

DATA STORAGE DEVICE AND DATA STORAGE METHOD, INFORMATION-PROCESSING
APPARATUS AND INFORMATION-PROCESSING METHOD, AND PROGRAM

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to a data storage device and data storage method, an information processing apparatus and information processing method, and a program.

Description of the Related Art:

In an electronic money system or a security system, the use of an IC (Integrated Circuit) card has more widely been increased. The "IC card" means a card-shaped device having embedded therein an IC chip. It has built therein for example an operation processing part such as a CPU (Central Processing Unit) for executing various kinds of processings, a memory for storing therein data necessary for executing these processings, etc. It operates with a prescribed reader/writer that has been utilized with respect thereto. Reading and writing of data with respect to the IC card are thereby executed in a state where the IC card is in electric contact with the reader/writer or in a state of non-contact therewith that uses electromagnetic waves.

For example, in an ISO (International Organization for Standardization) 7816, there is defined a standard for a contact type of IC card. According to this standard, there can be managed data with use of, for example, an EF (Elementary File) (corresponding to the so-called "file") for storing therein a file and a DF for storing therein the EF and DF (Dedicated File) (

corresponding to the so-called "directory (folder)"). Accordingly, if setting a certain piece of DF as a parent hierarchy and providing a DF that constitutes a said-parent's child hierarchy, it becomes possible to manage data in the form of a hierarchical structure.

By the way, in case using the IC card for the purpose of providing service by a plurality of managers, there can be considered as being available therefor a method of allotting the DF, serving as a hierarchy, to each of a plurality of the managers and storing with respect to this DF the EF having therein data regarding the provision of service by each manager.

Also, in case utilizing the IC card in connection with an electronic money system or a security system, ensuring the security for concealment of data, for prevention of the forgery of the IC card, etc. is important. To this end, it is necessary to perform the resources management for storage of data or to perform the access control the access of that with respect to data is highly flexible and yet has a high level of security.

As the technique for performing the access control the access of that with respect to data is highly flexible and yet has a high level of security, there is, for example, a technique that is described in an official gazette of Japanese Patent Application No. 2000-36021. According to this cited invention, there are area-definition areas corresponding to the directories of the IC cards. Those area-definition areas store therein the ranges of codes that are the ranges of usable identification codes (each corresponding to a filename or directory name). Said area-definition areas constitute a hierarchical structure in which according to those

ranges of codes the data in one area-definition area is used as that corresponding to a parent hierarchy and the data in another is used as that corresponding to a child hierarchy. Further, in the area-definition areas, there are also stored the capacities (empty capacities). By these empty capacities and ranges of codes, in the hierarchy that falls upon a certain area-definition area, the usable capacity and identification code therein are respectively limited.

Further, according to that cited invention, there is used two or more in number a hierarchical key that is used with respect to each hierarchy corresponding to the memory area having such data stored therein, or a data memory area key that is used with respect to the memory area having such data stored therein. Using those keys, there are produced authentication keys that are used for authentication. According to each of those authentication keys, authentication is performed. And, the authentication key that is used when utilizing the parent's hierarchy is made unknown to the user who uses the child's hierarchy. Further, a right to access the exercise of that is permitted with respect to the child's hierarchy is given with respect to the service-definition area that among the area-definition areas constitutes a child's hierarchy. Therefore, the manager who manages the parent's hierarchy becomes able to give each user the right to have access to a different service-definition area.

As the electronic money becomes more diffused and as the service, that uses an IC card, becomes more diversified, there has been an increasing demand for the provision of more services through mutual use, by a plurality of service providers, of one sheet of IC

card.

In case making mutual use of one sheet of IC card by a plurality of service providers, it must be arranged that the information or application regarding a specific service a certain service provider offers cannot be accessed when permission therefor is made by the other service providers that make mutual use of that IC card. With this security being maintained as is, it must be arranged that the information or application regarding the service that is mutually used can be possessed by each of the service providers that are performing their mutual use operation.

However, in case data for realizing various kinds of services that are jointly use-operated or individually use-operated by a plurality of service providers has been defined within the IC card as physically specific or individual blocks, the following means becomes necessary. Namely, it becomes necessary to use, within the reader/writer and IC card, means for, when part of the data that is being jointly use-operated has been reloaded, synchronizing the data contents in a specific block for providing its relevant service with those in another specific block for providing its relevant service. As a result of this, the cost of the reader/writer and that of the IC card have both been increased. Further, when defining the data for realizing various kinds of services physically as specific blocks, owing to the physical blocks with respect to that a plurality of definitions have been made the memory capacity inside the card is wasted. This has caused an obstruction when supplying more points of service.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above-described circumstances. That is, the present invention is intended, in an IC card by the use of that for example a plurality of enterprises provide a plurality of services, to cause a specific-usable service and a commonly usable service to co-exist while ensuring the security as taken with respect to the applications or data that is used to provide the respective enterprises' services.

In accordance with a first aspect of the present invention, there is provided a data storage device operable to communicate with an information-processing apparatus, comprising:

a first memory having a first storing area and a second storing area,

the first storing area including first data, which includes second data, and first authentication information with respect to the first data, and

the second storing area including third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data;

a data input/output control operable to control (i) data communication between the data storage device and the information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

a processing unit operable to process the fourth data based on the associated second data when the data input/output control has permitted the information-processing apparatus to manipulated the second data.

In accordance with a second aspect of the present invention, there is provided a data storage device, comprising:

a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith, and the specific storage area having link data associated with certain of the data stored in the common area such that use of the first authentication information also enables access to the certain data in the common storage area.

In accordance with a third aspect of the present invention, there is provided a method, comprising:

storing first data, which includes second data, and first authentication information with respect to the first data, in a first memory of a data storage device, the first memory having a first storing area and a second storing area;

storing third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data, in the second storing area of the first memory;

controlling (i) data communication between the data storage device and an information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

processing the fourth data based on the associated second data when the information-processing apparatus has manipulated the second data.

In accordance with a fourth aspect of the present invention, there is provided a storage medium including a software program stored thereon that is capable of controlling a processor of a data storage device to perform steps, comprising:

- storing first data, which includes second data, and first authentication information with respect to the first data, in a first memory of the data storage device, the first memory having a first storing area and a second storing area;

- storing third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data, in the second storing area of the first memory;

- controlling (i) data communication between the data storage device and an information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

- processing the fourth data based on the associated second data when the information-processing apparatus has manipulated the second data.

In accordance with a fifth aspect of the present invention, there is provided an information-processing apparatus operable to perform data communication with a data storage device, comprising:

a data input/output control operable to control data communication with the data storage device;

a first memory operable to store respective authentication information, which may be used for enabling communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

a second memory operable to store information indicative of the data communication between the information-processing apparatus and the data storage device, the information being organized in association with the respective authentication information.

In accordance with a sixth aspect of the present invention, there is provided a method, comprising:

controlling data communication between an information-processing apparatus and a data storage device;

using respective authentication information stored in a first memory of the information-processing apparatus to enable communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

storing information indicative of the data communication between the information-processing apparatus and the data storage device in a second memory of the information-processing apparatus, the information being organized in association with the respective authentication information.

In accordance with a seventh aspect of the present invention, there is provided a storage medium including a software program stored thereon that is capable of controlling a processor of an information-processing apparatus to perform steps, comprising:

controlling data communication between the information-processing apparatus and a data storage device;

using respective authentication information stored in a first memory of the information-processing apparatus to enable communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

storing information indicative of the data communication between the information-processing apparatus and the data storage device in a second memory of the information-processing apparatus, the information being organized in association with the respective authentication information.

In accordance with an eighth aspect of the present invention, there is provided a data communication system, comprising:

a data storage device including a memory having a specific storage area and a common storage area, data in the specific storage area being accessible, by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith, and the specific storage area having link data associated with certain of the data stored in the common area such that use of the first authentication information also enables access to the certain data in the common storage area; and

an information-processing apparatus operable to (i) communicate with the data storage device by way of presenting authentication information thereto, and (ii) access the certain data stored in the common storage area through the link data of the specific storage area by presenting the first authentication information to the data storage device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating the construction of a card system to that the present invention is applied;

FIG. 2 is a block diagram illustrating the construction of a reader/writer of FIG. 1;

FIG. 3 is a block diagram illustrating the construction of an IC card of FIG. 1;

FIG. 4 is a block diagram illustrating the construction of a controller of FIG. 1;

FIG. 5 is a view illustrating a logical format of the EEPROM of FIG. 3;

FIG. 6 is a view illustrating the construction of applications recorded in the EEPROM of FIG. 3;

FIG. 7 is a view illustrating the relationship between an IC card issuer and its co-operators;

FIG. 8 is a view illustrating examples of the applications recorded in the EEPROM of FIG. 3;

FIG. 9 is a view illustrating the delivery/receipt of an authentication key between the managers;

FIG. 10 is a view illustrating the processing for authenticating the IC card that is executed in an issuer's managed

terminal apparatus;

FIG. 11 is a view illustrating the processing for authenticating the IC card that is executed in a co-operator's managed terminal apparatus;

FIG. 12 is a flow chart illustrating the processing of the terminal apparatus;

FIG. 13 is a flow chart illustrating a commonly accessible electronic value filling process;

FIG. 14 is a flow chart illustrating a specific-accessible service point write-in process;

FIG. 15 is a flow chart illustrating the commonly accessible electronic value and specific-accessible service point write-in process;

FIG. 16 is a view illustrating the accessing right to the applications in the specific and the common area that is imparted to a co-operator that co-operates with the IC card's issuer;

FIG. 17 is a flow chart illustrating a point/value utilization process that is executed by an object store with respect to that specific access is permitted;

FIG. 18 is a flow chart illustrating an electronic value utilization process that is executed by an object store with respect to that common access is permitted;

FIGS. 19A and 19B are views each illustrating the IC card issuer, the co-operator, and an IC card center;

FIG. 20 is a block diagram illustrating the construction of the personal computer of FIG. 19;

FIG. 21 is a flow chart illustrating the settlement process

that is executed by each of the IC card issuer, the co-operator, and the IC card center;

FIG. 22 is a flow chart illustrating the settlement process that is executed by each of the IC card issuer, the co-operator, and the IC card center;

FIG. 23 is a view illustrating the accessing right to the applications in the specific and the common area that is imparted to a co-operator that co-operates with the IC card's issuer;

FIG. 24 is a view illustrating the accessing right to the applications in the specific and the common area that is imparted to a co-operator that co-operates with the IC card's issuer;

FIG. 25 is a view illustrating the accessing right to the applications in the specific and the common area that is imparted to a co-operator that co-operates with the IC card's issuer;

FIG. 26 is a view illustrating the accessing right to the applications in the specific and the common area that is imparted to a co-operator that co-operates with the IC card's issuer;

FIG. 27 is a flow chart illustrating the electronic value write-in process the write-in of that with respect to the electronic value is performed using a specific key other than an issuer's one;

FIG. 28 is a flow chart illustrating the settlement process that in case the write-in with respect to the electronic value has been performed using a specific key other than an issuer's one is executed in each of the issuer and the co-operator;

FIG. 29 is a view illustrating the delivery/receipt of a common key between the managers; and

FIG. 30 is a view illustrating the common possession of

services (applications) between the managers.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will hereafter be explained with reference to the drawings.

FIG. 1 illustrates the construction of a non-contact type card system to which the present invention has been applied.

This non-contact type of card system is constructed of a reader/writer 1, an IC card 2, and a controller 3. Between the reader/writer 1 and the IC card 2, non-contact type transmission and reception of data are performed using electromagnetic waves.

Namely, the reader/writer 1 transmits a prescribed command to the IC card 2. The IC card 2 receives that command and thereby executes a piece of processing corresponding to that command. And, the IC card 2 transmits to the reader/writer 1 response data that responds to the processed result.

The reader/writer 1 is connected to the controller 3 via a prescribed interface (e.g. the one that is prepared in accordance with a standard of RS-485A). The controller 3 supplies a prescribed control signal to the reader/writer 1 to thereby cause it to execute its prescribed piece of processing.

FIG. 2 is a block diagram illustrating the construction of the reader/writer 1 illustrated in FIG. 1.

An IC 21 is constructed of a DPU (Data Processing Unit) 31 that executes processing of data, an SPU (Signal Processing Unit) 32 that executes processing of data, which is transmitted to the IC card 2, and that executes processing of data, which has been received from the IC card 2, an SCC (Serial Communication

Controller) 33 that performs communication with the controller 3, and a memory 34 constructed of a ROM (Read Only Memory) 41 that stores therein beforehand information necessary for processing of data and a RAM (Random Access Memory) 42 that temporarily stores therein data that is in the course of processing. All elements that are included from the DPU 31 to the memory 34 are connected to one another via a bus 35.

Also, to this bus 35, there are connected, too, a flash memory 22 that stores therein prescribed data such as, for example, data necessary for authentication and a drive 28. To the drive 28 there are mounted according to the necessity a magnetic disk 45, an optical disk 46, a magneto-optical disk 47, and a semiconductor memory 48. Thereby, transmission and reception of data are performed between the both.

An antenna 27 monitors the state of load while radiating prescribed electromagnetic waves. By doing so, the antenna 27 detects whether the IC card 2 has been mounted with respect thereto. It thereby performs transmission and reception of data with respect to the IC card 2 that has been mounted thereto. The details on the transmission and reception of data with respect to the IC card 2 will be described later.

A demodulator circuit 25 demodulates a modulated wave (ASK (Amplitude Shift Keying) modulated wave) that it has received via the antenna 27, and outputs to the SPU 32 the data that has been demodulated.

The SPU 32 has input thereto via the demodulator 25 the response data that has been transmitted on from the IC card 2. It

executes a prescribed piece of processing (e.g. BPSK (Binary Phase Shift Keying) modulation (coding into the Manchester code), etc.) with respect to that response data. It simultaneously similarly executes a prescribed piece of processing with respect to the command that is to be transmitted to the IC card 2. It thereafter outputs the resulting signal to a modulator circuit 23.

The DPU 31 has input thereto via the SPU 32 and bus 35 the response data received from the IC card 2 and has input thereto via the SCC 33 and bus 35 the control signal input from the controller 3. It thereby executes processing that accords with the response data and control signal that has been input thereto. It outputs the command, that is to be transmitted to the IC card 2, to the SPU 32 via the bus 35, or outputs the data, that is to be transmitted to the controller, to the SCC 33 via the bus 35.

The modulator circuit 23 performs ASK modulation of a carrier wave, the frequency of that is prescribed (e.g. 13.56 MHz), and that is supplied from an oscillator (OSC) 26, according to the data that is supplied from the SPU 32. It outputs the thus-produced modulation waves to the IC card 2 via the antenna 27 as the electromagnetic waves. It is to be noted that it is arranged that at this time the modulator circuit 23 performs ASK modulation by its modulation degree being made less than 1. It is thereby arranged that even when the data has a low level the maximum amplitude of the modulation waves be prevented from becoming zero.

The SCC 33 supplies the data, that has been input from the controller 3, to the DPU 31 via the bus 35, or outputs the data, that has been input from the DPU 31 via the bus 35, to the

controller.

FIG. 3 is a block diagram illustrating the construction of the IC card 2 illustrated in FIG. 1.

An IC 51 of the IC card 2 receives the modulation waves that have been transmitted on from the reader/writer 1 through the antenna 53. A capacitor 52 constitutes an LC circuit jointly with the antenna 53 and the modulation waves thereof tune (resonate) with the electromagnetic waves having a prescribed frequency (carrier frequency).

