at least part of an input payment carrier number and first and/or second consolidated payment carrier number ranges to determine whether an input payment carrier number falls within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system or within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system. The transaction terminal storage holds at least one of a plurality of first consolidated payment carrier number ranges for which an assigned billing currency is a reference currency for the transaction terminal system, or a plurality of second consolidated payment carrier number ranges for which an assigned billing currency is not the reference currency for the transaction terminal system, where at least one consolidated payment carrier number range is defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers associated with a given currency to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers associated with the given currency. Where it is determined that the input payment carrier number does not fall within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system, and/or where it is determined input payment carrier number falls within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system, the method further includes transmitting a rate request message that identifies the payment carrier number to the host system to identify a billing currency for the payment carrier and a billing currency conversion rate and receiving a rate response message from the host system identifying the payment carrier billing currency and the billing currency conversion rate.

A method of operating such a host system can comprise receiving, at a host communications interface, a rate request message from a transaction terminal system. Host system processing means can respond to receipt of a rate request message from the transaction terminal system identifying a received payment carrier number by comparing at least part of an input payment carrier number to consolidated payment carrier number ranges defined in billing currency storage to identify in which payment carrier number

range the received payment carrier number lies, and to identify a billing currency associated with that received payment carrier number. The billing currency storage defines for each of a plurality of billing currencies, a plurality of consolidated payment carrier number ranges for which an assigned currency is the billing currency, wherein at least one consolidated payment carrier number range is defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers associated with the billing currency to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers associated with the given currency. The method can further include the host system processing means identifying a currency conversion rate between a reference currency for the transaction terminal system that sent the rate request message and an identified billing currency for the payment carrier number from currency conversion rate storage identifying conversion rates between currencies, and generating a rate response message to be sent to the transaction terminal system identifying the payment carrier billing currency and the billing currency conversion rate.

A method of controlling such a computer system to generate consolidate payment carrier number ranges can comprise: storing in computer system storage, received payment carrier number ranges, each payment carrier number range being defined by a range of consecutive payment carrier numbers extending from a lowest payment carrier number for the payment carrier number range to a highest payment carrier number for the payment carrier number range. Processing means of the computer system consolidates received payment carrier number ranges to generate at least one consolidated payment carrier number range defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers. The consolidated payment carrier number ranges are stored in computer system storage.

Aspects of the invention can be implemented by one or more computer program products comprising program code operable to carry out such methods. The comprise program product can include a computer readable medium or carrier carrying the program code.

Although various aspects of the invention are set out in the accompanying claims, other aspects of the invention include any combination of features from the described embodiments and/or the accompanying dependent claims with the features of the

independent claims, and not solely the combinations explicitly set out in the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments are described, by way of example only, with reference to the accompanying drawings.

Figure 1 is a schematic block diagram illustrating an example of a configuration of a card payment system providing dynamic currency conversion.

Figure 2 is a block diagram illustrating an example of a transaction terminal system.

Figure 3 is a block diagram illustrating an example of a dynamic currency conversion host system.

Figure 4 is a flow diagram illustrating the generation of range tables for use in transaction terminal system of Figure 2 and the host system of Figure 3;

Figure 5 illustrates in more detail part of the process of generating the range tables.

Figure 6 is a flow diagram illustrating part of the operation of the transaction terminal system of Figure 2;

Figure 7 is a flow diagram illustrating part of the operation of the host system of Figure 3.

DETAILED DESCRIPTION

Example embodiments of the invention are described hereinafter that aim to provide efficient use of network bandwidth and storage utilisation by consolidating payment carrier number ranges to generate a consolidated payment carrier number range defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers.

Figure 1 is a schematic block diagram illustrating an example system employing payment carriers in the form of a payment card system 100. In the present description, reference is made throughout to a payment card for convenience as common form of payment carrier. A payment card could be credit, debit, or other form of payment card. However, rather than a payment card, the means to effect the payment may be other than a

card. For example, it has been suggested to base payment systems on mobile telephones, personal data assistants (PDAs), or other form of tokens to effect payment. Accordingly, where reference is made in the description to a payment card, it is to be understood that the payment card may be replaced by another form of payment carrier, for example a mobile telephone, a PDA, or the like that is configured to conduct payment transactions, for example by appropriate software and a mechanism for transferring information to and from a payment terminal system (for example in a contactless manner). Accordingly, references to a payment card are to be interpreted as an example of a payment carrier.

Figure 1 illustrates a transaction terminal system (or transaction station system) 10 that includes card payment functionality and additionally includes dynamic currency conversion (DCC) system functionality. The transaction terminal system 10 can be configured as a point of sale terminal located, for example, in the premises of a retailer, or may, for example, be an automated teller machine.

The transaction terminal system 10 can include one or more interfaces for receiving card payment and purchase details. The transaction terminal system 10 is in communication via a communications network (for example via the Internet, a telephone network or another network) with a computer system 12 of a bank that provides banking services for the retailer, hereinafter referred to as an acquirer bank system 12. As a part of processing a card payment, the transaction terminal system 10 generates a payment authorisation request message 20.

The acquirer bank system 12 can include one or more computers. The acquirer bank system 12 can be operable to receive the payment authorisation request message 20 from the transaction terminal system 10 and to return an authorisation response message 30 in due course to the transaction terminal system 10. The acquirer bank system 12 is further in communication via a communications network (for example via the Internet, a telephone network or another network) with a network 14 of computer systems of a payment card operator (hereinafter referred to as the scheme network system 14). Although only one scheme network system 14 is shown in Figure 1, the acquirer bank system 12 will be in communication with respective scheme networks systems for respective payment card operators.

The acquirer bank system 12 is operable to analyse a payment authorisation request message 20 received from the transaction terminal system 10 to determine an appropriate

scheme network system 14 for the card concerned and to forward a payment authorisation request message 22 to the appropriate scheme network system 14.

The scheme network system 14 can be operable to receive the payment authorisation request message 22 from the acquirer bank system 12 and to return an authorisation response message 28 in due course to the acquirer bank system 12. The scheme network system 14 is further in communication via a communications network (for example via the Internet, a telephone network or another network) with a computer system 16 of a financial institution that issued the payment card (hereinafter referred to as the issuing financial institution system). Although only one issuing financial institution system 16 is shown in Figure 1, the scheme network system 14 can be in communication with respective issuing financial institution systems 16 for respective issuing financial institutions.

The scheme network system 14 can be operable to analyse the received payment authorisation request message 22 to identify the issuing financial institution that issued the payment card. The scheme network system 14 is then operable to forward a payment authorisation request message 24 to the issuing financial institution system 16 concerned, and to receive a response message 26 from the issuing financial institution system 16.

The issuing financial institution system 16 can be operable to receive the payment authorisation request message 24, to process the authorisation request by comparing the details of the payment request to records held for the payment card concerned, and then to transmit an appropriate authorisation response message 26 to the scheme network system 14. The authorisation response message includes various details including confirmation as to whether the payment is authorised or not. The authorisation response message 26 is then forwarded via the scheme network system 14, the acquirer bank system 12 to the transaction terminal system 10.

In the following, further detail will be given of rate request and rate response messages passed between the transaction terminal system 10 and the DCC host system 18 to determine whether a DCC operation is to be performed.

On confirmation of a currency for a transaction, the transaction terminal system 10 can be operable to transmit an authorization request message or a financial presentment request message or a financial presentment advice message or clearing message (e.g. for

the card holder's home or billing currency message) to the issuing financial institution 16 via the acquirer bank system 12 and the scheme network systems 14.

Figure 2 is a schematic block diagram of an example of a transaction terminal system 10. The example transaction terminal system 10 illustrated in Figure 2 includes one or more processors 40, storage 42 (which can include volatile and non-volatile memory and storage), for the storage of programs and data. Figure 2 illustrates that the storage 42 can include, for example, a card processing application forming a card processing (CP) application module 44, a DCC application forming a DCC module 46 and reference country and/or currency information 48, a local currency card file 49 that identifies cards that have been issued in a currency local to the terminal and/or a foreign currency table 47. It should be noted that the storage 42 can contain other applications and data.

The reference country/currency information 48 can be held, for example as an ISO country code and an alpha currency code and/or a numeric currency code in a file in the storage 42 or in a register.

In an example embodiment the local currency file 49 is implemented as a range table, generated in manner to be described with reference to Figure 4. The local currency file 49 identifies one or more ranges of payment card numbers that have been issued by banks and other financial institutions with the local currency of the transaction terminal system 10 as the billing currency for the payment card, whereby the user (card holder) for a payment card having a number in the one or more ranges in the local currency file would not be eligible for dynamic currency conversion. Individual entries in the local currency file can include fields such as, for example, one or more of the following fields for:

a lower value of card account number range;

a upper value of card account number range;

an alpha local currency code (e.g. a 2-3 character alpha ISO currency code);

a numeric local currency code (e.g. a 3-digit numeric ISO currency code);

a local country code (e.g. an ISO country code).

In an example embodiment the foreign currency file 47 is implemented as a range table, generated in manner to be described with reference to Figure 4. The foreign currency file 49 identifies ranges of payment card numbers that have been issued by banks and other financial institutions with a currency other than the local currency of the

transaction terminal system 10 as the billing currency for the payment card, a payment card having a number in the one or more ranges in the foreign currency file would be eligible for dynamic currency conversion. Individual entries in the foreign currency file can include fields such as, for example, one or more of the following fields for:

a lower value of card account number range;

a upper value of card account number range;

an alpha foreign currency code (e.g. a 2-3 character alpha ISO currency code);

a numeric foreign currency code (e.g. a 3-digit numeric ISO currency code);

a country code (e.g. an ISO country code).

Figure 2 also represents, schematically, a keyboard/keypad 50, a scanner 52 and a card reader 54. The keyboard/keypad 50 can be keyboard/keypad with separate keys, or can be configured as a touch screen keyboard/keypad and can be used for the input of numerical and/or other characters as appropriate. The scanner 52 can, for example be a bar code scanner, an RFI tag scanner or the like. The card reader 54 can be configured to read data from a payment card. The card reader 54 can be a magnetic stripe reader, a chip card reader, a contactless reader for a contactless payment card, an RFI tag reader, etc., as appropriate. Also, where appropriate, the card reader 54 can also be operable to write information to a suitably configured payment card. The transaction terminal system 10 can also be configured with an appropriate interface to interact with other sorts of payment carriers (for example mobile telephones or PDAs), for example using contact-based or contactless data exchange to receive data from a payment carrier and/or to transmit information to a payment carrier.

Figure 2 further represents, schematically, a display 56, a printer 58 and a communication interface 62. The display 56 can be a numeric display, an alphanumeric display, an image display, etc. as appropriate to display input data and/or messages to assist the user (e.g. a payment card holder) and/or a retailer/merchant in operation of the transaction terminal system 10. The printer can be used for printing purchase receipts and/or other information. The communications interface 60 enables communications via one or more communications channels 62 from the transaction terminal system 10 to the DCC host system 18, either directly or via an intermediate network (not shown).

In the example described above, the transaction terminal system 10 is an automated teller system or a point of sale system. However, it should be understood that the

transaction terminal system 10 could also be in the form of a workstation connected to the Internet. The transaction terminal system 10 may also be fully or partially integrated into the transaction system of a hotel, theatre, retail establishment, or the like.