An interface part 61 of the IC 51 has an ASK demodulation part 81 that wave-detects the modulation waves (ASK modulation waves) that it has received via the antenna 53, and demodulates them. The ASK demodulation part 81 then outputs the post-modulation data to a BPSK modulation part 62 and to a PLL (Phase Locked Loop) part 63. The interface part 61 also has a voltage regulator 82 that stabilizes the signal the ASK demodulation part 81 has wave-detected, and the voltage regulator 82 supplies it to each of its relevant circuits as a direct current power source. Further, the interface part 61 has an oscillator circuit 83 that oscillates a signal having the same frequency as the clock frequency of the data signal and that outputs that signal to the PLL part 63.

Data is transmitted from the IC card 2 to the reader/writer 1. In this case, an ASK modulation part 84 of the interface part 61 causes, for example, a prescribed switching element to go "on"/"off" in correspondence with the data that is supplied from a calculation part 64 via a BPSK modulation part 68. And, only when the switching element is in a state of being "on", the ASK modulation part 84

causes a prescribed magnitude of load to be connected to the antenna 53 in parallel therewith. By doing so, the ASK modulation part 84 causes the fluctuation in the load of the antenna 53 that serves as the power source for the IC card 2. According to the fluctuation in the load of the antenna 53, the ASK modulation part 84 performs ASK modulation of the modulation waves the IC card 2 is receiving via the antenna 53. (When receiving data from the IC card 2, namely when transmitting data to the IC card 2, the reader/writer 1 has kept constant the maximum amplitude of the modulation waves it outputs. The ASK modulation part 84 performs ASK modulation of those modulation waves according to the fluctuation in the load of the antenna 53.) The ASK modulation part 84 transmits those modulation components to the reader/writer 1 via the antenna 53 (i.e. the ASK modulation part 84 causes the fluctuation in the terminal voltage of the antenna 27 of the reader/writer 1).

The PLL part 63 receives data from the ASK demodulation part 81 and, from this data, produces a clock signal that is synchronized with that data. That clock signal is output to the BPSK demodulation part 62 and to the BPSK modulation part 68. When the data that has been modulated by the ASK demodulation part 81 is being BPSK-modulated, the BPSK demodulation part 62 demodulates that data (decoding of the one-chester code) according to the clock signal supplied from the PLL part 63, and outputs the thus-demodulated data to the calculation part 64.

In case the data supplied from the BPSK demodulation part 62 is the one that has already been encoded, the calculation part 64 decodes that data by its encoding/decoding part 92. Thereafter,

this data is processed in a sequencer 91. It is to be noted that in case that data is the one that is not encoded, the data supplied from the BPSK demodulation part 62 is directly supplied to the sequencer 91 without being passed through the encoding/decoding part 92.

The sequencer 91 executes various kinds of processings that accord with the commands that are input thereto. Namely, the sequencer 91 executes write-in or read-out of data with respect to, for example, an EEPROM (Electrically Erasable and Programmable Read Only Memory) 66 and in addition executes necessary steps of calculation processing with respect to that data. Further, the sequencer 91 executes access control resulting from performance of authentication, the management of the EEPROM 66, etc.

A parity calculation part 93 of the calculation part 64 calculates, for example, a lead Solomon's code, as parity data, from the data stored in the EEPROM 66 or from the data stored in the EEPROM 66. Further, after having executed a prescribed step of processing in the sequencer 91, the calculation part 64 outputs to the BPSK modulation part 68 the response data corresponding to that prescribed step of processing (the data that is transmitted to the reader/writer 1). The BPSK modulation part 68 performs BPSK modulation of the data that has been supplied by the calculation part 64, and outputs the post-modulation data to the ASK modulation part 84 of the interface part 61.

The ROM 65 stores therein a program for executing processing by the sequencer 91 and stores therein data that is necessary for the execution of the program. The RAM 67 temporarily stores

therein, for example, data that when the sequencer 91 performs processing occurs in the course of the processing. The EEPROM 66 is a non-volatile memory, which even after the IC card 2 terminates its communication with the reader/writer 1 and the supply of the power thereto has been stopped continues to have its data kept stored therein.

Next, the data transmission/reception processing between the reader/writer 1 and the IC card 2 will be explained.

The reader/writer 1 that has been explained using FIG. 2 radiates prescribed electromagnetic waves from its antenna 27, and, in this state, monitors the state of load of the antenna 27. The reader/writer 1 thereby is kept on standby until it detects the variation in this state of load due to the approach thereto of the IC card 2. It is to be noted that it may be arranged to cause the reader/writer 1 to perform the following piece of processing (polling). Namely, the reader/writer 1 may radiate electromagnetic waves that have been ASK-modulated by data whose pattern is a prescribed short pattern and may thereby repeat a calling over the IC card 2 until a response from the IC card 2 is obtained within a prescribed length of time.

When in the reader/writer 1 the approach thereto of the IC card 2 is detected, the SPU 32 thereof operates as follows. Namely, the SPU 32 uses a rectangular wave signal having a prescribed frequency (e.g. the frequency twice as high as the clock frequency of the data) as a carrier wave. The SPU 32 thereby causes BPSK modulation through the use of data transmitted to the IC card 2 (e.g. a command corresponding to a piece of processing that the IC

card 2 is caused to execute or data that is written into the IC card 2 or the like). The thus-produced modulated wave (BPSK modulated signal) is output to the modulator circuit 23.

Incidentally, at the time of the BPSK modulation, it is possible to cause the data to correspond to a change in the phase of the modulated wave by utilizing a technique of differential conversion. In this case, even when the BPSK modulated signal is inverted, it is demodulated to the original data. Therefore, it becomes unnecessary to consider the conversion of the polarity of the modulated wave when performing demodulation.

The modulator circuit 23 performs ASK modulation of a prescribed carrier wave, with use of the BPSK modulation signal input thereto, at a degree of modulation (= the maximum amplitude of the data signal/the maximum amplitude of the carrier wave) the value of that is less than 1 (for example, 0.1). The modulator circuit 23 transmits the thus-produced modulated wave (ASK modulated wave) to the IC card 2 through the antenna 27.

Incidentally, when no transmission is performed, of the two levels (high level and low level) of the digital signal it is arranged that the modulator circuit 23 produces a modulated wave through the use of, for example, a high-level digital signal.

The IC card 2 that has been explained using FIG. 3 has the IC circuit that is constructed of the antenna 53 and the capacitor 52, in which part of the electromagnetic waves radiated by the antenna 27 of the reader/writer 1 is converted to an electric signal. This electric signal (the modulated wave) is output to the interface part 61 of the IC 51. And, the ASK demodulation part 81

of the interface part 61 performs rectification and smoothing of that modulated wave and thereby performs envelope wave detection of it. The ASK demodulation part 81 supplies the signal that is thereby produced, to the voltage regulator 82 and simultaneously suppresses the direct current components of that signal. It thereby extracts data signal from that signal. It then outputs this signal to the BPSK demodulation part 62 and to the PLL part 63.

It is to be noted that at this time the terminal voltage V_0 of the antenna 53 is expressed in the form of, for example, the following equation (1).

$$V_0 = V_{10} (1 + k \times V_s(t)) \cos(\omega t) \quad \dots (1)$$

where the $V_{10} \cos(\omega t)$ represents the carrier wave; the k represents the degree of modulation; and the $V_s(t)$ represents the data the SPU 32 outputs.

Also, the low-level value V_{LR} of the voltage V_1 after the rectification performed by the ASK demodulation part 81 is expressed in the form of, for example, the following equation (2).

$$V_{LR} = V_{10}(1 + k \times (-1)) - V_f \quad \dots (2)$$

where the V_f represents the voltage drop that occurs in the diode (not illustrated) constituting a rectifier circuit that in the ASK demodulation part 81 is intended to perform rectification and smoothing. The V_f generally is 0.7 volts or so.

When the voltage regulator 82 receives the signal that has been rectified and smoothed by the ASK demodulation part 81, the voltage regulator 82 stabilizes this signal and supplies it to each of the respective relevant circuits including the calculation part 64 as a direct current power source. It is to be noted that here,

as stated above, since the degree of modulation k of the modulated wave is less than 1, the fluctuation in the voltage (the difference between the high level and the low level) after rectification is small. Accordingly, in the voltage regulator 82, it is possible to easily produce the direct current power source.

Here, for example, in case having received the modulated wave the degree of modulation k of that is 5% so that the V_{10} may become equal to or more than 3 volts, the post-rectification low-level voltage V_{LR} becomes equal to or more than $2.15 (= 3 \times (1 - 0.05) - 0.7)$ volts. Therefore, the voltage regulator 82 can supply a voltage that is sufficiently high as the power source, to each of the respective relevant circuits. Further, in this case, the amplitude $2 \times k \times V_{10}$ (the Peak-to-Peak value) of the alternating current component (data component) of the post-rectification voltage V_L becomes $0.3 (= 2 \times 0.05 \times 3)$ volt or more. Therefore, the ASK demodulation part 81 can perform demodulation of the data at a sufficiently high S/N ratio.

In this way, by utilizing the ASK modulated wave the degree of modulation k of that is less than 1, the communication in a state where the error rate is low (i.e. the S/N ratio is high) becomes possible. Simultaneously, the direct current voltage that is sufficient as the power source is supplied to the IC card 2.

When receiving the data (BPSK modulated signal) from the ASK demodulation part 81, the BPSK demodulation part 62 demodulates that data according to the clock signal supplied from the PLL part 63, and outputs the demodulated data to the calculation part 64.

In case the data that has been supplied by the BPSK

demodulation part 62 is the encoded data, the calculation part 64 decodes the encoded data through the operation of the encoding/decoding part 92. This data is supplied to the sequencer 91 and is processed. It is to be noted that the reader/writer 1 is kept on standby in the state of going on to transmit data the value of that is 1 during that time period, i.e. a time period that lasts from the time when the reader/writer 1 has transmitted data to the IC card 2 to the time when the reader/writer 1 receives a response to that data. Accordingly, in that time period, the IC card 2 is receiving the modulated wave the maximum amplitude of that is fixed.

Upon completion of its processing, the sequencer 91 outputs to the BPSK modulation part 68 the response data (the data that it is to transmit to the reader/writer 1) that concerns the processed result, etc. The BPSK modulation part 68 performs BPSK modulation (encoding of the one chester code) of the data that has been input thereto. It thereafter outputs the resulting signal to the ASK modulation part 84 of the interface part 61.

And, the ASK modulation part 84 causes the load connected to each end of the antenna 53 to fluctuate, utilizing the switching element or the like, in correspondence with the data from the BPSK modulation part 68. It thereby performs ASK modulation of the modulated wave it is receiving correspondingly to the data it transmits (at the time of transmitting data from the IC card 2, as stated above, the maximum amplitude of the modulated wave the reader/writer 1 outputs is made fixed). By that ASK modulation, the ASK modulation part 84 causes the fluctuation of the terminal voltage of the antenna 27 of the reader/writer 1, thereby

transmitting the resulting data to the reader/writer 1.

On the other hand, at the time of receiving the data from the IC card 2, the modulator circuit 23 of the reader/writer 1 keeps transmitting the data the value of that is 1 (the high level). And, in the demodulation circuit 25, the data that has been transmitted on from the IC card 2 is detected from a minute level of fluctuation (e.g. several tens of micro-volts) in the terminal voltage of the antenna 27 electro-magnetically coupled to the antenna 53 of the IC card 2.

Further, in the demodulator circuit 25, the signal it has detected (the ASK modulated wave) is demodulated by being amplified with a high-gain amplifier (not illustrated). And the digital data that is resultantly obtained is output to the SPU 32. The SPU 32 demodulates the data having been input thereto (the BPSK modulated signal) and outputs the resulting data to the DPU 31 via the bus 35. The DPU 31 processes the data that has been input from the SPU 32. It according to the processed result determines whether it terminates its communication. And, when it has been determined that it performs the communication again, the DPU 31 performs the communication between the reader/writer 1 and the IC card 2 in the same way as in the above-described case. On the other hand, when it has been determined that the DPU 31 terminates the communication, the communication processing between the reader/writer 1 and the IC card 2 is terminated.

As described above, the reader/writer 1 transmits data to the IC card 2 by utilizing the ASK modulation whose degree of modulation k is less than 1, while the IC card 2 receives that data

and performs processing corresponding to it. The IC card 2 return-transmits the data corresponding to this processed result to the reader/writer 1.

Next, FIG. 4 is a block diagram illustrating the construction of the controller 3 illustrated in FIG. 1.

A control part 101 has input thereto via an internal bus 102 a signal corresponding to each of various kinds of instructions the user has input using an input part 103, and executes various steps of processing that are based on the instructions that have been input thereto. A memory 104 stores therein a program the control part 101 uses, parameters for being used for calculation, parameters that suitably vary during the execution of the program, etc. The control part 101 and the memory 104 are connected to each other by the internal bus 102.

The internal bus 102 is also connected to the input part 103, a display part 105, a drive 106, and a network interface 107. The input part 103 consists of, for example, a keyboard, a mouse, or a bar-code reader and, when inputting various kinds of instructions or data to the control part 101, is operated by the user. The display part 105 consists of, for example, a CRT (Cathode Ray Tube) or the like, and displays various kinds of items of information by means of a text or a picture image. To the drive 106, according to the necessity, there is mounted a magnetic disk 111, an optical disk 112, a magneto-optical disk 113, or a semiconductor memory 114. Each of these elements performs data transmission and reception between itself and the drive.

The network interface 107 is connected to the reader/writer

1 via an RS-485A for example. Or it is connected to a LAN (Local Area Network) by the use of a prescribed interface cable or the like. Or it is connected to a wide-band network such as, for example, an Internet communication network, via the telephone lines not illustrated.

Next, using FIG. 5, an explanation will be given of the logical format of the EEPROM 66 illustrated in FIG. 3.

The EEPROM 66 is constructed in units of a block. For example, in FIG. 5, one block is constructed of 16 bytes.

Further, in FIG. 5, by setting the logical address in the uppermost block to be #0000h (the h represents a hexadecimal number), the logical addresses are allocated on the ascending order. It is to be noted that, in FIG. 5, the addresses from #0000h to #FFFFh are allocated as the logical addresses. Accordingly, 65536 ($=2^{16}$) pieces of blocks are constructed.

It is arranged that the respective blocks be used as user blocks or system blocks. In the respective blocks of the EEPROM 66, they are allocated as the user blocks on the ascending order of the logical addresses. Also, on the descending order thereof, they are allocated as the system blocks. Namely, in FIG. 5, the logical addresses for the user blocks increase in the downward direction, while those for the system blocks increase in the upward direction. And, when the empty blocks have become none, it becomes possible to form neither the user blocks nor the system blocks. Accordingly, the border between the user blocks and the system blocks is not made fixed. Also, the number of the user blocks or the number of the system blocks is not particularly limited (however, in the case of

FIG. 5, the sum total of the user blocks and system blocks is limited to a value that is 65536 pieces or less).

As the system blocks there are five kinds of blocks that include a manufacture ID (Identification) block, issuance ID block, system-definition block, area-definition blocks, and service-definition blocks. Incidentally, in the case of FIG. 5, the blocks that are set to be area-definition blocks or service-definition blocks are illustrated as area/service-definition blocks.

Among the system blocks, three thereof that are the manufacture ID block, issuance ID block, and system-definition block are fundamentally the ones already disposed at the time of the issuance of the IC card 2. Those three system blocks are disposed respectively in the logical address #FFFFh, #FFFEh, and #FFFDh. And, the area/service-definition blocks are disposed respectively at the positions on and upper than the logical address #FFFCh on the order wherein they are produced.

In the manufacture ID block, there is disposed information regarding the manufacture of the IC card 2. Namely, in the manufacture ID block, for example, a unique manufacture ID, manufacture date, or manufacturer code is disposed.

In the issuance ID block, there is disposed information regarding the issuance of the IC card 2. Namely, in the issuance ID block, for example, there is disposed the date on which the IC card 2 is issued, the code that represents the order on which the IC card has been issued, or the card ID.