Figure 3 is a schematic block diagram of an example of a DCC host system 18. The example DCC host system 18 illustrated in Figure 3 includes one or more processors 70, storage 72 (which can include volatile and non-volatile memory), for the storage of programs and data. Figure 3 illustrates that the storage 72 includes one or more DCC programs forming a DCC module 76 and one or more data tables including a billing currency file 75, currency conversion, or exchange rate tables 74, a country to currency table 77 and a default currency table 73. It should be noted that the storage 72 can contain other applications and data.

The billing currency file 75 can, for example, be in the form of a billing currency file (BCF 75) generated in manner to be described with reference to Figure 4 that can have entries that can include various fields, including, for example, fields for:

an account billing file identifier;

a lower value of card account number range;

a upper value of card account number range;

an alpha billing currency code (e.g. a 2-3 character alpha ISO currency code);

a numeric billing currency code (e.g. a 3-digit numeric ISO currency code);

an indication as to whether the billing currency is a DCC supported currency.

The exchange rate tables 74 can contain information from which current exchange rate data can be extracted. A header entry in the exchange rate table can include various fields, including for example, one or more of the following fields for:

an outgoing file prefix;

a file identifier;

a start effective date;

a start effective time;

a base currency code (e.g., using an ISO currency code);

a country code (e.g., using an ISO country code);

a file sequence number (e.g., 001, unless more than one file for the date);

a file extension (e.g., DAT).

A volume in the exchange rate tables 74 can include various fields, including, for example, one or more of the following fields for:

a volume header;

a start effective date;

a start effective time;'

a Rate ID.

Individual exchange rate entries in the exchange rate tables 74 can include various fields, including, for example, one or more of the following fields for:

an alpha currency code (e.g., an ISO standard 3 character alpha code);

a numeric currency code (e.g., an ISO standard 2-3 character numeric code);

a Euroband indicator (e.g. a flag to indicate whether the currency is a Euroband currency);

an exchange rate (e.g., a rate of exchange rounded to 4 decimal places);

a merchant FX-rate category (e.g., to indicate FX-rate risk profile for merchant);

a valid from date (e.g., the date from which the exchange rate is valid);

a valid from time (e.g., the time on that date from which the exchange rate is valid);

a valid to date (e.g., the date after which the exchange rate is not valid);

a valid to time (e.g., the time on that date after which the exchange rate is not valid);

a markup percentage value (e.g., percentage value to mitigate exchange rate risk);

a markup precision value (e.g., to indicate a markup decimal place precision).

A final field in the exchange rate tables 74 can include various fields, including, for example, one or more of the following fields for:

a trailer line;

a checksum on the currency code field

a checksum on the exchange rate field;

a record count.

A country to currency table 77 is used to map between a country and its official currency. Typically one official national currency is associated with per country, but there may be multiple countries associated with one official national currency, e.g. EURO. In one example, the country to currency table is arranged by country and each entry for a country identifies an official national currency associated therewith. In this example, each

entry can include one or more fields including, for example, one or more of the following fields:

a country code (e.g., an ISO country code);

an alpha currency code (e.g., an ISO standard 3 character alpha code);

a numeric currency code (e.g., an ISO standard 2-3 character numeric code).

The default currency table 73 can be used to identify a default currency to be used for a transaction. The default currency table 73 can include, for example, a mapping between a non-supported DCC currency indicated in the billing currency file and a default supported DCC currency and can be used in certain circumstances to identify a default DCC currency to be used when a payment card is used that was issued for a currency that is not supported by the transaction terminal system 10 and/or the dynamic currency conversion system. It can also be used in certain circumstances to identify a default DCC currency to be used for a payment card that is not issued for the local currency for the transaction terminal system 10. In one example, the default currency table 73 is arranged by input currency (e.g. the currency local to the terminal payment system and/or a non-supported currency, etc.) and each entry for an input currency identifies a corresponding default currency associated therewith. In this example, each entry can include one or more fields including, for example, one or more of the following fields:

an alpha input currency code (e.g., an ISO standard 3 character alpha code);

a numeric input currency code (e.g., an ISO standard 2-3 character numeric code);

an alpha default currency code (e.g., an ISO standard 3 character alpha code);

a numeric default currency code (e.g., an ISO standard 2-3 character numeric code).

Figure 3 also represents, schematically, a keyboard 78 and a display 80. The keyboard 78 can be keyboard with separate keys, or can be configured as a touch screen keyboard and can be used for the input of numerical and/or other characters as appropriate. The display 80 can be a numeric display, an alphanumeric display, an image display, etc. as appropriate to enable an operator to view system data.

Figure 3 further illustrates a printer 82 and a communications interface 84. The printer can be used for printing system data. The communications interface 84 enables communication via one or more communication channels 86 with the transaction terminal system 10 and the acquirer bank system 12, either directly or via intermediate networks (not shown).

Figure 4 is a flow diagram illustrating an example of a process for generating the local and foreign currency files 49 and 47 of Figure 2 and the billing currency file 75 of Figure 3.

As illustrated in Figure 4, the process 100 starts at 110. The process 100 can be performed by the processor (s) of the DCC host system 18, or can be performed by a separate computer system. When describing Figure 4, for convenience, where reference is made to the "system" performing the steps of the method, it is to be understood that this refers to the processor(s) of the DCC host system 18, or a separate computer system, as appropriate, performing those steps.

At 112, the system receives account files from a scheme operator. The account files can be in the format for example, or card account range update files as described in the introduction.

The present method provides a way of consolidating this range information in a manner that enables the generation of look up tables that can be used in an efficient manner to identify a currency code that is associated with a given card number, without needing to store all of the range information provided by the scheme operators.

In step 114, the system is operable to sort the ranges according to the consecutive account ranges based, for example, on the lower values of the card account ranges (i.e., the numbers in the left hand column of Table 1 below). For example, in the present example, the files can be sorted with the consecutive ranges of card numbers ordered in numerical order based on the lower values of the card account ranges. If, as mentioned in the introduction, the range information supplied by the scheme operator separates the BIN number for the account range low and account range high values, then the BIN can be added as higher significant digits to the account range low and account range high numbers and then the sort can be performed. The result of step 114 can, for example be files ordered as shown in Table 1 for currency code 036, with appropriate sets of ranges for other currency codes.

It should be noted that Table 1 gives an example illustration of such information, it being understood that the actual data shown is constructed for purpose of illustration only.

TABLE 1

Account Range – Low	Account Range - High	Billing Currency Code
5160000000000000000	5160099999999990000	036
5163100000000000000	5163109999999990000	036
5163190000000000000	5163219999999990000	036
5163230000000000000	5163249999999990000	036
5163260000000000000	5163269999999990000	036
5163290000000000000	5163309999999990000	036
5163390000000000000	5163409999999990000	036
5163480000000000000	5163489999999990000	036
5163500000000000000	5163509999999990000	036
5163590000000000000	5163609999999990000	036
5163700000000000000	5163709999999990000	036
5163790000000000000	5163809999999990000	036
5163850000000000000	5163859999999990000	036
5163890000000000000	5163899999999990000	036
5169990000000000000	5169999999999990000	036
5313500000000000000	5313509999999990000	036
5313550000000000000	5313569999999990000	036
5313580000000000000	5313599999999990000	036
5353170000000000000	5353171099999990000	036
5402150000000000000	5402159999999990000	036
5404820000000000000	5404829999999990000	036
5430480000000000000	5430489999999990000	036
5430490000000000000	5430499999999990000	036
5430600000000000000	5430609999999990000	036
5435680000000000000	5435689999999990000	036
5436040000000000000	5436049999999990000	036
5437930000000000000	5437935699999990000	036

As illustrated in Table 1, the card account range update files contain information which can include, for example, for each entry in the range, the lowest point in an account range, a highest point in an account range and a card holder billing currency code. A number of the higher order digits identify a range of card numbers issued by a given financial institution and the remaining lower order digits identify individual card numbers within the range of card numbers.

The part of the card numbers (i.e. the number of higher order digits) used uniquely to identify a currency code associated with a financial institution may comprise a variable number of digits, not just the 5 or 6 digits of the traditional Bank Identification Number (BIN). This is due to the way that the number ranges are allocated by the scheme operators, and takes into account factors such as, for example, the varying sizes of financial institutions. Currently, for example, rather than 5 or 6 digits, it may take up to 11 digits to identify a range of consecutive card numbers that are allocated to a given currency code for a given financial institution.

This is illustrated, for example in Table 2. Here, it will be noted that it takes 11 digits to identify that a card number relates to the second range of card numbers 52139110441000000000 to 52139120219999999999 corresponding to currency code 946, rather than relating to the range 52139110440000000000 to 52139110440999999999 corresponding to currency code 840.

TABLE 2

Account Range – Low	Account Range - High	Billing Currency Code
5213911044000000000	5213911044099999999	840
5213911044100000000	5213912021999999999	946
5213912022000000000	5213912022099999999	978
5213912022100000000	5213919999999999999	946
5218608000000000000	5218608999999999999	978
5218609000000000000	5218609999999999999	840
5218618000000000000	5218618999999999999	978
5218619000000000000	5218619999999999999	840
5116821100000000000	5116821109999999999	978
5116822100000000000	5116822109999999999	826
5116827100000000000	5116827199999999999	826
5116828100000000000	5116828199999999999	826
5116829100000000000	5116829199999999999	826

In step 116, the system consolidates account ranges for a given billing currency to provide consolidated ranges having consecutive payment card numbers from a lowest card account number to a highest card account number in the range for a given billing currency. The consolidation of step 116 results in information about respective bank identification numbers being lost in the ranges. However, this does not matter as the bank identification numbers are no longer relevant to the organisation of the consolidated ranges. However, the present invention is based on the realisation that the identification of the individual financial institutions is not relevant to the process of determining eligibility for DCC and also for identifying appropriate billing currencies to perform a DCC operation.

The consolidation performed in step 116 can be performed in multiple passes, as illustrated, for example, in Figure 5. Figure 5 illustrates the reordered ranges represented as a file 166-0-0 for the ranges of card numbers (e.g., for the ranges as shown in Table 1 are all associated with the currency code 036). Additional files 166-N-0 (where N= 1 to n-1) can be processed in a similar manner for the card ranges associated with each of the other n-1 card schemes (e.g., VISA, Mastercard, AMEX) in a set of n card schemes.

In a first pass 116-1 the ranges of the initial file 166-0-0 can be re-ordered using zero tolerance. In other words, the ranges can be re-ordered looking for a zero gap between the high end of one range and the low end of another range. This consolidation means that consecutive ranges of card numbers associated with a same currency can be consolidated into one larger range. In the first pass, one or more selected digits of the card numbers can be ignored (e.g., the four lowest significant bits), if it is known that these do not contribute to the card number ranges allocated to the financial institutions. The result of the first pass is a consolidated file 166-0-1 in which consecutive ranges are merged.

In a further pass 116-2, the ranges of the file 166-0-1 can be re-ordered using a first tolerance. In other words the ranges can be re-ordered looking for a given or configurable gap (e.g., 10%) between the high end of one range and the low end of another range. In this phase of the consolidation, adjacent ranges of card numbers in file 166-0-1 that are separated by a gap less than 10% of the number of card numbers in the adjacent ranges and with same associated currency code can be consolidated into one larger range. As in the first pass, one or more selected digits of the card numbers can be ignored (e.g., the four lowest significant bits), if it is known that these do not contribute to the card number

ranges allocated to the financial institutions. The result of the second pass is a consolidated table 166-0-1.

The further pass can optionally be repeated a selectable number of times to further reduce the number of ranges within the file 166-0-1 based on the distribution of card number ranges to provide an appropriate compression of the range table 166-0-1.