In the system-definition block, there is disposed, for example, the number of system blocks or user blocks that the EEPROM

66 possesses, or the system keys. It is to be noted that the system key is used when mutual authentication is performed between the IC card 2 and each of the reader/writer 1 and controller 3.

The area-definition block is produced, for example, by the memory areas of the EEPROM 66 being allocated to specific-use-operation areas and joint-use-operation areas as later described, etc. And, in that area-definition block, there is disposed information for managing the memory areas having had those use-operation areas disposed therein, etc. Namely, in the area-definition block, there are disposed, for example, the range of code that corresponds to the specific-operation-use area and joint-use-operation area, the empty capacity of each relevant memory area, the area key, etc.

In the service-definition block, there are disposed items of information (the capacities of the service areas, the service keys, etc.) for managing the service areas having disposed therein applications, as later described, that are used for providing various kinds of services.

Next, an example of the data structure of data stored in the EEPROM 66 of the IC card 2 to which the present invention has been applied will be explained with reference to FIG. 6.

The data stored in the EEPROM 66 includes an OS (Operation System), a common area including an electronic money area and a joint-use-operation, or commonly accessible, area, a specific area, and a card format-definition block that corresponds to the system block explained using FIG. 5.

The OS is a fundamental program for managing an API (

Application Program Interface) for having access to each of the applications that are used for providing various kinds of services disposed in the common area and specific area. In the electronic money area there is disposed an application for providing an electronic money that can be used by the terminal apparatus that all enterprises, co-operating with one another, and the like are managing. Here, the "terminal apparatus" is constructed of, for example, the reader/writer 1 and the controller 3, illustrated in FIG. 1. Of the data stored in the EEPROM 66 of the IC card 2 that has been mounted thereinto, with respect to a prescribed service area thereof, the terminal apparatus performs read and write of data. The terminal apparatus thereby provides a prescribed kind of service.

With respect to the applications that are disposed in the electronic money area and joint-use-operation, or commonly accessible, area, a right to access is authenticated by a common key K_{IF} that will later be described using FIG. 9. Namely, in each of those areas there is disposed an application that the co-operating enterprises, etc., other than an issuer (here referred to as "an issuer A") that has issued the IC card can utilize. The applications disposed in the joint-use-operation area are not utilizable by all the terminal apparatus of the co-operating enterprises. Namely, according to the contents of the co-operations between the issuer A and the co-operating enterprises that manage the terminal apparatus, the applications that are utilizable are limited (the method for limitation will later be described).

With respect to the applications that are disposed in the

specific area, a right to access is authenticated by a specific key A that is owned by the issuer A. In that area, there are disposed the applications the issuer A utilizes.

By the way, there can be considered to exist a case where, under the assumption that the issuer A of the IC card 2 be a company A, the user purchases an item of goods from a company B that is co-operating with the company A. And in this case the user settles the price of that item of goods, by the use of the IC card 2, by utilizing the electronic money service the company A manages. In other words, the company B's managed terminal apparatus has permitted with respect thereto an access to the application for providing an electronic money service that is disposed in a "sum of money area" of the joint-use-operation area of the company A's issued IC card 2.

In this case, the following two steps of processing are originally the same. One is the step of processing in which to utilize the electronic money through the use of the company A's managed terminal apparatus with use of the company A's issued IC card 2 (the process that utilizes the application disposed in a "cashless" in the specific area). The other is the step of processing in which to utilize the electronic money through the use of the company B's managed terminal apparatus with use of the company A's issued IC card 2. In this case, when the service blocks for providing the same kind of service exist in the specific area and in the joint-use-operation area, a real block for this application is disposed in the joint-use-operation area. And, in the relevant block in the specific area, a link with the real block

is made. Thereby, each of the corresponding applications becomes able to be executed.

Namely, with respect to the common applications, the same application is not prepared doubly with respect to the specific area and the joint-use-operation area, but actually the application is disposed with respect to either one of them (in this case, the joint-use-operation area). When an access to the relevant application has occurred from the specific area, there is used the link with the corresponding application in the joint-use-operation area. It is thereby arranged to prevent the waste of the memory capacities in the EEPROM 66 of the IC card 2. In addition, by adopting this linked structure of the data, in case there are common data to both of the specific area and the common area and data has been changed in one of the areas, it becomes unnecessary to execute the processing for changing data in the other thereof by making this processing synchronous to the former change.

Next, an explanation will be given of the case where with respect to the issuer A of the IC card 2 other enterpriser or the like makes a request to have its co-operation with the issuer A, with reference to FIG. 7.

The issuer A issues the IC card 2 according to, for example, a user's request. In the EEPROM 66 of the IC card 2, as explained using FIG. 6, there are recorded the following data. They include the OS, the electronic money area, the joint-use-operation, commonly accessible, area in which there is disposed the application accessible from the co-operating enterprises' managed terminal apparatus, the specific area in which there is disposed the

application accessible from the issuer A's managed terminal apparatus, and data disposed in the card format-definition block.

A data-issuing machine 121 is constructed of, for example, the reader/writer 1 and the controller 3 illustrated in FIG. 1. Also, the data-issuing machine 121 can be installed, for example, in a railway station, a retailing store, or other facilities.

When wanting to change or renew data stored in the EEPROM 66 of the IC card 2, the issuer A registers into the data-issuing machine 121 the contents it wants to change or update. When thereafter the user mounts his IC card 2 into the data-issuing machine 121 (the user brings the IC card 2 into a state where the IC card 2 can make communication with the reader/writer 1 the data-issuing machine 121 contains therein), the data-issuing machine 121 operates as follows. Namely, the data-issuing machine 121 transmits commands and necessary data to the IC card 2 according to the information registered therein to thereby reload or update the contents of the data recorded in the EEPROM 66 of the IC card 2.

On the other hand, assume that a manager B and a manager C each want to provide the service based on the use of the IC card 2 the issuer A has issued. In this case, those managers each conclude a contract with the issuer A, and they have supplied from the issuer A to them necessary data for execution of the authentication processing for authenticating the IC card 2. Those necessary data include a service code corresponding to accessible applications that are accessible according to the contents of the contract, and a necessary common key K_{IF} that is necessary for accessing the applications disposed in the joint-use-operation area explained in

connection with FIG. 6. It may be arranged that those necessary data be supplied, for example, from the issuer A's managed terminal apparatus to the manager B's or C's managed terminal apparatus via a network such as the Internet lines, etc. Or it may be arranged that those necessary data be recorded in, for example, a removable disk and that this removable disk be supplied from the issuer A to the manager B or C.

Also, assume that a manager D, under the control of the manager B, wants to provide the service based on the use of the IC card 2. In this case, the manager D concludes a contract with the manager B, and they have supplied from the manager B to it necessary data for execution of the authentication processing for authenticating the IC card 2. Those necessary data include a service code, and a necessary common key K_{IF} , corresponding to accessible applications that are accessible according to the contents of the contract.

In FIG. 7, an explanation has been given of the case where the manager B and manager C co-operating with the issuer A and the manager D co-operating with the manager B enables the applications of the common areas of the issuer A's issued IC card 2 to be utilized with respect to the issuer A's issued IC card 2 through the use of their own companies' terminal apparatus. However, it may be arranged that each of the managers B, C, and D issues the IC card 2 in which there are disposed in its specific area the applications for providing its own services.

Namely, assume that the issuer A's issued IC card be an IC card 2-1. Then, the manager B can issue an IC card 2-2 the specific

area of that is of a type wherein a right to access is controlled by its own specific key B and has the applications recorded therein, and the common area of that is of a type wherein a right to access is controlled by a common key K_{IF} and has the applications recorded therein. Similarly, the manager C can issue an IC card 2-3 the specific area of that is of a type wherein a right to access is controlled by its own specific key C and has the applications recorded therein, and the common area of that is of a type wherein a right to access is controlled by a common key K_{IF} and has the applications recorded therein. Further, the manager D can issue an IC card 2-4 the specific area of that is of a type wherein a right to access is controlled by its own specific key D and has the applications recorded therein, and the common area of that is of a type wherein a right to access is controlled by a common key K_{IF} and has the applications recorded therein.

An enterpriser that wants to make utilizable by its own company's terminal apparatus the applications in the common area of each of the other companies' issued IC card 2-1 to 2-4 can request co-operating with the issuer of the corresponding IC card. And that enterpriser has supplied thereto an area code corresponding to the utilizable application and has only to register that area code in its company's managed terminal apparatus.

In case, in this way, a plurality of enterprises each issue the IC card 2 by that it can provide its specific service, it may be arranged that enterprises other than the managers that manage the terminal apparatus (e.g. every manager from the issuer A to manager D of FIG. 7) have, for example, an IC card center installed for them

and thereby have the applications in the common area of their IC card 2 unification-managed. In this case, enterprises that want to participate in the IC card system and thereby to provide the service based on the use of the IC card 2 having a common format can register itself in the IC card center and, for example, can pay a registration fee. By doing so, each of those enterprises, when it itself wants to issue the IC card 2, can have a peculiar specific key supplied thereto and issue the IC card 2 for providing its own company's specific service to the user. In addition, that enterpriser can have supplied thereto the common key K_{IF} for accessing the common area of the IC card 2 other enterpriser issues, by using its own company's terminal apparatus.

The IC cards 2-1 to 2-4 can take various kinds of forms correspondingly to the services their respective IC card 2 issuers provide to the user. With reference to FIG. 8, examples of the forms of the services that are provided by the IC cards 2 will hereafter be explained.

The IC card 2-1 is the one that has been produced, for example, by the function as a prepaid card (that is utilizable from the company A's managed vending machines, gulleys, stands, etc.) being added to the function of the IC card (a student identification card, a company's staff identification card, etc.). The IC card 2-1 is utilized, for example, in a school, an office, etc. Also, in case the application regarding a common electronic money disposed in the company A's specific area is the same application as the one corresponding to, for example, the electronic money provided to the IC card system and utilizable in other enterpriser or store (e.g.

the application disposed in the electronic money area, explained using FIG. 6), a link is made between the common electronic money in the specific area and the corresponding application in the common area (hereinafter, the same applies to the cards 2-2 to 2-4 as well).

The IC card 2-2 is the one that is produced, for example, by the function of a prepaid card being added to the cash card of the bank. In this IC card 2-2, in case imparting an addition with respect to the value deposited in the toward-bank electronic money area of it, that addition may be performed as follows. Namely, the user may directly deposit his cash each time the necessity arises, or may transfer money from his account to a prescribed money receipt account. Or the user may produce another account in the same branch office he uses his account in, and thereby may transfer a prescribed amount of money into it as the money that is utilizable by the IC card 2, beforehand, thereby the management thereof may be performed.

The IC card 2-3 is the one that for example has the function of a prepaid card for settlement of the Internet transactions. And, the IC card 2-4 has, excepting that it is prepared for the utilization of the common area, an area whose format is for specifically disposing the applications for providing of their services by various kinds of enterprises or organizations.

Next, an example of a method of supplying authentication information such as the common key K_{IF} in that the issuer A of FIG. 7 supplies that information with respect to the managers B, C, and D will now be explained with reference to FIG. 9. That common key K_{IF} is the one that is intended to permit to each of those managers a

right to access the applications disposed in the common area.

The issuer A of the IC card 2 determines the system key that as explained using FIG. 5 is stored in the system-definition block of the EEPROM 66 and the specific key A that as similarly explained serves as the area key in the area-definition area (e.g. #0000h) corresponding to the specific area. The issuer A thereby causes the system key and the specific key A to be stored, respectively, in the system-definition block of the EEPROM 66 of the IC card 2 it issues and in the area-definition area #0000h thereof, beforehand.

Hereinafter, regarding the area key in the area-definition area #xxxxh, it is described as the area key #xxxxh as the necessity arises.

The control part 101 of the controller 3 of the issuer A's managed terminal apparatus encodes the system key with use of the specific key A to thereby produce an area intermediate key K_A beforehand. Incidentally, as the method of encoding, it is possible to adopt, for example, a DES (Data Encryption Standard) or an FEAL (Fast Data Encipherment Algorithm).

And, when giving the manager B the right to access the common area, the issuer A supplies to the manager B the following. It includes the common key K_{IF} that serves as the area key of the area-definition area (e.g. #0100h) corresponding to the common area, the area intermediate key K_A , the service code and service key corresponding to the application the issuer A permits access to, and the area code #0000h. Namely, the control part 101 of the controller 3 of the issuer A's managed terminal apparatus has supplied thereto from the input part 103 the common key K_{IF} that

serves as the area key of the area-definition area (e.g. #0100h) corresponding to the common area, the area intermediate key K_A , the service code and service key corresponding to the application the issuer A permits access to, and the area code #0000h. It transmits these data items to the controller 3 of the manager B by way of the internal bus 102, network interface 107, and wide-band network such as the Internet communication network not illustrated.

Accordingly, although the manager B's terminal apparatus can recognize the area intermediate key K_A and common key K_{IF} , it cannot recognize the system key and the specific key A of the issuer A that is, so to speak, the parent. However, since the common key K_{IF} of the manager B is the one that has been given to the terminal apparatus of the manager B that is, so to speak, the child, by the terminal of the issuer A that is the parent, the issuer A that is the parent has a recognition of the common key K_{IF} of the manager B that is the child.

The control part 101 of the controller 3 of the manager B's managed terminal apparatus codes the area intermediate key K_A that has been gotten from the issuer A, by the use of the common key K_{IF} that has been gotten from the issuer A. It thereby produces the area intermediate key K_B . It thereby supplies it to the reader/writer 1, together with the common key K_{IF} and the service code and service key, corresponding to the application the access to that has been permitted to it, via the following. Namely, via the internal bus 102, network interface 107, and the network cable such as the RS-485A. It thereby causes these data to be kept stored in the flash memory 22 of the reader/writer 1.

In case imparting the right to access the common area to the manager C, also similarly, the control part 101 of the controller 3 of the issuer A's managed terminal apparatus supplies to the manager C's controller 3 the common key K_{IF} , area intermediate key K_A , service code and service key corresponding to the application the access to that is permitted to it, and area code #0000h.

Accordingly, although the manager C's terminal apparatus can recognize the area intermediate key K_A and the common key K_{IF} , it cannot recognize the system key and the specific key A of the issuer A that is the parent.

The control part 101 of the controller 3 of the manager C's managed terminal apparatus codes the area intermediate key K_A that has been gotten from the issuer A that is the parent, by the use of the common key K_{IF} that has been gotten similarly from the issuer A. It thereby produces an area intermediate key K_C . It thereby supplies it to the reader/writer 1 together with the common key K_{IF} and the service code and service key corresponding to the application the access to that is permitted to it, via the internal bus 102, network interface 107, and network cable such as the RS-485A. It thereby causes these data to be kept stored in the flash memory 22 of the reader/writer 1.

On the other hand, in case imparting to the manager D a part of the right to access the application the access to that is permitted to itself, also similarly, the control part 101 of the controller 3 of the manager B's managed terminal apparatus supplies to the controller 3 of the manager D's managed terminal apparatus the area intermediate key K_B , service code and service key

corresponding to the application the access to that is permitted to it, common key K_{IF} , area code #0100h, and area code #0000h of the issuer A that is the parent.

Accordingly, although the manager D's terminal apparatus can recognize the area intermediate key K_B and the common key K_{IF} , it cannot recognize the system key and the specific key A of the issuer A.

The control part 101 of the controller 3 of the manager D's managed terminal apparatus codes the area intermediate key K_B that has been gotten from the manager A that is the parent, by the use of the common key K_{IF} that has been gotten similarly from the manager B. It thereby produces an area intermediate key K_D . It thereby supplies it to the reader/writer 1 together with the common key K_{IF} and the service code and service key corresponding to the application the access to that is permitted to it, via the internal bus 102, network interface 107, and network cable such as the RS-485A. It thereby causes these data to be kept stored in the flash memory 22 of the reader/writer 1.