Additional consolidation can be provided by an additional pass 116-3 in which a determination is made as to whether a range of card numbers for any other card scheme (e.g., from the files 166-N-0) falls between adjacent ranges in the file 166-0-1. If no ranges fall within between an adjacent pair of ranges, then these can be further consolidated.

The additional pass 116-3 can be repeated a selectable number of times or until, for example, until no further consolidation is possible (i.e., all adjacent pairs of ranges have an intervening range for another currency code).

It should be noted that steps 116-2 and 116-3 can each be performed zero, one or more times. In other words, one or both of steps 116-2 and 116-3 can be omitted.

Table 3 illustrates an example of the reduced content of a table 166-0-1 following such a consolidation process as described with reference to Figure 5. As for Table 1, it should be noted that Table 3 gives an example illustration of such information, it being understood that the actual data shown is constructed for purpose of illustration only.

TABLE 3

Account Range – Low	Account Range - High	Billing Currency Code
5160000000000000000	5160099999999990000	036
5163100000000000000	5163269999999990000	036
5163290000000000000	5163489999999990000	036
5163500000000000000	5163899999999990000	036
5169990000000000000	5169999999999990000	036
5313500000000000000	5313599999999990000	036
5353170000000000000	5353171099999990000	036
5402150000000000000	5436049999999990000	036
5437930000000000000	5437935699999990000	036

Returning to Figure 4, in step 118, the system generates range files for the transaction terminal systems including, for any given transaction terminal system, both consolidated ranges which are applicable to the currency for that local transaction terminal system. The format of the range files can be chosen to minimise the number of digits needed to identify the ranges concerned. In one example, a number of most significant digits needed to identify the upper and lower numbers in the range is used. See for example Table 4, which corresponds to Table 3, but where it is assumed that the last four digits of each number is 0000, and, for the account range (low) value, each digit between the digits held in the table and the last four digits is a 0, and, for the account range (high) value, each digit between the digits held in the table and the last four digits is a 9. It should be noted, that any suitable encoding and/or file format can be used as appropriate.

TABLE 4

Account Range – Low	Account Range - High	Billing Currency Code
516	516000	036
51631	516326	036
516329	516348	036
51635	51638	036
516999	516	036
53135	53135	036
535317	53531710	036
540215	543604	036
543793	54379356	036

The resulting range files are then transmitted to the transaction terminal systems to be stored in the local currency file 49. Optionally, range files can also be generated for those ranges of card numbers which do not correspond the local or reference currency allocated to a given transaction terminal. In that case, the consolidated ranges for card account numbers not corresponding to the local or reference currency for the transaction terminal system can be transmitted to the transaction terminal system and can be stored in the foreign currency file 47. As indicated, in a particular embodiment of the invention, only the local currency file 49 is transmitted to a given transaction terminal system, the

foreign currency file 47 being populated in addition or instead of the local currency file as an option in an alternative embodiment.

In step 120, billing currency files are generated for the host system to include all of the consolidated ranges with the corresponding billing currencies for the respective ranges being stored in the billing currency file 75 of the DCC host system 18 shown in Figure 3. The billing currency files can be generated using a format such as described above with respect to step 118. Optionally, the billing currency file entry, as well as identifying an account range and a billing currency code, can also include an indication as to whether the billing currency is a supported currency for the DCC system,

The process 100 terminates at step 122.

As described with reference to Figure 2, a terminal transaction system 10 can be provided with a local currency file 49 and/or a foreign currency file 47. The purpose of the local currency file and/or the foreign currency file is to determine whether a payment card used at the transaction terminal system a billing currency which corresponds to a reference currency for the transaction terminal system as stored in the reference country/currency record 48. This determination can either be performed in a positive manner, by determining that the payment card concerned has a billing currency corresponding to the reference currency of the terminal system (in which case the local currency file can be used) or in terms of a negative determination that the billing currency of the payment card is not a foreign currency which is different from the reference currency recorded in the reference country/currency file 48. As, typically, the local currency file 49 will contain less entries (that is less ranges) than the foreign currency file 47, a transaction terminal system will normally only be provided with a local currency file 49. However, given that the currency concerned is determined by comparison of at least a part of a payment card number to a said of one or more ranges of card numbers to which would be assigned a given billing currency, in some embodiments, it may be that the foreign currency file 47 is in fact smaller than the local currency file 49. In such a case, a foreign currency file 47 could be provided instead of the local currency file 49. In the example to be described with reference to Figure 6, it is assumed that a local currency file 49, and not a foreign currency file 47, is provided in the transaction terminal system 10.

Figure 6 is a flow diagram illustrating part of the operation of the transaction terminal system of Figure 2. The process 200 starts at 210.

At 212, the payment card number (or Personal Account Number PAN) is received from the payment card by input of that payment card number at the transaction terminal system. The payment card number can be entered in any conventional matter by manual input, by reading information from a magnetic stripe, by reading from a chip held on the payment card or by a contact less transfer of data from a payment card (or in each case from another form of payment carrier). In step 214, at least a part of the payment card number is compared to the range file (that is to the local currency file 49) to identify whether the payment card number falls within the range or ranges identified as ranges of card numbers for which the billing currency is the same currency as the reference for the transaction terminal system. The comparison of the payment card number to the respective ranges can be performed in any appropriate manner, for example using a conventional binary search algorithm, which enables a particular value (that is the payment card value) rapidly to be identified as being within one of the available ranges. The part of the payment card number that is compared is an amount needed to identify whether the payment card number falls within the relevant ranges. In one example, the first ten leading digits of the payment card number are compared. In other examples another set of digits can be compared, or indeed the whole payment card number can be compared, as long as the digits that are compared are sufficient to identify whether the payment card number falls within the relevant range(s) or not.

At 216, if it is determined that the billing currency of the payment card is not the same as the reference currency for the transaction terminal system 10 (i.e. it is not a local card), then at 218, a rate request is sent to a host system to identify a currency that could be offered for dynamic currency conversion, and an appropriate exchange rate for that conversion. The processing by the host system is described with reference to Figure 7. At step 220, a rate response is received from the host system. It is assumed that the rate response identifies a currency that can be offered to a user for dynamic currency conversion, and also identifies the exchange rate to be used.

At step 222, the transactional terminal system computes an offer to be made to the user for dynamic currency conversion. In order to compute the offer to be made, the transaction terminal system uses a transaction amount input by means of one or more of the input mechanisms provided at the transaction terminal system, and the exchange rate identified in the rate response message. The transactional terminal system is operable to

offer to the user the option of proceeding with purchase in the reference currency for the transaction terminal system, or in the DCC currency which can be offered along with an indication of the applicable exchange rate and the value of the transaction in the DCC currency computed at the offered exchange rate. As will be explained with reference to Figure 7, the DCC currency which can be offered will typically be the billing currency for the payment card. However, in certain circumstances, the DCC currency offered may be a different currency. If the currency offered is not the billing currency, but is, for example, a default currency, then the information provided to the user will indicate this fact to the user so that the user is in a position to make an objective decision as to whether to accept DCC offer or not. The DCC offer can be made by displaying the appropriate data on a display of the transaction terminal system, by means of an audio output, by putting a document, or in any other appropriate manner.

If in step 224, the user accepts the DCC offer then at step 228, the transaction is conducted in the DCC currency offered to the user. Alternatively, if it is determined at step 216 that the currency of the payment card is the same as the reference currency of the transaction terminal, or at step 224 the user declines to accept the DCC offer, then at step 226 the transaction is conducted in the reference, or local, currency of the transaction terminal system. The transaction is then conducted in the appropriate currency as indicated at 226 or 228, and the process terminates 230.

Figure 7 is a flow diagram illustrating the aspects of the operation of the DCC host system 18 on receiving a rate request from a transaction terminal system. The process 300 starts at 310. At 312 the rate request message is received from the transaction terminal system. The rate request message identifies, among other data, at least a part of the payment card number, an identification of the transaction terminal from which the rate request message was sent, (to identify routing information for returning a reply), and optionally a transaction amount.

At step 314, at least a part of the payment card number is compared to a billing currency file to identify billing currency. As described earlier, the billing currency file 75 contains ranges of card numbers consolidated to include consecutive ranges of those card numbers, associated with specific billing currencies. The comparison process performed in step 314 can be conducted in any appropriate manner. For example, an associative lookup could be performed to identify whether the received card payment number is greater than a

lower end of a range of numbers, or lower than the higher end of a range of numbers, to identify that the card number lies within that range. In the event of a positive comparison between a particular range and the card number, the billing currency can then be identified from the billing currency file. Alternatively, other techniques for identifying a particular range within which the payment card number lies can be determined by, for example, a binary sort algorithm as described earlier with respect to the operation of step 214 of the transaction terminal system. The part of the payment card number that is compared is an amount needed to identify whether the payment card number falls within the relevant ranges. In one example, the first ten leading digits of the payment card number are compared. In other examples another set of digits can be compared, or indeed the whole payment card number can be compared, as long as the digits that are compared are sufficient to identify whether the payment card number falls within the relevant range(s) or not.

Optionally, the billing currency file can also include an indication of currencies which are supported by the DCC system. In this case, optionally, at step 316, a determination can be made whether the billing currency of a payment card is a billing currency which is supported by the DCC system. If the billing system is not supported, then optionally, in step 318, a default currency corresponding to the billing currency can be identified in a default currency table. The default currency table includes mappings from identified billing currencies to default currencies. In step 320, the default currency is set as the DCC currency.

If in step 316 it is determined that the billing currency is supported, then at step 322 the billing currency becomes the DCC currency. At step 324, the reference currency can be identified from the rate request message received from a transaction terminal system either directly in that the reference currency is contained within the rate request from the transaction terminal system or, for example, from transaction terminal country data which can then be used to access a country to currency translation table (not shown) to identify a reference currency, and then an exchange rate from the reference currency to the DCC currency is accessed in the rate tables 74.

At 326, the host system is operable to generate a rate response message and to send the rate response message to the transaction terminal system that issued the rate request,

using the identifier of the transaction terminal system and/or addressing information contained within the rate request message. The process terminates at step 328.

Conventional encryption techniques can be used to secure the transmission of the messages described above and/or for the storage of information in the processes described above.

Although the embodiments described above have been described in detail, numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. It is intended that the following claims be interpreted to include all such variations and modifications and their equivalents.

CLAIMS

1. A transaction terminal system comprising:

- an input interface to receive payment carrier data for a payment carrier, including at least a payment carrier number for the payment carrier;
- a communications interface to connect to a remote host system;
- range storage defining payment carrier number ranges, wherein the payment carrier number ranges define at least one of
  - a plurality of first consolidated payment carrier number ranges for which an assigned billing currency is a reference currency for the transaction terminal system, or
  - a plurality of second consolidated payment carrier number ranges for which an assigned billing currency is not the reference currency for the transaction terminal system,
  - wherein at least one consolidated payment carrier number range comprises a plurality of ranges of consecutive payment carrier numbers associated with a given currency and has a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lowest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with a given currency to a highest payment carrier number from a second, highest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency; and
- transaction terminal system processing means operable

to compare at least part of an input payment carrier number and the consolidated payment carrier number ranges to determine whether an input payment carrier number falls within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system or within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system, and

where it is determined that the input payment carrier number does not fall within a consolidated payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system, and/or where it is determined input payment carrier number falls within a consolidated payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system

- to transmit a rate request message that identifies the payment carrier number to the host system to identify a billing currency for the payment carrier and a billing currency conversion rate; and
- to receive a rate response message from the host system identifying the payment carrier billing currency and the billing currency conversion rate.