It is to be noted that the common key K_{IF} that the issuer A has imparted to each of the managers B and C and that the manager B has imparted to the manager D is written beforehand into the area-definition area #0100h of the EEPROM 66 of the IC card 2, which defines the common area.

Here, an explanation has been given of the case where the issuer A of the IC card 2 supplies authentication information such as the common key K_{IF} to the manager B and to the manager D. However, the same processing is executed also when the above-

described IC card center supplies the authentication information such as the common key K_{IF} to each of the manager B and the manager D.

Next, in case, under the assumption that the supply of the right to access such as that explained in connection with FIG. 9 has been performed, the IC card 2 has been mounted to the issuer A's terminal apparatus, the mutual authentication between the issuer A's terminal apparatus and the IC card 2 in that case will be explained with reference to FIG. 10.

Assume a case where the application stored in the specific area of the EEPROM 6 of the IC card 2 is executed using the issuer A's managed terminal apparatus and a prescribed kind of service be provided to the user. In this case, as illustrated in FIG. 10, the controller 3 of the issuer A's terminal apparatus encodes the following service key by the use of the area intermediate key K_A . That is, the service key (the service key stored in the service-definition area #xxxxh is hereinafter described as the necessity arises as the service key #xxxxh) stored in the service-definition area (e.g. the service-definition area #0008h) corresponding to the application disposed in the specific area. The controller 3 thereby produces a service intermediate key $K_{\#0008h}$. And, it thereby registers this key into the flash memory 22 of the reader/writer 1 together with the area intermediate key K_A . In addition, the issuer A's controller 3 registers the following codes into the flash memory 22 of the reader/writer 1. That is, the area code #0000h in the area-definition area #0000h corresponding to the specific area and the service code in the service-definition area corresponding to the

application, in the specific area, produced in the hierarchy of that area-definition area #0000h.

Namely, assume a case where the IC card 2 is mounted into the issuer A's managed terminal apparatus and the user has instructed the utilization of its desired service. In this case, the DPU 31 of the reader/writer 1 of the issuer A's managed terminal apparatus reads in from the flash memory 22 the area code #0000h registered therein and the service code (e.g. the service code #0008h) corresponding to the service the user has wanted to utilize, similarly registered therein. The DPU 31 transmits these data to the IC card 2 mounted, via the bus 35, SPU 32, modulator circuit 27, and antenna 27. The sequencer 91 of the IC card 2 has input thereto the area code #0000h and service code #0008h from the issuer A's terminal apparatus via the antenna 53, interface part 61, and BPSK demodulation part 62.

And, in the IC card 2, the system key stored in the system-definition block (FIG. 5) is read out from the data stored in the EEPROM 66. Simultaneously, the specific key A is read out from the area-definition area having the area code #0000h received from the issuer A's terminal apparatus. Further, the system key is encoded using the specific key A. Resultantly, there is produced the same key as the area intermediate key K_A registered in the issuer A's terminal apparatus. This same key as the area intermediate key K_A is used as a first access key (authentication key) K_{bc} that is used for authentication of the right to access the specific key.

Also, in the IC card 2, the service key #0008h is read out from the service-definition area having the service code #0008h

received from the issuer A's terminal apparatus. And, the area intermediate key K_A is encoded using the service key #0008h.

Resultantly, there is produced the same key as the area intermediate key $K_{\#0008h}$ registered in the issuer A's terminal apparatus of FIG.

10. This same key as the area intermediate key $K_{\#0008h}$ is used as a second access key (authentication key) K_{ac} that is used for authentication of the right to access the corresponding application.

Accordingly, in the issuer A's terminal apparatus, there are registered the area intermediate key K_A that is the first access key K_{bc} and the service intermediate key $K_{\#0008h}$ that is the second access key K_{ac} . On the other hand, in the IC card 2, the area intermediate key K_A that is the first access key K_{bc} and the service intermediate key $K_{\#0008h}$ that is the second access key K_{ac} are produced. Thereby, the utilization of the application in the specific area corresponding to the service key $K_{\#0008h}$ is authenticated.

Next, in case, under the assumption that the supply of the right to access such as that explained in connection with FIG. 9 has been performed, the IC card 2 has been mounted to the issuer C's terminal apparatus, the mutual authentication between the issuer C's terminal apparatus and the IC card 2 in that case will be explained with reference to FIG. 11.

Assume a case where the application stored in the common area of the EEPROM 66 of the IC card 2 is executed using the issuer C's managed terminal apparatus and a prescribed kind of service be provided to the user. In this case, the controller 3 of the issuer C's managed terminal apparatus encodes by the use of the area intermediate key K_C the following service key disposed in the common

area. That is, the service key (e.g. the service key #1022h) corresponding to the application the access to that is permitted to the manager C. The controller 3 thereby produces a service intermediate key $K_{\#1022h}$. And, it thereby registers this key into the flash memory 22 of the reader/writer 1 together with the area intermediate key K_c . And, the controller 3 of the manager C's managed terminal apparatus registers into the flash memory 22 of the reader/writer 1 of the manager C's managed terminal apparatus the following codes. That is, the area code #0000h of the issuer A, the area code #0100h corresponding to the common area, and the service code in the service-definition area (e.g. the service-definition area #1022h) corresponding to the application the utilization of that has been permitted to it under a relevant contract.

Namely, assume a case where the IC card 2 is mounted into the issuer C's managed terminal apparatus and the terminal apparatus has been operated by the user so as for him to instruct the utilization of a desired service. In this case, the DPU 31 of the reader/writer 1 of the terminal apparatus reads in from the flash memory 22 the area codes #0000h and #0100h registered therein and the service code (e.g. the service code #1022h) corresponding to the service the user has wanted to utilize, similarly registered therein. The DPU 31 transmits these code data to the IC card 2 mounted, via the bus 35, SPU 32, modulation circuit 23, and antenna 27. The sequencer 91 of the IC card 2 has input thereto the area codes #0000h and #0100h and service code #1022h from the manager C's terminal apparatus via the antenna 53, interface part 61, and BPSK demodulation part 62.

And, in the IC card 2, the system key stored in the system-definition block explained using FIG. 5 is read out from the data stored in the EEPROM 66. Simultaneously, the specific key A or common key K_{IF} is read out from the area-definition area having the area code #0000h or #0100h received from the manager C's terminal apparatus. Further, the system key is encoded using the specific key A. Resultantly, there is produced the same key as the area intermediate key K_A . And the same key as that area intermediate key K_A is encoded using the common key K_{IF} . Resultantly, there is produced the same key as the area intermediate key K_C registered in a service provider apparatus 111 of FIG. 14. This same key as the area intermediate key K_C is used as a first access key K_{bc} that is used for authentication of the right to access the common area.

Also, in the IC card 2, from the data stored in the EEPROM 66, the service key #1022h is read out from the service-definition area having the service code #1022h received from the issuer C's managed terminal apparatus. And, the same key as the area intermediate key K_C is encoded using the service key #1022h. Resultantly, there is produced the same key as the area intermediate key $K_{\#1022h}$ registered in the issuer C's managed terminal apparatus. This same key as the area intermediate key $K_{\#1022h}$ is used as a second access key K_{ac} that is used for authentication of the right to access the corresponding application.

Accordingly, in the manager C's managed terminal apparatus, there are registered the area intermediate key K_C that is the first access key K_{bc} and the service intermediate key $K_{\#1022h}$ that is the second access key K_{ac} . On the other hand, in the IC card 2, the area

intermediate key K_c that is the first access key K_{bc} and the service intermediate key $K_{\#1022h}$ that is the second access key K_{ac} are produced.

And, assume a case where, as a result of the mutual authentication, both the data of the IC card 2 and the data of the manager C's managed terminal apparatus have been the ones each of that is proper with respect to the other. In this case, the IC card 2 permits with respect to the manager C's managed terminal apparatus the access to the service area that is managed by the service-definition area having the service code that has been transmitted on from the manager C's managed terminal apparatus. Therefore, in the case that has been explained using FIG. 11, the manager C's managed terminal apparatus becomes able to access the application of the service area that is managed by the service-definition area #1022h of the IC card 2.

That is to say, in the manager C's terminal apparatus in that the area intermediate key K_c , area code #0000h, #0100h, service key #1022h, and service code #1022h are each registered, access can be had to the service area that is under the control of the service-definition area #1022h. But, the manager C's terminal apparatus has not had registered therein other service codes the utilization of that is not permitted under a relevant contract. Therefore, the manager C's terminal apparatus cannot access, until it has issued with respect to it a relevant service code by the issuer A under a new relevant contract, the application in the service area managed in the corresponding relevant service-definition area.

As described above, the terminal apparatus managed

respectively by the manager B that has co-operated with the issuer A issuing the IC card 2, manager C that has similarly co-operated with it, and manager D that has co-operated with the manager B can each utilize, according to the contents of the corresponding co-operation, the application stored in the EEPROM 66 of the IC card 2. (Namely, each of them can access the application corresponding to the service code that has been supplied from the issuer A).

Next, the processing of the terminal apparatus to that the present invention has applied will be explained with reference to the flow chart of FIG. 12. Here, an explanation will be given of the processing executed using the terminal apparatus that has the specific key A and common key K_{IR} and that is managed by the issuer A.

The reader/writer 1 of the terminal apparatus, in step S1, detects the mounting of the IC card with respect to it, for example, by monitoring the state of load of the antenna 2. In step S2, the reader/writer 1 has input thereto from the controller 3 a signal indicating an object-to-be-opened file, which signal among the applications stored in the EEPROM 66 indicates which one of the files should be opened. (Namely, that signal is the one indicating a utilization application with respect to that the user has input with use of the input part 103 of the controller 3 and that has been designated based on the user's operation indicating the utilization of, deposit into, etc. the electronic money). The signal indicating the object-to-be-opened is input to the DPU 31 via the SCC 33 and the bus 35.

In step S3, the reader/writer 1 of the terminal apparatus

performs authentication by the use of the specific key A through the execution of the processing explained using FIG. 10. Namely, the DPU 31 of the reader/writer 1 reads in via the bus 35 the authentication information based on the use of the specific key A stored in the flash memory 22. The DPU 31 then transmits that information to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the modulator circuit 25. It then inputs this response result to the DPU 31 via the bus 35.

In step S4, the DPU 31 of the reader/writer 1 determines whether the reader/writer 1 and the IC card 2 have been correctly authenticated each other, by the specific key A and according to the response signal input in step S3 from the IC card 2. In case in step S4 it has been determined that correct authentication has not been performed, the processing proceeds to step S11.

In case it has been determined in step S4 that correct authentication has been performed (namely, in case the IC card 2 mounted has been the one issued by the issuer A), the DPU 31 of the reader/writer 1 in step S5 acts or operates on the signal indicating the object-to-be-opened file input in step S2. The DPU 32 according to that signal produces a control signal (including the service code corresponding to the object-to-be-opened file) for gaining the right to access the object-to-be-opened file disposed in the EEPROM 66 of the IC card 2. It then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25. Then, it inputs the

corresponding response result to the DPU 31 via the bus 35.

In step S6, the DPU 31 of the reader/writer 1 determines, according to the response signal input in step S5 from the IC card 2, whether it has been able to get the right to access the object-to-be-opened file. In case it has been determined in step S6 that the DPU 31 has failed to get the right to access the object-to-be-opened file, the processing proceeds to step S10.

In case it has been determined in step S6 that the relevant terminal apparatus has been able to get the accessing right, the DPU 31 of the reader/writer 1 produces according to the signal indicating the object-to-be-opened file input in step S2 the following control signal. Namely, the control signal for opening the object-to-be-opened file in the EEPROM 66 of the IC card 2. The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator 23, and antenna 27 together with the specific key A registered in the flash memory 22.

In step S8, the reader/writer 1 performs data transmission/reception with the IC card 2 according to the necessity. In this step S8, the reader/writer 1 executes the command-processings based on, for example, the operation designating the utilization (subtraction) of the electronic money, the filling (addition) thereof, etc. that the user has input in step S2 by the use of the input part 103 of the controller 3. Concrete examples of the processings that are executed will be described later with reference to FIGS. 13 to 18.

In step S9, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S8 into the RAM 42 of the

memory 34 of the reader/writer 1 as a case of utilizing the specific key A. The DPU 31 also produces a control signal for recording into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulation 23, and antenna 27. The antenna 53 of the IC card 2 receives the control signal and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S8 is kept stored in the RAM 67, thereby the processing is terminated.

Assume a case where it has been determined in step S4 that no correct authentication has been performed with the use of the specific key A (namely, a case where the IC card 2 is the one that has been issued by other manager than the issuer A). In step S11, the reader/writer 1 of the terminal apparatus performs authentication with use of the common key K_{IF} according to the process explained using FIG. 11. That is to say, the DPU 31 of the reader/writer 1 reads in the bus 35 the authentication information, the authentication of that is performed using the common key K_{IF} stored in the flash memory 22. Then, it transmits that authentication information to the IC card 2 via the bus 35, SPU 32, modulator 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25. And, it inputs the response result to the DPU 31 via the bus 35.

In step S12, the DPU 31 of the reader/writer 1 operates on the response signal that has been input in step S164 from the IC

card 2. The DPU 31 determines according to that response signal whether the correct authentication has been performed by the common key K_{IF} . In case it has been determined in step S12 that the correct authentication is not performed, the processing proceeds to step S10.

In case it has been determined in step S12 that correct authentication has been performed, in step S13 the DPU 31 of the reader/writer 1 acts or operates on the signal that indicates the object-to-be-opened file that has been input in step S2. The DPU 31 then produces a control signal for gaining the accessing right for the object-to-be-opened file disposed in the EEPROM 66 of the IC card 2 (the control signal including the service code corresponding to the object-to-be-opened file). It then transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 2 and inputs the response result to the DPU 31 via the bus 35.

In step S14, the DPU 31 of the reader/writer 1 determines, according to the response signal input in step S5 from the IC card 2, whether it has been able to get the right to access the object-to-be-opened file. In case it has been determined in step S14 that the DPU 31 has failed to get the right to access the object-to-be-opened file, the processing proceeds to step S10.

In case it has been determined in step S14 that the relevant terminal apparatus has been able to get the accessing right, the DPU 31 of the reader/writer 1 in step S15 produces according to the signal indicating the object-to-be-opened file input in step S2 the

following control signal. Namely, the control signal for opening the object-to-be-opened file in the EEPROM 66 of the IC card 2. The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27 together with the common key K_{IF} registered in the flash memory 22.

In step S16, the reader/writer 1 performs data transmission/reception with the IC card 2 according to the necessity. In this step S2, the reader/writer 1 executes the command-processings input by using the input part 103 of the controller 3 by users based on, for example, the operation designating the utilization of the electronic money, the reference to the data kept stored in the file. Concrete examples of the processings that are executed will be described later with reference to FIGS. 13 to 18.

In step S17, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S16 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the common key K_{IF} . The DPU 31 also produces a control signal for recording into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the control signal and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S16 is kept stored in the RAM 67, thereby the processing is terminated.

In the following cases, the DPU 31 of the reader/writer 1 in

step S10 produces a control signal indicating the contents of the error, and outputs it to the controller 3 via the bus 35 and SCC 33. Namely, a first case is the one wherein in step S6 it has been determined that the DPU 31 has failed to get the accessing right. A second case is the one wherein in step S12 it has been determined that no correct authentication has been performed through the use of the common key K_{IF} . And a third case is the one wherein in step S24 it has been determined that the DPU 31 has failed to get the accessing right. The control part 101 of the controller 3 has input thereto the control signal from the reader/writer 1 via the network interface 107 and the internal bus 102. It then produces an error message for being displayed on the display part 105 and outputs it to the display part 105 via the internal bus 102, thereby the processing is terminated.

Next, concrete examples of the processings explained using FIG. 12 will be explained with reference to FIGS. 13 to 18.

For example, assume that the following be registered in the electronic money area of the common area, or the mutual-use-operation area, of the IC card 2, which has been explained using FIG. 6. Namely, the respective co-operating stores, and the application (the for-joint-use-operation, or commonly accessible, electronic value file) enabling the use of the "for-joint-use-operation (commonly accessible) electronic value" that can be used when purchasing an item of goods (i.e. having the same value as that of money or currency). Also, in the specific area, as well, of the IC card 2, there is disposed the commonly accessible electronic value file, that is linked with the commonly accessible electronic

value file of the common area.

It is here assumed that it be set that the commonly accessible electronic value can be used the stores of all enterprises taking part in the IC card use operation system.

(Namely, it is set that all terminal apparatus each have registered therein an area code corresponding to the application for executing the subtraction of the amount of commonly accessible electronic value). On the other hand, it is assumed that it be set that the application for increasing the amount of electronic value by the filling, i.e. deposit of money or the like, with respect to the commonly accessible electronic value can only be used with the terminal apparatus the enterpriser having issued the corresponding IC card 2 manages.

With reference to the flow chart of FIG. 13, the commonly accessible electronic value filling process the terminal apparatus, managed by the issuer A that has issued the IC card 2, executes will now be explained.

In step S21, the reader/writer 1 of the terminal apparatus detects the IC card 2 that has been mounted thereto. Then, the reader/writer 1 has input thereto from the controller 3 the filling amount of for-joint-use-operation, or commonly accessible, electronic value the user has input using the input part 103 of the controller 3. Namely, the object-to-be-opened file is a for-joint-use-operation electronic value file, and the filling amount of for-joint-use-operation electronic value is input to the DPU 31 via the SCC 33 and the bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus,

in step S22 and in step S23, executes the same pieces of processing as in the step S3 and in the step S4 of FIG. 12. In case it has been determined in step S23 that correct authentication has not been performed, the processing proceeds to step S29.

In case it has been determined in step S23 that correct authentication has been performed (namely, in case the IC card 2 has been the one issued by the issuer A), the DPU 32 of the reader/writer 31 in step S24 produces a control signal (including the service code corresponding to the for-joint-use-operation, or commonly accessible, electronic value file) for gaining the right to access the for-joint-use-operation electronic value file recorded in the specific area of the EEPROM 66 of the IC card 2. It then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. It is to be noted that the real file of the for-joint-use-operation electronic value stored in the specific area of the EEPROM 66 of the IC card 2 is recorded in the common area. And, that real file is linked from the for-joint-use-operation electronic value file recorded in the specific area. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25. Then, it inputs the corresponding response result to the DPU 31 via the bus 35.

In step S25, the DPU 31 of the reader/writer 1 determines, according to the response signal input in step S24 from the IC card 2, whether the terminal apparatus has permitted thereto the right to access the application corresponding to the addition processing of the amount of value with respect to the for-joint-use-operation electronic value file. In case it has been determined in step S25

that the terminal apparatus does not have permitted thereto the accessing right, the processing proceeds to step S29.

In case it has been determined in step S25 that the accessing right is permitted, the DPU 31 of the reader/writer 1 in step S26 produces the following control signal. Namely, the control signal for opening the joint-use-operation electronic value file (real file) in the common area, which file is linked with and from the joint-use-operation electronic value file in the specific area in the EEPROM 66 of the IC card 2. Then the SPU 31 transmits that control signal to the IC card 2 together with the specific key A via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

In step S27, the DPU 31 of the reader/writer 1 executes a filling piece of processing for filling the for-joint-use-operation electronic value, according to the filling amount of money the user has input using the input part 103 of the controller 3. Namely, the DPU 31 produces the following control signal. The one for adding the filling amount of money input from the controller 3, to the remainder of the for-joint-use-operation electronic value recorded in the for-joint-use-operation electronic value file and registered in the common area of the IC card 2. The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

The antenna 53 of the IC card 2 receives the ASK modulation signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Prescribed pieces of processing are executed in the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, the

control signal that has been transmitted from the reader/writer 1 is input to the sequencer 91. Then the sequencer 91 according to the control signal input thereto changes the remainder of the for-joint-use-operation electronic value recorded in the EEPROM 66.

In step S28, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S27 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the specific key A. The DPU 31 also produces a control signal for recording the same log into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulation signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S27 is kept stored in the RAM 67, thereby the processing is terminated.

In case correct authentication has not been performed in step S23 or in case it has been determined in step S25 that the accessing right to the relevant file (the accessing right for accessing the addition processing) is not permitted, in step S29 the same processing as in the step S10 of FIG. 12 is executed, thereby the processing is terminated.

Also, it may be arranged that the issuer A records into the specific area of the EEPROM 66 of the IC card 2 the application for providing as the service with respect to the user the following service. The service that supplies a service point that is

utilizable only by the terminal apparatus the issuer A manages. For example, it may thereby be arranged that the service point corresponding to the amount of money at which an item of goods has been purchased, etc. can be supplied to the IC card 2 the corresponding user has. In this case, the control part 101 of the controller 3 calculates the adding amount of money corresponding to the for-specific-use-operation service point according to the utilized amount of money of the for-joint-use-operation electronic value the user has input using the input part 103 of the controller 3, etc. Then the control part 101 outputs the resulting adding amount of money to the reader/writer 1 via the internal bus 102 and the network interface 107.

Next, the for-specific-use-operation, or specific-accessible, service point write-in process that the terminal apparatus managed by the issuer A executes will be explained with reference to the flow chart of FIG. 14.

In step S41, the reader/writer 1 of the issuer A's managed terminal apparatus detects the IC card that has been mounted thereto. And, it has input thereto the adding amount of money corresponding to the for-specific-use-operation service point, from the controller 3. Namely, the object-to-be-opened file is the for-specific-use-operation service point file. The adding amount of money corresponding to the for-specific-use-operation service point is input to the DPU 31 via the SCC 33 and the bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus, in step S42 and in step S43, executes the same pieces of processing as in the step S3 and in the step S4 of FIG. 12. In case it has

been determined in step S43 that correct authentication has not been performed, the processing proceeds to step S49.

In case it has been determined in step S43 that correct authentication has been performed (i.e. in case the IC card 2 is the issuer A's issued IC card 2), in step S44 the DPU 31 of the reader/writer 1 produces the following control signal. The control signal for gaining the accessing right to the for-specific-use-operation, or specific-accessible, service point file recorded in the specific area of the EEPROM 66 of the IC card 2 (the control signal including the service code corresponding to the for-specific-use-operation service point file). It then transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25 and inputs the response result to the DPU 31 via the bus 35.

In step S45, the DPU 31 of the reader/writer 1 determines, according to the response signal input in step S44 from the IC card 2, whether it has had permitted thereto the right to access the addition processing with respect to the for-specific-use-operation service point. In case it has been determined in step S45 that the accessing right is not permitted, the processing proceeds to step S49.

In case it has been determined in step S45 that the accessing right is permitted, in step S46 the DPU 31 of the reader/writer 1 produces the following control signal. The control signal for opening the for-joint-use-operation service point addition file that is disposed in the EEPROM 66 of the IC card 2. The DPU 31

transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27 jointly with the specific key A registered in the flash memory 22.

In step S47, the DPU 31 of the reader/writer 1 acts or operates on the adding amount of money corresponding to the for-specific-use-operation service point, that has been input from the controller 3 in step S41. The DPU 31 according to that adding amount of money executes the addition processing corresponding to the for-specific-use-operation service point. Namely, the DPU 31 produces a control signal for adding the adding amount of money corresponding to the for-specific-use-operation service point to the following for-specific-use-operation service point remainder. Namely, the for-specific-use-operation service point remainder that is recorded in the for-specific-use-operation service point file registered in the specific area of the IC card 2. The DPU 31 then transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Prescribed pieces of processing are executed in the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, the control signal that has been transmitted from the reader/writer 1 is input to the sequencer 91. Then the sequencer 91 according to the control signal input thereto changes the remainder of the for-joint-use-operation electronic value recorded in the EEPROM 66.

In step S48, the DPU 31 of the reader/writer 1 records the

log of the processing executed in step S47 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the specific key A. The DPU 31 also produces a control signal for recording the same log into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S47 is kept stored in the RAM 67, thereby the processing is terminated.

In case correct authentication has not been performed in step S43 or in case it has been determined in step S45 that the accessing right to the relevant file (the accessing right for accessing the addition processing) is not permitted, in step S49 the same processing as in the step S10 of FIG. 12 is executed, thereby the processing is terminated.

For example, it may be arranged that the issuer A of the IC card 2 can provide through the use of the issuer A's managed terminal apparatus the following service. Namely, the service of adding the for-specific-use-operation service point explained using the flow chart of FIG. 14 at the time of the filling with respect to the for-joint-use-operation electronic value explained using the flow chart of FIG. 13. In this case, the control part 101 of the controller 3 operates on the filling amount of money with respect to the for-joint-use-operation electronic value that the user has input

using the input part 103 of the controller 3. The control part 101 according to that filling amount calculates the adding amount corresponding to the for-specific-use-operation service point, for example, using a prescribed calculation method of calculating 5% of that filling amount. The control part 101 thereby outputs it to the reader/writer 1 via the internal bus 102, and network interface 107.

The write-in process for the for-joint-use-operation electronic value and for-specific-use-operation service point will now be explained with reference to the flow chart of FIG. 15.

In step S61, the reader/writer 1 of the terminal apparatus detects the IC card 2 that has mounted thereto. It then has input thereto from the controller 3 the following. Namely, the filling amount of for-joint-use-operation electronic value and the adding amount corresponding to the for-specific-use-operation service point determined correspondingly to that filling amount, that the user has input using the input part 103 of the controller 3. Namely, the object-to-be-opened file is the for-joint-use-operation electronic value file and the for-specific-use-operation service point file. And the filling amount of for-joint-use-operation electronic value and the adding amount corresponding to the for-specific-use-operation service point are input to the DPU 31 via the SCC 33 and the bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus, in step S62 and in step S63, executes the same pieces of processing as in the step S3 and in the step S4 of FIG. 12. In case it has been determined in step S63 that correct authentication has not been performed, the processing proceeds to step S69.

In case it has been determined in step S63 that correct authentication has been performed (i.e. in case the IC card 2 is the issuer A's issued IC card 2), in step S64 the DPU 31 of the reader/writer 1 produces the following control signal. The control signal for gaining the accessing right for the for-common-use-operation electronic value file and for-specific-use-operation service point file recorded in the specific area of the EEPROM 66 of the IC card 2. (The control signal including the service code corresponding to the for-common-use-operation electronic value file and for-specific-use-operation service point file). It then transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

It is to be noted that the real file of the for-joint-use-operation electronic value file stored in the specific area of the EEPROM 66 of the IC card 2 is recorded in the common area. And that real file is linked with the for-joint-use-operation electronic value file recorded in the specific area. Also, the for-specific-use-operation service point file stored in the specific area of the EEPROM 66 of the IC card 2 is the application stored only in the specific area. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25, and inputs the response result thereof to the DPU 31 via the bus 35.

In step S65, the DPU 31 of the reader/writer 1 determines, according to the response signal input in step S64 from the IC card 2, whether it has had permitted thereto the following rights to access. Namely, the right to access the addition processing for the amount of value the addition of that is performed using the for-joint-use-operation electronic value file and the right to access

the addition processing that is executed using the for-joint-use-operation service point file. In case it has been determined in step S65 that the accessing right is not permitted, the processing proceeds to step S69.

In case it has been determined in step S65 that the accessing right is permitted, in step S66 the DPU 31 of the reader/writer 1 produces the following control signal according to the following indication signals. These indication signals are the ones that respectively indicate the filling amount of for-joint-use-operation electronic value and the adding amount of for-specific-use-operation service point, each of that has been input in step S61. That control signal is the one for opening the for-joint-use-operation electronic value file (i.e. real file) linked with the for-joint-use-operation electronic value file in the specific area disposed in the EEPROM 66 of the IC card 2, and the for-specific-use-operation service point file in the specific area. The DPU 31 transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27 jointly with the specific key A.

In step S67, the DPU 31 of the reader/writer 1 operates on the filling amount that is added to the for-joint-use-operation electronic value and has been input in step S61. The DPU 31 according to that filling amount that is added to the for-joint-use-operation electronic value executes the filling process with respect to the for-joint-use-operation electronic value and the addition processing corresponding to the for-specific-use-operation service point. Namely, the DPU 31 produces the following control signals.

Namely, one control signal is the one for adding the filling amount for the for-joint-use-operation electronic value input from the controller to the remainder of the for-joint-use-operation electronic value recorded in the for-joint-use-operation electronic value file registered in the common area of the IC card 2. The other control signal is the one for adding the adding amount corresponding to the for-specific-use-operation service point input from the controller 3 to the remainder of the for-specific-use-operation service point recorded in the for-specific-use-operation service point file registered in the specific area. The DPU 31 then transmits them to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Prescribed pieces of processing thereby are executed in the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, the control signal that has been transmitted from the reader/writer 1 is input to the sequencer 91. Then the sequencer 91 according to the control signal input thereto changes the remainders of the for-joint-use-operation electronic value and for-specific-use-operation service point recorded in the EEPROM 66.

In step S68, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S67 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the specific key A. The DPU 31 also produces a control signal for recording the same log into the RAM 67 of the IC card 2, and transmits it to the

IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S67 is kept stored in the RAM 67, thereby the processing is terminated.

In case correct authentication has not been performed in step S63 or in case it has been determined in step S65 that the accessing right to the relevant file (the accessing right for accessing the addition processing) is not permitted, in step S69 the same processing as in the step S10 of FIG. 12 is executed, thereby the processing is terminated.

Next, with reference to FIG. 16, there will be explained the right to access the application for executing pieces of processing on the for-joint-use-operation electronic value and for-specific-use-operation service point.

For example, assume that a for-joint-use-operation electronic value of 1000 yen be registered in the common area of the company A's issued IC card 2 and that a for-specific-use-operation service point of 50 points (corresponding to 50 yen) be registered in the specific area. In this case, regarding the for-joint-use-operation electronic value and for-specific-use-operation service point that each are registered in the enterpriser A's issued IC card 2, using the specific key A registered in the company A's terminal apparatus 131-1, it is possible to access the application for

executing each of the addition processing and subtraction processing concerned therewith. (In case in the company A's terminal apparatus 131-1 access is had to the application concerned with the for-joint-use-operation electronic value by the use of the registered specific key A, in actuality access is had to the application concerned with the for-joint-use-operation electronic value in the common area, by way of the linked portion in the specific area.)

However, in the co-operating company B's terminal apparatus 131-2, it is certainly possible to access the application for executing the subtraction processing with respect to the for-joint-use-operation electronic value by using the common key K_{IF} registered therein. However, that terminal apparatus does not have the right to access the application for executing the addition processing with respect to the for-joint-use-operation electronic value and that for executing the processing with respect to the for-specific-use-operation service point registered in the specific area. That is to say, assume that the user has paid 200 yen by using the enterpriser A's managed terminal apparatus 131-1. In this case, it results that the user pays 200 yen from the amount of money of 1050 yen that is obtained by adding up the two service blocks. But, in case the user has paid 200 yen through the use of the company B's managed terminal apparatus 131-2, it results that the user pays 200 yen from the 1000 yen in the common area.

Next, there will be explained with reference to the flow chart of FIG. 17 the point/value utilization process in the case where the company A's issued IC card 2 has been used in an object store with respect to that the specific-use-operation of the IC card

2 is permitted. (This object store, for example, is the one that is equipped with the company A's managed terminal apparatus 131-1 in FIG. 16.)