2. The transaction terminal system of claim 1, wherein the consolidated payment carrier number ranges are determined by comparing respective ranges of consecutive payment carrier numbers associated with a given currency and consolidating numerically adjacent ranges of consecutive payment carrier numbers associated with the given currency where a numerically intermediate range of payment carrier numbers is not allocated to another currency.

3. The transaction terminal system of claim 1 or claim 2, wherein the consolidated ranges are determined in one or more passes.

4. The transaction terminal system of claim 3, wherein at least one pass includes consolidating numerically consecutive ranges of consecutive payment carrier numbers associated with a given currency.

5. The transaction terminal system of claim 3 or claim 4, wherein at least one pass includes consolidating ranges of consecutive payment carrier numbers separated by a selected tolerance.

6. The transaction terminal system of any one of claims 3 to 5, wherein at least one pass includes determining whether a range of consecutive payment carrier numbers associated with a different currency lies numerically between two ranges of consecutive payment carrier numbers associated with a given currency.

7. The transaction terminal system of any one of the preceding claims, wherein at least one of the lowest payment carrier number and the highest payment carrier number from a range of consecutive payment carrier numbers is represented by a truncation of the payment carrier number.

8. The transaction terminal system of any one of the preceding claims, comprising storage operable to store a reference currency indicator for the transaction terminal system, wherein the rate request message identifies the reference currency for the transaction terminal system.

9. The transaction terminal system of any one of the preceding claims, wherein the rate request message identifies the transaction terminal system.

10. The transaction terminal system of any one of the preceding claims, wherein the transaction terminal system, in response to receipt of a response message from the host system identifying the payment carrier billing currency and the billing currency conversion rate, is operable to present an option to a user to conduct a transaction in the payment carrier billing currency at the billing currency conversion rate or to conduct the transaction in the reference currency for the transaction terminal system.

11. The transaction terminal system of claim 10, comprising an input interface to receive transaction data for a transaction to be performed using the payment carrier, wherein the transaction terminal system is operable to present the option to conduct a transaction in the payment carrier billing currency and at the billing currency conversion rate with a transaction amount converted at the billing currency conversion rate or to conduct the transaction in the reference currency with a transaction amount in the reference currency.

12. The transaction terminal system of claim 10 or claim 11, wherein the transaction terminal system is responsive to the user selecting the option via an input interface to conduct a transaction in the billing currency for the payment carrier and at the billing currency conversion rate, to proceed to process the transaction in the payment carrier billing currency at the billing currency conversion rate.

13. The transaction terminal system of any one of the preceding claims, wherein the input interface comprises one or more of:

a keyboard and/or keypad having discrete or integrated keys, a touch screen keyboard an/or keypad or other form of keyboard or keypad;

a bar code scanner, an RFI tag scanner, and/or other form of scanner;

a magnetic card stripe reader, a chip card reader, a contactless card reader, an RFI tag reader or other form of card reader;

a voice responsive input;

a wireless payment carrier interface.

14. The transaction terminal system of any one of the preceding claims, comprising an output device operable to present information to a user.

15. A host system comprising:

- a host communications interface to connect to a transaction terminal system;
- billing currency storage defining for each of a plurality of billing currencies, a plurality of consolidated payment carrier number ranges for which an assigned currency is the billing currency, wherein at least one consolidated payment carrier number range comprises a plurality of ranges of consecutive payment carrier numbers associated with a given currency and has a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lowest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with a given currency associated with the billing currency

to a highest payment carrier number from a second, highest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency;

- currency conversion rate storage identifying conversion rates between currencies;

- host system processing means responsive to receipt of a rate request message from the transaction terminal system identifying a received payment carrier number

to compare at least a part of an input payment carrier number to the consolidated payment carrier number ranges defined in the billing currency storage to identify in which consolidated payment carrier number range the received payment carrier number lies, and to identify a billing currency associated with that received payment carrier number,

to identify a currency conversion rate between a reference currency for the transaction terminal system that sent the rate request message and an identified billing currency for the payment carrier number, and

to generate a rate response message to be sent to the transaction terminal system identifying the payment carrier billing currency and the billing currency conversion rate.

16. The host system of claim 15, wherein the consolidated payment carrier number ranges are determined by comparing respective ranges of consecutive payment carrier numbers associated with a given currency and consolidating numerically adjacent ranges of consecutive payment carrier numbers associated with the given currency where a numerically intermediate range of payment carrier numbers is not allocated to another currency.

17. The host system of claim 15 or claim 16, wherein the consolidated ranges are determined in one or more passes.

18. The host system of claim 17, wherein at least one pass includes consolidating numerically consecutive ranges of consecutive payment carrier numbers associated with a given currency.

19. The host system of claim 17 or claim 18, wherein at least one pass includes consolidating ranges of consecutive payment carrier numbers separated by a selected tolerance.

20. The host system of any one of claims 17 to 19, wherein at least one pass includes determining whether a range of consecutive payment carrier numbers associated with a different currency lies numerically between two ranges of consecutive payment carrier numbers associated with a given currency.

21. The host system of any one of claims 15 to 20, wherein at least one of the lowest payment carrier number and the highest payment carrier number from a range of consecutive payment carrier numbers is represented by a truncation of the payment carrier number.

22. The host system of any one of claims 15 to 21, wherein the host system is operable to determine a reference currency for the transaction terminal system from an indication of the reference currency for the transaction terminal system in a received rate request message.

23. The host system of any one of claims 15 to 24, comprising a reference currency storage identifying a reference currency for a transaction terminal system, the host system being operable to identify a reference currency for a rate response message using an indication of a transaction terminal system in a received rate request message to access the reference currency storage.

24. A dynamic currency conversion system comprising at least one transaction terminal system as claimed in any of claims 1 to 14 and a host system as claimed in any of claims 15 to 23.