In step S81, the reader/writer 1 of the terminal apparatus detects the IC card 2 that has been mounted thereto. Then the reader/writer 1 has input thereto the amount of money that the store has utilized and that the user has input from the controller 3 by the use of the input part 103 thereof. Namely, the object-to-be-opened file is the for-joint-use-operation electronic value file and for-specific-use-operation service point file each of that can be utilized for purchasing an item of goods in the object store with respect to that the specific-use-operation of the IC card 2 is permitted. And the user's utilizing amount of money, i.e. a sum total of the subtracting amount of money corresponding to the for-joint-use-operation electronic value and the subtracting amount of money corresponding to the for-specific-use-operation service point is input to the DPU 31 via the SCC 33 and bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus, in step S82 and in step S83, executes the same pieces of processing as in the step S82 and in the step S83 of FIG. 12. In case it has been determined in step S83 that correct authentication has not been performed, the processing proceeds to step S91.

In case it has been determined in step S83 that correct authentication has been performed (i.e. in case the IC card 2 is the issuer A's issued IC card 2), in step S84 the same processing as in step S64 of FIG. 15 is executed.

In step S85, the DPU 31 of the reader/writer 1 determines,

according to the signal input in step S84 from the IC card 2, whether it has had permitted thereto the following rights to access. Namely, the right to access the subtraction processing for the amount of value the subtraction of that is performed using the for-joint-use-operation electronic value file and the right to access the subtraction processing that is executed using the for-joint-use-operation service point file. In case it has been determined in step S85 that the accessing right is not permitted, the processing proceeds to step S91.

In case it has been determined in step S85 that the accessing right is permitted, in step S86 the DPU 31 of the reader/writer 1 produces the following control signal. The control signal for opening the for-joint-use-operation electronic value file (i.e. real file) in the common area linked with the for-joint-use-operation electronic value file in the specific area disposed in the EEPROM 66 of the IC card 2 and the for-specific-use-operation service point file in the specific area. The DPU 31 transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27 jointly with the specific key A.

In step S87, the DPU 31 of the reader/writer 1 reads in from the for-joint-use-operation electronic value file (i.e. real file) in the common area and the for-specific-use-operation service point file in the specific area, which have been opened in step S86, the following amounts of money. Namely, the amount of money corresponding to the for-joint-use-operation electronic value and that corresponding to the for-specific-use-operation service point. The DPU 31 thereby calculates a utilizable range of the amounts of

money (i.e. a sum of the amount of money corresponding to the for-joint-use-operation electronic value and that corresponding to the for-specific-use-operation service point.). Thereby, the DPU 31 according to the signal indicating the user's utilizing amount of money determines whether his utilizing amount of money is within the utilizable range input in the step S81. In case it has been determined in step S87 that his utilizing amount of money is not within the utilizable range, the processing proceeds to step S91.

In case it has been determined in step S78 that the utilizing amount of money is within the utilizable range, in step S88 the DPU 31 of the reader/writer 1 calculates the subtracting amount of money to be subtracted from each of the for-joint-use-operation electronic value and the for-specific-use-operation service point, according to the user's utilizing amount of money that has been input in step S81. In calculating that subtracting amount of money, there may be adopted the following methods. Namely, it may be arranged to preferentially perform the subtraction from the for-specific-use-operation service point. Or it may be arranged that the subtraction ratio between the for-joint-use-operation electronic value and the for-specific-use-operation service point be able to be set through the user's operation.

In step S89, the DPU 31 of the reader/writer 1 executes the subtraction process for the for-joint-use-operation electronic value and that for the for-specific-use-operation service point. Namely, the DPU 31 produces a control signal for subtracting the utilizing amount of money corresponding to the for-joint-use-operation electronic value and that for the for-specific-use-operation service

point, each of that has been calculated in step S88, from the following remainders. Namely, one remainder is the one of the for-joint-use-operation electronic value recorded in the for-joint-use-operation electronic value file that is registered in the common area of the IC card 2. The other remainder is the one of the by-specific-use-operation service point recorded in the for-specific-use-operation service point file that is registered in the specific area. The DPU 31 thereby transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Prescribed pieces of processing thereby are executed in the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, the control signal that has been transmitted from the reader/writer 1 is input to the sequencer 91. Then the sequencer 91 according to the control signal input thereto changes the remainders of the for-joint-use-operation electronic value and for-specific-use-operation service point recorded in the EEPROM 66.

In step S90, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S89 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the specific key A. The DPU 31 also produces a control signal for recording the same log into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the

reader/writer 1 and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S89 is kept stored in the RAM 67, thereby the processing is terminated.

In case correct authentication has not been performed in step S83 or in case it has been determined in step S85 that the accessing right to the relevant file (the accessing right for accessing the subtraction processing) is not permitted, or it has been determined in step S87 that the utilizing amount of money is not within the utilizable range, in step S91 the same processing as in the step S10 of FIG. 12 is executed, thereby the processing is terminated.

Next, there will be explained with reference to the flow chart of FIG. 18 the electronic value utilization process that is executed by the following object store with respect to that the joint use operation is permitted. (That store is the one equipped with the terminal apparatus 131-2 that is managed by, for example, the company B in FIG. 16 that is other than the issuer of the IC card 2).

In step S101, the reader/writer 1 of the terminal apparatus detects the IC card 2 that has been mounted thereto. Then, the reader/writer 1 has input thereto from the controller 3 the utilizing amount in the store the user has input using the input part 103 of the controller 3. Namely, the object-to-be-opened file is a for-joint-use-operation electronic value file that can be utilized for purchasing an item of goods in the object store with

respect to that the joint use operation is permitted. And the user's utilizing amount of money, i.e. the subtracting amount of money with respect to the for-joint-use-operation electronic value is input to the DPU 31 via the SCC 33 and the bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus, in step S102 and in step S103, executes the same pieces of processing as in the step S11 and in the step S12 of FIG. 12. In case it has been determined in step S103 that correct authentication has not been performed, the processing proceeds to step S111.

In case it has been determined in step S103 that correct authentication has been performed (namely, in case the IC card 2 has been the one that is able to be authenticated using the common key K_{IR}), the DPU 32 of the reader/writer 31 in step S104 produces the following control signal. (The control signal includes the service code corresponding to the for-joint-use-operation electronic value file). That control signal is the one for gaining the right to access the for-joint-use-operation electronic value file and the for-joint-use-operation service point file recorded in the specific area of the EEPROM 66 of the IC card 2. The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

In step S105, the DPU 31 of the reader/writer 1 determines, according to the signal input in step S104 from the IC card 2, whether the terminal apparatus has permitted thereto the right to access the application corresponding to the subtraction processing for the subtracting amount of value with respect to the for-joint-use-operation electronic value file. In case it has been determined

in step S105 that the terminal apparatus does not have permitted thereto the accessing right, the processing proceeds to step S111.

In case it has been determined in step S105 that the accessing right is permitted, the DPU 31 of the reader/writer 1 in step S106 produces the following control signal. Namely, the control signal for opening the for-joint-use-operation electronic value file in the common area, which file is disposed in the EEPROM of the IC card 2. Then the DPU 31 transmits that control signal to the IC card 2 together with the common key K_{IF} via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and demodulator circuit 25, and inputs the response signal thereof to the DPU 31 via the bus 35.

In step S107, the DPU 31 of the reader/writer 1 reads in the for-joint-use-operation electronic value remainder from the for-joint-use-operation electronic value file in the common area that has been opened in step S106. Thereby, the DPU 31 according to the signal indicating the user's utilizing amount of money determines whether his utilizing amount of money is within the utilizable range (the range defined by the for-joint-use-operation electronic value remainder). In case it has been determined in step S107 that his utilizing amount of money is not within the utilizable range, the processing proceeds to step S111.

In case it has been determined in step S107 that the utilizing amount of money is within the utilizable range, in step S108 the DPU 31 of the reader/writer 1 calculates the subtracting amount of money with respect to the for-joint-use-operation

electronic value according to the user's utilizing amount of money that has been input in step S101.

In step S109, the DPU 31 of the reader/writer 1 executes the subtraction process for the for-joint-use-operation electronic value. Namely, the DPU 31 produces a control signal for subtracting the utilizing amount of money corresponding to the for-joint-use-operation electronic value that has been calculated in step S108, from the following remainder. Namely, the remainder of the for-joint-use-operation electronic value recorded in the for-joint-use-operation electronic value file that is registered in the common area of the IC card 2. The DPU 31 thereby transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Prescribed pieces of processing thereby are executed in the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, the control signal that has been transmitted from the reader/writer 1 is input to the sequencer 91. Then the sequencer 91 according to the control signal input thereto changes the remainder of the for-joint-use-operation electronic value recorded in the EEPROM 66.

In step S110, the DPU 31 of the reader/writer 1 records the log of the processing executed in step S109 into the RAM 42 of the memory 34 of the reader/writer 1 as a case of utilizing the common key K_{IF} . The DPU 31 also produces a control signal for recording the

same log into the RAM 67 of the IC card 2, and transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1 and supplies it to the interface part 61. Thereby, in the interface part 61, BPSK demodulation part 62, and calculation part 64, a prescribed piece of processing is executed. And, the log of the processing executed in step S109 is kept stored in the RAM 67, thereby the processing is terminated.

In case correct authentication has not been performed in step S103 or in case it has been determined in step S105 that the accessing right to the relevant file (the accessing right for accessing the subtraction processing) is not permitted, or it has been determined in step S107 that the utilizing amount of money is not within the utilizable range, in step S111 the same processing as in the step S10 of FIG. 12 is executed, thereby the processing is terminated.

In each of the processes that have been explained with reference to the flow charts of FIGS. 17 and 18, the log of the utilization is recorded by being classified in units of a key that is used. As a result of this, the settlement corresponding to the utilization (local utilization) of the IC card 2 based on the use of the specific key can be performed within a relevant company's system.

And, it may be arranged that, in order to execute the settlement processing corresponding to the joint utilization, the log of the utilization in the case where the IC card 2 has been

utilized using the common key K_{IF} be gathered at the above-described IC card center. It may thereby be arranged that the settlement processing corresponding to the joint utilization be executed by the IC card center. It may thereby be arranged that the settlement information indicating the result of the settlement processing be notified to each of the respective co-operating managers. Assume now that a company A be the issuer of the IC card 2 and that a company B be a company with that the company A co-operates. Then, there are, for example, the following two recovery methods for recovering the log of the utilization corresponding to the utilization of the common key K_{IF} . One recovery method is that, as illustrated in FIG. 19A, the company A's terminal apparatus 131-1 supplies the whole utilization log to the company A's managed personal computer 141-1. And, of the whole utilization log that has been input, the personal computer 141-1 transmits the log in the case where the IC card has been utilized using the common key K_{IF} to a personal computer 141-3 of the IC card center. The other recovery method is that, as illustrated in FIG. 19B, the company A's terminal apparatus 131-1 the log in the case where the IC card has been utilized using the common key K_{IF} , directly, to the personal computer 141-3 of the IC card center.

The personal computer 141-3 of the IC card center has input thereto the log in the case where the IC card 2 has been utilized using the common key K_{IF} . The personal computer 141-3 thereby executes the settlement processing corresponding to the joint utilization. The personal computer 141-3 thereby supplies the settlement information, which is the result of the executed

settlement processing, to the personal computer 141-1 of the company A, which is the issuer of the IC card 2, and the personal computer 141-2 of the company B, which is the company with that the company A co-operates.

FIG. 20 is a block diagram illustrating the construction of the personal computer 141-1. It is to be noted that the construction of the personal computers 141-2 and 141-3 is the same as that of the personal computer 141-1. Therefore, an explanation of that construction will be omitted.

The CPU 151 has input thereto signals that correspond to various kinds of instructions the user has input using the input part 154, by way of an input/output interface 152 and an internal bus 153. The CPU 151 also has input thereto a control signal that the other personal computers, etc. have transmitted, by way of the network interface 160. The CPU 151 thereby executes various kinds of pieces of processing that are based on the use of the signals that have been input thereto. The ROM 155 has stored therein data that are basically fixed of the programs and calculation parameters the CPU 151 uses. The RAM 156 has stored therein the programs the CPU 151 executes uses in its operation and the parameters that suitably vary during the execution of the operation of the CPU 151. The CPU 151, ROM 155, and RAM 156 are connected to one another by means of an internal bus 153.

The internal bus 153 is connected also to the input/output interface 152 as well. The input part 154 consists, for example, of a keyboard or mouse that when inputting various kinds of instruction commands to the CPU 151 the user operates. The display part 157

consists, for example, of a CRT or the like, and the display thereof is performed with the use of various kinds of items of information, texts, or images. A HDD (hard disk drive) 158 drives a hard disk and causes the hard disk to record therein or reproduce therefrom the program or information the CPU 151 executes. With respect to a drive 159, as the necessity arises, there is mounted a magnetic disk 161, an optical disk 162, a magneto-optical disk 163, or a semiconductor memory 164. Thereby, transmission/reception of data is performed between the both.

The network interface 160 is connected to a LAN (Local Area Network) by the use of, for example, a prescribed interface cable, etc. The network interface 160 is connected to a wide-band network such as, for example, an Internet communication network through the telephone lines not illustrated. The network interface 160 thereby performs data transmission/reception to and from, for example, the terminal apparatus 131, personal computer 141-2, personal computer 141-3, etc.

These elements from the input part 154 to the network interface 160 are each connected to the CPU 151 by way of the input/output interface 152 and the internal bus 153.

Next, an explanation will be given of the settlement process (FIG. 19A) that is executed between the company A that is the issuer of the IC card 2 and the company B in the following case with reference to FIG. 21. Namely, the case where the company A's terminal apparatus 131-1 supplies all the utilization logs to the issuer A's personal computer 141-1 and this computer 141-1 transmits to the IC card center the utilization logs based on the use of the

common key K_{IF} .

In step S 121, the control part 101 of the controller 3 of the company A's managed terminal apparatus 131-1 reads in via the network interface 107 and the internal bus 102 the utilization log recorded in the RAM 42 of the reader/writer 1. (That utilization log is, for example, the one that is recorded through the execution of the step S28 of FIG. 13, the step S48 of FIG. 14, the step S68 of FIG. 15, the step S90 of FIG. 17, or the step S110 of FIG. 18.) Thereafter, the control part 101 supplies that utilization log to the company A's personal computer 141-1 via the internal bus 102 and the network interface 107.

In step S122, the CPU 151 of the personal computer 141-1 analyzes the utilization log input thereto via the network interface 160, input/output interface 152, and internal bus 153. The CPU 151 thereby classifies it into the log utilized using the common key A and the log utilized using the common key K_{IF} .

In step S123, the CPU 151 of the personal computer 141-1 determines according to the analysis result in step S122 whether the utilization based on the use of the common key K_{IF} has been performed.

In step S123, in case it has been determined that no utilization based on the use of the common key K_{IF} has been performed, the CPU 151 in step S124 performs the following settlement. Namely, the settlement corresponding to the local utilization based on the use of the specific key A, i.e. the local utilization that has been performed using the IC card 2 a relevant company itself has issued and using the terminal apparatus 131-1

this relevant company itself manages.

Assume next that it has been determined in step S123 that the utilization based on the use of the common key K_{IF} has been performed. Then, the CPU 151 notifies the utilization log corresponding to the common key K_{IF} to the personal computer 141-3 of the IC card center via the internal bus 153, input/output interface 152, and network interface 160. Then the CPU 151 executes the above-described processing in the step S124.

In step S126, the CPU 151 of the personal computer 141-3 of the IC card center has notified thereto the utilization log corresponding to the common key K_{IF} the personal computer 141-1 has transmitted in step S125. This notification is made via the network interface 160, input/output interface 152, and internal bus 153. The CPU 151 of the personal computer 141-3 of the IC card center has received therein not only the notification from the company A that has been made in step S125 but also the notification from each enterpriser to that the company A is contracted.

In step S127, the CPU 151 of the personal computer 141-3 analyzes the input utilization log corresponding to the common key K_{IF} in each enterpriser's terminal apparatus by a method of, for example, classifying and calculating it every utilizing enterpriser.

In step S128, the CPU 151 of the personal computer 141-3 converts the mutual utilization (enterpriser-to-enterpriser's) relationship into a matrix every issuer of the IC card according to the analyses results in step S127.

In step S129, the CPU 151 of the personal computer 141-3 produces the settlement information for being notified to each

company, by the use of the matrix of the mutual or joint utilization (enterpriser-to-enterpriser's) relationship having been produced in step S128. The CPU 151 then notifies that information to the company A's personal computer 141-1 and company B's personal computer 141-2 via the internal bus 153, input/output interface 152, and network interface 160.

In step S130, the CPU 151 of the personal computer 141-1 receives the settlement information corresponding to the mutual utilization the personal computer 141-3 has transmitted in step S129, via the network interface 160, input/output interface 152, and internal bus 153. Similarly, in step S132, the CPU 151 of the personal computer 141-2 receives the settlement information corresponding to the mutual utilization the personal computer 141-3 has transmitted in step S129, via the network interface 160, input/output interface 152, and internal bus 153. Here in this context of the specification, explanation is made under the assumption that mutual utilization has been performed between the companies A and B.

In step S131, the CPU 151 of the personal computer 141-1 acts or operates on the settlement information corresponding to the mutual utilization that it has received in step S130, as follows. Namely, that CPU 151, for example, accesses the server not illustrated of a prescribed banking system via the Internet lines, etc. That CPU 151 thereby executes the settlement processing through which to confirm, for example, the transfer with respect to the company B or the receipt from the company B. Similarly, in step S133, the CPU 151 of the personal computer 141-2 operates on the settlement information corresponding to the mutual utilization that

it has received in step S130. That CPU 151 thereby executes the settlement processing through which to confirm, for example, the transfer with respect to the company A or the receipt from the company A.

Next, with reference to the flow chart of FIG. 22, an explanation will be given of the settlement processing between the companies A and B (FIG. 19B) that is executed in the following case. Namely, the case where the log that is obtained when the terminal apparatus 131-1 of the company A, which is the issuer of the IC card 2, has been utilized using the common key K_{IF} is directly transmitted to the IC card center.

In step S141, the control part 101 of the controller 3 of the terminal apparatus 131-1 reads in the utilization log that is recorded in the RAM 42 of the reader/writer 1 via the network interface 107 and the internal bus 102. The control part 101 then classifies that log into the one corresponding to the utilization performed using the specific key A and the one corresponding to the utilization performed using the common key K_{IF} .

In step S142, the control part 101 of the controller 3 of the terminal apparatus 131-1 notifies, of the utilization logs classified in step S141, the log corresponding to the utilization performed using the common key K_{IF} to the personal computer 141-3 of the IC card center. This notification is made via the internal bus 102 and the network interface 107.

In step S143, the control part 101 of the controller 3 of the terminal apparatus 131-1 supplies, of the utilization logs classified in step S141, the log corresponding to the utilization

performed using the specific key A to the personal computer 141-1 of the company A. This supply is made via the internal bus 102 and the network interface 107.

The CPU 151 of the personal computer 141-1 has input thereto in step S144 the log corresponding to the utilization performed using the specific key A via the network interface 160, input/output interface 152, and internal bus 153. The CPU 151 thereby in step S145 executes the settlement corresponding to the local utilization through the same process as in the case of the step S124 of FIG. 21.

In step S146, the CPU 151 of the personal computer 141-3 of the IC card center has notified thereto via the network interface 160, input/output interface 152, and internal bus 153 the following utilization log. Namely, the utilization log corresponding to the common key K_{IF} the reader/writer 1 of the company A's terminal apparatus 131-1 has transmitted in step S142. The CPU 151 of the personal computer 141-3 of the IC card center receives not only the notification from the company A but also the notification from each enterpriser that the company A is contracted to.

In step S147 to step S153, the same pieces of processing as those in the steps S127 to step S133 explained using FIG. 21 are executed, whereby the settlement processing is executed between the companies A and B.

In the settlement system that has been explained using FIGS. 21 and 22, only necessary information alone (i.e. the utilization log corresponding to the common key K_{IF}) is transmitted to the personal computer 141-3 of the IC card center. Therefore, it is unnecessary that the personal computer 141-3 of the IC card center

manages all the transactions. Namely, the personal computer 141-3 of the IC card center has only to receive the transactions corresponding to the mutual utilization from each enterpriser and distribute the processed results thereof to each enterpriser. Therefore, it is possible to mitigate the processing burden upon the IC card center. Further, the transactions corresponding to the specific utilization can be settled only on the side of the company A that is the issuer of the IC card 2. Therefore, the IC card 2-issuing enterpriser's system (e.g. the personal computer 141-1) has only to be structured correspondingly to the amount of transactions that occur from the specific utilization.

Next, using FIG. 23, an example wherein the IC card system having applied thereto the present invention is applied to the cash card of the financial institution such as a bank will be explained.

Assume for example that the common area of the IC card 2 issued by a bank C has registered therein a bank code and an account number. And assume also that the specific area thereof has registered therein a specific application peculiar to the bank C, personal information, and remainder. In this case, regarding the bank code, account number, specific application, personal information, and remainder, registered in the bank C' issued IC card 2, read-out and rewrite of data are possible with use of the specific key C. Namely, with respect to those respective items of information, read-out and rewrite of data (i.e. the addition and subtraction of data) can be performed using the specific key C registered in the bank C's terminal apparatus 131-3. It is to be noted that in case in the bank C's terminal apparatus access is had

to the application in the common area by using the specific key C access is actually had to the application in the common area via the linked portion in the specific area. This method of accessing is the same as in the case explained using FIG. 16. (In the following description, in case access is had to the application in the common area by using the specific key, the methods of accessing are all the same.)

On the other hand, in the co-operating bank D's terminal apparatus 131-4, the bank code and account number that are recorded in the common area can certainly be read in through the use of the common key K_{IF} that is registered. However, that terminal apparatus 131-4 has no accessing right with respect to the application registered in the specific area. Namely, the user, in case he uses the bank C's managed terminal apparatus 131-3, can be given the service such as payment from his bank account or deposit of money into his savings account. On the other hand, in the case of utilizing the terminal apparatus other enterpriser (e.g. a bank D) manages, the user cannot be given the service such as payment from his bank account or deposit of money into his savings account. However, the user can be given the service corresponding to the application in the common area the accessing right with respect to that has been permitted to that other enterpriser. (That service is, for example, the reference-to-remainder to the for-common-use-operation electronic value that is recorded in the for-common-use-operation electronic money area, etc. that has been explained using FIG. 6.)

Next, using FIG. 24, an example wherein the IC card system

having applied thereto the present invention is applied to the fare adjustment of a railroad company will be explained.

Assume that, for example, the common area of the IC card 2 the railroad company E has issued has registered therein information indicating the station at which a passenger (user) gets on the train, the station at which a passenger (user) gets off the train, and an SF (Stored Fare). Assume also that the specific area of that IC card 2 has registered therein commuter-pass information of the railroad company E. The SF represents the value (i.e. the thing having the same value as that of the currency) that has been paid or transferred to a prescribed financial institution, etc. beforehand as the fare utilizable in the co-operated railroad company. Regarding the information indicating the station at which a passenger (user) gets on the train and the station at which a passenger (user) gets off the train, SF, and commuter-pass information of the railroad company E, registered in the railroad company E's issued IC card 2, access can be had to the relevant applications for executing addition and subtraction processings through the use of the specific key E registered in the railroad company E's terminal apparatus 131-5.

Certainly, in the co-operated railroad company F's terminal apparatus, access can be had through the use of the common key K_{IF} to the following applications. Namely, the applications for reading out and subtracting of the information indicating the getting-on station and getting-off station and SF information, that are registered in the common area in the railroad company E's issued IC card 2. However, in that terminal apparatus, there is no accessing

right with respect to the applications registered in the specific area. In other words, in case the user has used the terminal apparatus 131-5 that is managed by the railroad company E, he can certainly be given the service such as purchase of the commuter pass, filling of the SF, adjustment of the fare for the extra distance he has ridden, etc. However, in case he uses the terminal apparatus other enterpriser (e.g. the railroad company F) manages, he cannot be given the service such as purchase of the commuter pass, filling of the SF, etc. But he can be given the service (e.g. adjustment of the fare for the extra distance he has ridden) through the use of the application in the common area the accessing right with respect to that has been permitted to that other enterpriser.

Next, using FIG. 25, an example wherein the IC card system having applied thereto the present invention is applied to an electronic-ticket service will be explained.

Assume that for example the common area of each of the IC cards 2 having been issued by companies G, H, and I has registered therein the following application. The application for write therein of ticket information of an event such as, for example, a concert.

Assume that for example it be possible to perform the following write-in. Namely, the company G's managed terminal apparatus 131-7 can write ticket information into the IC card 2 via the Internet lines 171. The company H's managed terminal apparatus 131-8 can write ticket information into the IC card 2 via a data-writing apparatus 172 installed at a station, large-sized store, etc. The company I's terminal apparatus 131-9 is installed at a

ticket center, etc. and can write ticket information into the IC card 2.

And in the terminal apparatus 131-10 of an event operation/run enterpriser J co-operating with each of said companies G, H, and I it is only possible to read out through the use of the common key K_{IF} registered the following ticket information. The ticket information recorded in the common area. However, that terminal apparatus has no accessing right with respect to the application regarding the write-in of the ticket information. That is to say, in the terminal apparatus 131-10 of the event operation/run enterpriser J, it is certainly impossible to issue any ticket (write ticket information into the IC card 2). But it is possible to read in ticket information registered in the common area. Therefore, it is possible to confirm that the user has purchased a ticket of the relevant event through the use of the terminal apparatus 131-7 to 131-9. (That purchase is followed by the fact that the ticket information is written into the IC card 2 through the intermediary of the terminal apparatus 131-7 to 131-9.)

Next, an example wherein the IC card system having applied thereto the present invention is applied to an off-line debit service will be explained with reference to FIG. 26.

For example, in the terminal apparatus 131-11 of a co-operating store K for providing the off-line debit service, it can utilize through the use of the registered common key K_{IF} only the following application. The application for executing read-in of the code number registered in the common area and for executing subtraction processing of the amount trusted similarly registered

therein. That terminal apparatus 131-11 has no accessing right to the processing in which to perform addition with respect to the amount trusted. Here, the "amount trusted" is as follows. Assume that the users who each possess the IC card 2 include for example a user M, who has an ordinary account in a bank K. The "amount trusted" is the one wherein a prescribed amount of money has been transferred from the amount deposited in that ordinary account to a for-use-M off-line debit account in the same branch office of the same bank. The "amount trusted" is intended to permit the utilization of the off-line debit by using that "amount trusted" as the amount mortgaged.

Through the use of the co-operating terminal apparatus 131-11 for providing the off-line debit service, the user can be given the service of the price settlement executed for example when he has purchased an item of goods. However, the user cannot be given the service of that an addition (transfer) is performed with respect to the amount trusted. And, regarding the bank L's issued IC card 2, through the use of the bank L's managed terminal apparatus 131-12, access can be had to the application for processing addition or subtraction with respect to the amount trusted via the specific key L. So the user can enjoy the service of performing addition (transfer) with respect to the amount trusted through the use of the bank L's managed terminal apparatus 131-12.

The adjustment of the amount of money the user has utilized through the off-line debit service is executed through the use of the bank L's terminal apparatus 131-12, for example, by preparing in the specific area of the IC card 2 the following application. The

application for executing a batch process that regards the settlement of the off-line debit money. The user cannot buy an item of goods, etc. the price of that exceeds the amount greater than the amount trusted. Therefore, it is possible to prevent the overuse of the amount trusted. Also, it may be arranged, for example, to necessarily execute the batch process of the settlement at the time of the transfer of the amount trusted or the reference-to-remainder of the amount trusted. It may thereby be arranged to enable the execution of the batch process regarding the settlement of the off-line debit service without user's special operation.

In the foregoing explanation, unless using the IC card 2 issuer's specific key, it has been impossible to execute the addition processing of performing addition with respect to the value recorded in the IC card. That addition processing includes the filling processing with respect to the for-joint-use-operation, or commonly accessible, electronic value. (That is, access had to the application corresponding to the addition processing for executing addition with respect to the commonly accessible electronic value.) However, it may be arranged to keep a prescribed specific key stored in the EEPROM 66 of the IC card 2 beforehand so as to achieve the following end. Namely, so as to, for example, impart to a prescribed specific key other than the issuer's specific key the accessing right to the application corresponding to the addition processing for executing the commonly accessible electronic value. By doing so, it may be arranged to enable the execution of the filling processing with respect to the commonly accessible electronic value through the use of the issuer's permitted terminal

apparatus managed by a prescribed manager.

Next, the write-in process for writing into the electronic value through the use of the specific key other than the issuer's specific key will be explained with reference to the flow chart of FIG. 27. Here, it is assumed that the issuer A of the IC card 2 cooperates with a money-receipt business agent B. Assume the following case under that assumption. The case where the accessing right with respect to the application for executing the filling process for filling the commonly accessible electronic value in the common area recorded in the EEPROM 66 of the issuer A's issued IC card 2 be imparted beforehand to the following specific key B. The specific key B registered in the terminal apparatus that is managed by the money-receipt by-proxy-execution business agent B. By this previous imparting, the filling process of the commonly accessible electronic value is executed through the use of the money-receipt by-proxy-execution business agent B's managed terminal apparatus.

In step S161, the reader/writer 1 of the terminal apparatus detects the issuer A's issued IC card 2 that has been mounted. The reader/writer 1 has input thereto from the controller the filling amount for the commonly accessible electronic value that the user has input using the input part 103 of the controller 3. Namely, the object-to-be-opened file is the for-joint-use-operation, or commonly accessible, electronic value file, and the filling amount of money with respect to the commonly accessible electronic value is input to the DPU 31 via the SCC 33 and the bus 35.

The DPU 31 of the reader/writer 1 of the terminal apparatus, in step S162, performs authentication, with the use of the specific

key B, through the execution of the same processing as that in step S3 of FIG. 12. In step S163, that DPU 31 determines according to the signal input in step S162 from the IC card 2 whether the reader/writer 1 and the IC card 2 have been correctly authenticated each other through the use of the specific key B. In case it has been determined in step S163 that correct authentication has not been performed, the processing proceeds to step S169.

Assume that it has been determined in step S163 that correct authentication has been performed. (Namely, assume a case that the IC card 2 be the issuer A's issued IC card 2 the access to that based on the use of the specific key B is permitted.) Then, in step S164, the DPU 31 of the reader/writer 1 produces the following control signal. The control signal for gaining the accessing right with respect to the commonly accessible electronic value file recorded in the common area in the EEPROM 66 of the IC card 2. (That control signal includes the service code corresponding to the commonly accessible electronic value file). The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The SPU 32 receives the response signal from the IC card 2 via the antenna 27 and the demodulator circuit 25, and inputs the result of the response signal to the DPU 31 via the bus 35.

In step S165, the DPU 31 of the reader/writer 1 operates on the response signal that has been input in step S164 from the IC card 2. The DPU 31 determines according to that response signal whether the accessing right to the addition processing for an amount of value that can access the commonly accessible electronic value

file is permitted. In case it has been determined in step S165 that the accessing right is not permitted, the processing proceeds to step S169.

In case it has been determined in step S165 that the accessing right is permitted, the DPU 31 of the reader/writer 1, in step S166, produces the following control signal. The control signal for opening the commonly accessible electronic value file in the common area disposed in the EEPROM 66 of the IC card 2. Then the DPU 31 transmits it to the IC card 2 along with the specific key B via the bus 35, SPU 32, modulator circuit 23, and antenna 27.