25. A computer system operable to generate consolidate payment carrier number ranges for the transaction terminal system of any one of claims 1 to 14 or the host system of any one of claims 15 to 23, the computer system comprising:

- storage for received payment carrier number ranges, each payment carrier number range being defined by a range of consecutive payment carrier numbers extending from a lowest payment carrier number for the payment carrier number range to a highest payment carrier number for the payment carrier number range;
- processing means operable to consolidate received payment carrier number ranges to generate a consolidated payment carrier range, in order to generate at least one consolidated payment carrier number range comprising a plurality of ranges of consecutive payment carrier numbers associated with a given currency and having a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lowest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency to a highest payment carrier number from a second, highest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency;
- storage for the consolidated payment carrier number ranges.

26. The computer system of claim 25, wherein the processing means is operable to determine consolidated payment carrier number ranges by comparing respective ranges of consecutive payment carrier numbers associated with a given currency code and consolidating numerically adjacent ranges of consecutive payment carrier numbers associated with the given currency where a numerically intermediate range of payment carrier numbers is not associated with another currency.

27. The computer host system of claim 25 or claim 26, wherein the processing means is operable to determine consolidated ranges in one or more passes.

28. The computer system of claim 27, wherein the processing means is operable to perform at least one pass consolidating numerically consecutive ranges of consecutive payment carrier numbers associated with a given currency.

29. The computer system of claim 27 or claim 28, wherein the processing means is operable to perform at least one pass consolidating ranges of consecutive payment carrier numbers separated by a selected tolerance.

30. The computer system of any one of claims 27 to 29, wherein the processing means is operable to perform at least one pass determining whether a range of consecutive payment carrier numbers associated with a different currency lies numerically between two ranges of consecutive payment carrier numbers associated with a given currency.

31. The computer system of any one of claims 25 to 30, wherein at least one of the lowest payment carrier number and the highest payment carrier number from a range of consecutive payment carrier numbers is represented by a truncation of the payment carrier number.

32. The computer system of any one of claims 25 to 31, wherein the computer system is the host system of any one of claims 15 to 23.

33. A method of operating the transaction terminal system of any one of claims 1 to 14, the method comprising:

- an input interface receiving payment carrier data for a payment carrier, including at least a payment carrier number for the payment carrier;
- transaction terminal system processing means

comparing at least a part of an input payment carrier number and first and/or second consolidated payment carrier number ranges to determine whether an input payment carrier number falls within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system or within a payment carrier number range for which an assigned billing currency is not the reference

currency for the transaction terminal system, wherein transaction terminal storage holds at least one of

- a plurality of first consolidated payment carrier number ranges for which an assigned billing currency is a reference currency for the transaction terminal system, or
- a plurality of second consolidated payment carrier number ranges for which an assigned billing currency is not the reference currency for the transaction terminal system, and
- at least one consolidated payment carrier number range comprises a plurality of ranges of consecutive payment carrier numbers associated with a given currency and has a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lowest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with a given currency to a highest payment carrier number from a second, highest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency, and

where it is determined that the input payment carrier number does not fall within a payment carrier number range for which an assigned billing currency is the reference currency for the transaction terminal system, and/or where it is determined input payment carrier number falls within a payment carrier number range for which an assigned billing currency is not the reference currency for the transaction terminal system

- transmitting a rate request message that identifies the payment carrier number to the host system to identify a billing currency for the payment carrier and a billing currency conversion rate; and

- receiving a rate response message from the host system identifying the payment carrier billing currency and the billing currency conversion rate.

34. A method of operating the host system of any one of claims 15 to 23, the method comprising

- receiving, at a host communications interface, a rate request message from a transaction terminal system;
- host system processing means responding to receipt of a rate request message from the transaction terminal system identifying at least a part of a received payment carrier number;

to compare at least a part of an input payment carrier number to consolidated payment carrier number ranges defined in billing currency storage to identify in which payment carrier number range the received payment carrier number lies, and to identify a billing currency associated with that received payment carrier number, the billing currency storage defining for each of a plurality of billing currencies, a plurality of consolidated payment carrier number ranges for which an assigned currency is the billing currency,

wherein at least one consolidated payment carrier number range comprises a plurality of ranges of consecutive payment carrier numbers associated with a given currency and havs a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lowest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the billing currency to a highest payment carrier number from a second, highest, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency,

to identify a currency conversion rate between a reference currency for the transaction terminal system that sends the rate request message and an identified billing currency for the payment carrier number from currency conversion rate storage identifying conversion rates between currencies, and

to generate a rate response message to be sent to the transaction terminal system identifying the payment carrier billing currency and the billing currency conversion rate.

35. A method of controlling a computer system to generate consolidate payment carrier number ranges for the transaction terminal system of any one of claims 1 to 14 or the host system of any one of claims 15 to 23, the method comprising:

- storing in computer system storage, received payment carrier number ranges, each payment carrier number range being defined by a range of consecutive payment carrier numbers extending from a lowest payment carrier number for the payment carrier number range to a highest payment carrier number for the payment carrier number range;
- controlling processing means of the computer system to consolidate received payment carrier number ranges to generate a consolidated payment carrier range, in order to generate at least one consolidated payment carrier number range comprising a plurality of ranges of consecutive payment carrier numbers associated with a given currency and having a pair of adjacent ranges of consecutive payment carrier numbers separated by a gap in which no carrier numbers are associated with another currency, the consolidated payment carrier number range being defined by a lowest payment carrier number from a first, lower, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency to a highest payment carrier number from a second, higher, range of consecutive payment carrier numbers of said plurality of payment carrier ranges associated with the given currency; and
- storing the consolidated payment carrier number ranges in computer system storage.

36. A computer program product comprising program code operable to carry out the method of any of claims 33 to 35.