In step S167, the DPU 31 of the reader/writer 1 acts or operates on the filling amount of money with respect to the commonly accessible electronic value that the user has input in step S161 by using the input part 103 of the controller 3. Thereby, the DPU 31 according to that filling amount executes filling processing with respect to the commonly accessible electronic value. Namely, the DPU 31 produces the following control signal. The control signal for adding the adding amount of commonly accessible electronic value that has been input from the controller 3 to the following commonly accessible electronic value remainder. The remainder recorded in the commonly accessible electronic value file registered in the common area of the IC card 2. The DPU 31 then transmits that control signal to the IC card 2 via the bus 35, SPU 32, modulator 23, and antenna 27.

The antenna 53 of the IC card 2 receives the control signal and supplies it to the interface part 61. With respect to it, there is executed a prescribed piece of processing through the operations

of the interface part 61, BPSK demodulation part 62, and calculation part 64. Then, to the sequencer 91 there is input an ASK modulated signal that corresponds to the control signal transmitted from the reader/writer 1. According to the control signal that has been input to it, the sequencer 91 alters the remainder of the commonly accessible, or for-joint-use-operation, electronic value that is recorded in the EEPROM 66.

In step S168, the DPU 31 of the reader/writer 1 records, as a case of utilizing the specific key B, the log of the processing executed in step S167 into the RAM 42 of the memory 34 of the reader/writer 1. Simultaneously, the DPU 31 produces a control signal for recording the processing executed in step S167 into the RAM 67 of the IC card 2. It then transmits it to the IC card 2 via the bus 35, SPU 32, modulator circuit 23, and antenna 27. The antenna 53 of the IC card 2 receives the ASK modulated signal corresponding to the control signal transmitted from the reader/writer 1, and supplies it to the interface part 61. With respect to it, there is executed a prescribed piece of processing through the operations of the interface part 61, BPSK demodulation part 62, and calculation part 64. As a result of this, the log of the processing executed in step S167 is stored in the RAM 67, with the result that the process is terminated.

In case no correct authentication has been performed in step S163, or in case it has been determined in step S165 that the accessing right (the accessing right to the addition processing) to the file is not permitted, the same processing as that in step S10 of FIG. 12 is executed in step S169. The process thereby is

terminated.

Incidentally, here, the specific key B is registered in the issuer A's issued IC card 2 at the time of the co-operation. Through this registration, it has been arranged that the filling process for filling the commonly accessible electronic value can be executed using the money-receipt by-proxy-execution business agent B's managed terminal apparatus. However, it is also possible to arrange that, at the time of the co-operation, the issuer A of the IC card 2 supplies the specific key A to the money-receipt by-proxy-execution agent B, and to register the specific key A into the money-receipt by-proxy-execution agent B's managed terminal apparatus. By doing so as well, it is possible to execute the same process.

Next, the settlement process for price (commission) between the issuer A and the money-receipt by-proxy-execution agent B in the following case will be explained with reference to the flow chart of FIG. 28. Namely, the case where there has been executed the write-in process for performing write with respect to the electronic value through the use of the specific key other than the issuer's specific key, which write-in process is the one that has been explained using FIG. 27.

In step S171, the reader/writer 1 of the terminal apparatus (hereinafter, the terminal apparatus B) of the money-receipt by-proxy-execution agent B has mounted with respect thereto the issuer A's issued IC card 2. And the reader/writer 1 has input thereto a request for the following processing. The processing for filling a value into the IC card 2 (the filling of a value such as, for

example, an electronic money, commonly accessible electronic value, or an SF). The DPU 31 of the reader/writer 1 reads in from the IC card 2 that has been mounted a card ID disposed in the issuance ID block that has been explained using FIG. 5, via the antenna 27, demodulator circuit 25, SPU 32, and bus 35. Then, the DPU 31 supplies that card identification (ID) to the controller 3 via the bus 35 and the SCC 33.

In step S172, the control part 101 of the controller 3 has input thereto the card ID of the IC card 2 mounted with respect to the reader/writer 1, via the network interface 107 and the internal bus 102. Thereby, the control part 101 produces a signal for requesting being given a permission for executing the money-receipt by-proxy-execution processing with respect to the IC card 2. Then the control part 101 transmits that signal to the issuer A's managed personal computer (hereinafter, the personal computer A) via the internal bus 102, network interface 107, and wide-band network such as the Internet lines not illustrated.

The CPU 151 of the personal computer A has input thereto in step S173 the signal indicating the request for being given the permission for by-proxy execution from the terminal apparatus B via the following. Namely, the wide-band network such as the Internet lines not illustrated, network interface 160, input/output interface 152, and internal bus 153. In step S174, the CPU 151 transmits a signal indicating the permission for by-proxy execution to the terminal apparatus B via the following. Namely, the internal bus 153, input/output interface 152, network interface 160, the Internet lines not illustrated, etc.

In step S175, the terminal apparatus B has input thereto the signal indicating the permission for by-proxy execution that the personal computer A has transmitted in step S174. Then, in step S176, the terminal apparatus B executes the write-in process in which write-in is performed using the specific key other than the issuer's one and which has been explained using FIG. 27.

In step S177, the DPU 31 of the reader/writer 1 of the terminal apparatus B reads out the log of the processing executed in step S176, which has been recorded in the RAM 42 of the memory 34 in step S168 of FIG. 27. Then, the DPU 31 supplies it to the controller 3 via the bus 35 and SCC 33. The control part 101 of the controller 3 has input thereto the log of the processing executed in step S167, via the network interface 107 and internal bus 102. And the control part 101 transmits it to the personal computer A via the internal bus 102, network interface 107, wide-band network such as the Internet lines not illustrated, etc.

In step S178, the CPU 151 of the personal computer A reads in the by-proxy-execution permission log that has notified in step S174 to the terminal apparatus B. In step S179, the CPU 151 has input thereto the by-proxy-execution process that the terminal apparatus B has transmitted in step S177 via the following. The wide-band network such as the Internet lines not illustrated, network interface 160, input/output interface 152, and internal bus 153. Thereby, the CPU 151 confirms that the by-proxy-execution permission log it has read-in in step S178 and the by-proxy-execution log that has been input thereto are in coincidence with each other.

In step S180, the control part 101 of the controller 3 of the terminal apparatus B transmits the log of the by-proxy-execution process that has been input thereto in step S177, to the following. The money-receipt by-proxy-execution agent B's managed personal computer (hereinafter, the personal computer B). And the log is transmitted thereto via the internal bus 102, network interface 107, and network such as a LAN not illustrated.

In step S181, the CPU 151 of the personal computer B has input thereto the log of the by-proxy-execution process that the terminal apparatus B has transmitted in step S180 via the following. Namely, the network such as a LAN not illustrated, network interface 160, input/output interface 152, and internal bus 153. The CPU 151 converts the thus-input by-proxy-execution process log into a database, and calculates a sum total of the received amounts of money that have been received by-proxy-execution business (i.e. the deposited amounts of money).

The CPU 151 of the personal computer B, in step S182, calculates a by-proxy-execution commission the computer B demands of the issuer A. The CPU 151, in step S183, also, subtracts that by-proxy-execution commission from the total deposited amount of money. The CPU 151 thereby calculates the resulting amount of money to be paid to the issuer A. The CPU 151 then transmits, in step S184, the thus-calculated paid amount of money to the personal computer A via the following. Namely, the internal bus 153, input/output interface 152, network interface 160, and wide-band network such as the Internet lines not illustrated.

The CPU 151 of the personal computer A, in step S185,

operates on the log of the money-receiving by-proxy-execution operation that has been input in step S179 from the terminal apparatus B. According to that operation log, the CPU 151 subtracts from the total by-proxy-execution received amount of money the commission for being paid to the money-receipt by-proxy-execution agent B to thereby calculate the amount claimed with respect thereto. In step S186, the CPU 151 has input thereto the paying amount of money that the personal computer B has transmitted in step S184. Thereby, the CPU 151 confirms that the paying amount of money coincides with the amount claimed that has been calculated in step S185. In step S187, the CPU 151 produces a signal indicating the amount it claims with respect to the money-receipt by-proxy-execution agent B. The CPU 151 transmits that signal to the personal computer B via the following. Namely, the internal bus 153, input/output interface 152, network interface 160, wide-band network such as the Internet lines, etc.

In step S188, the CPU 151 of the personal computer B has input thereto a signal indicating the amount claimed that the personal computer A has transmitted in step S187. Thereby, the CPU 151 thereof confirms that the amount claimed coincides with the paying amount of money that it has calculated in step S184. In step S189, that CPU 151 pays the claimed amount of money to the issuer A through the execution of the following processing. Namely, the processing executed with respect to the issuer A, of transmitting to the server not illustrated of a prescribed financial institution via, for example, the Internet lines a signal for transferring the paying amount of money into the account the issuer A has.

In step S190, the CPU 151 of the issuer A's personal computer A accesses the server not illustrated of a prescribed financial institution via, for example, the Internet lines. Thereby, that CPU 151 confirms the receipt of the money from the money-receipt by-proxy-execution agent B through the processing of, for example, confirming the remainder of the account the issuer A has.

Also, regarding the delivery/receipt of the accessing right explained using FIG. 9, an explanation has been given of the following case. Namely, the issuer A supplies to each of its co-operated managers B and C the common key K_{IF} and the service code corresponding to the utilizable application based on the contents of the contract. By this supplying, the issuer A makes a prescribed piece of application in the common area utilizable in the manager B's or C's managed terminal as well. Further, through the co-operation of the manager B with the manager D, part of the by-manager B-utilizable applications can also be utilized by the manager D as well. Next, an explanation will be given of the following case by the use of FIG. 29. Namely, the case wherein the issuer A doesn't supply to each of its co-operated managers the service code based on the contents of the contract. Namely, in that case, with no such service code being supplied to each of those co-operated managers, they make a common possession, between themselves, of the applications in the common area that involves therein a more complex each other's relationship.

As illustrated in FIG. 29A, the manager A encodes the system key with the specific key A and supplies the encoded result to each

of the managers E and G that are the partners that the manager A co-operates with.

As illustrated in FIG. 29B, the manager E encodes with the common key K_{IF} the encoded result obtained by encoding the system key with the specific key A and input from the manager A. The manager E uses that encoded result as a first access key K_{E1} . Further, the manager E sequentially encodes the first access key K_{E1} (the encoded result obtained by encoding with the common key K_{IF}) with use of the following service keys #5008h, #5048h, #5088H, and #50C8h. Namely, the service keys corresponding to the applications the utilization of that is permitted to the manager E under the contents of the contract. The manager E uses the final encoded result as a second access key K_{E2} .

A manager F, as illustrated in FIG. 29C, has input thereto from the manager E the first access key K_{E1} (the encoded result based on the use of the common key K_{IF}), and encodes that first access key with the common key K_{IF} . The manager F uses that encoded result as a first access key K_{F1} . Further, the manager F sequentially encodes the first access key K_{F1} with the service keys #6008h and #6048h. The manager F supplies that encoded result to the manager E. The manager F sequentially causes the manager E to encode that encoded result with the following service keys #5048h and #5088h. Namely, the service keys corresponding to the applications the utilization of that is permitted to the manager E under the co-operation contract. Thereafter, the manager F has supplied thereto from the manager E that encoded result, and then supplies that encoded result to the manager G. The manager F causes the manager G to encode that

encoded result with the service key #70C8h corresponding to the application the utilization of that is permitted to the manager G under the co-operation. And the manager F has supplied from the manager G that encoded result, and uses it as a second access key K_{F2} .

On the other hand, as illustrated in FIG. 29D, the manager G encodes with the common key K_{IF} the encoded result input from the manager A that has been obtained by encoding the system key with the specific key A. The manager G uses that encoded result as a first access key K_{G1} . Further, the manager G sequentially encodes the first access key K_{G1} with the service keys #7008h and #70C8h corresponding to the application the utilization of that is permitted to the manager G under the co-operation. The manager G then supplies that final encoded result to the manager encoded result with the service key #6048h corresponding to the application the utilization of that is permitted to the manager F under the co-operation. Thereafter, the manager G supplies to the manager E the encoded result based on the use of the service key #6048 the encoding of that is performed by the manager F. Then the manager G sequentially causes the manager E to encode that encoded result with the service keys #5088h and #50C8h corresponding to the applications the utilization of that is permitted to the manager E under the co-operation. And the manager G has supplied thereto from the manager E that encoded result and uses it as a second access key K_{G2} .

In this case, in the IC card 2, using the common key K_{IF} and service key stored in its EEPROM 66, there is encoded the system key according to the same procedure as that explained in connection with

FIG. 11. Resultantly, there are produced the first access key and the second access key. Resultantly, between each of the managers E, F, and G, it becomes possible to make a common use, such as that illustrated in FIG. 30, of the application disposed in the service-definition area in the common area.

Namely, data transmission/reception for permitting an accessing right to the application disposed in the common area is performed as explained using FIG. 29. Resultantly, the manager E can access each of the applications disposed in the service-definition areas #5008, #5048h, #5088h, and #50C8h.

And, the manager F can access the service-definition areas #6008h and #6048h the accessing right to that is permitted to itself. In addition, the manager F can also access the service-definition area #5048h and #5088h with respect to that the manager E has the service key and also access the service-definition area #700C8h with respect to that the manager G has the service key. Similarly, the manager G can access the service-definition areas #7008h and #70C8h with respect to that the manager G itself has the service key. In addition, the manager G can also access the service-definition area #5088h and #50C8h with respect to that the manager E has the service key and also access the service-definition area #6048h with respect to that the manager F has the service key.

Incidentally, in the delivery and receipt of key such as that illustrated in FIG. 29, it is impossible that the service key itself of a certain manager will be known by the other managers. Namely, it is impossible that the service keys #5008h, #5048h, #5088h, and #50C8h of the manager E will be known by any one of the

managers F and G. Similarly, it is impossible that the service keys #6008h and #6048h of the manager F will be known by any one of the managers E and G. Further, it is impossible that the service keys #7008h and #70C8h of the manager G will be known by any one of the managers E and F.

The above-described series of processings can be executed through the use of hardware but also be executed through the use of software. When the series of processings are executed through the use of software, the software may be installed from a recording medium storing the program therein into a computer that has an exclusive piece of hardware in which the program constituting that software is incorporated or into, for example, a general-purpose personal computer that enables executing various kinds of functions by having installed therein various kinds of programs. Or that software may be downloaded via communication networks such as cellular phone networks, the Internet, and the like.

That recording medium is constructed of a package medium, etc. The package medium is the following medium that, as illustrated in FIG. 2, 4, or 20, is distributed, separately from the relevant computer, in order to provide a program to the user and that has recorded therein the program. Namely, the medium consists of the magnetic disk 45, 111, or 61 (including a floppy disk), the optical disk 46, 112, or 162 (including CD-ROM (Compact Disk-Read Only Memory), DVD (Digital Versatile Disk)), the magneto-optical disk 47, 113, or 163 (including an MD (Mini-Disk)), or the semiconductor memory 48, 114, or 164.

Also, in the specification of this patent application, the

steps that each describe the program recorded in the recording medium include the pieces of processing that are time-series executed in the order of the corresponding described instructions. Those steps include, in addition, the pieces of processing that even when not time-series executed are executed in parallel or individually separately.

Additionally, in the specification of this patent application, the system represents the entire apparatus that is constructed of a plurality of devices.

In the data storage device and data storage method of the present invention, data is recorded in a first recording area for recording therein first data and first authentication information with respect to the first data and in a second recording area for recording therein second data and second authentication information with respect to the second data; the input/output of the data with respect to the information-processing apparatus is controlled; according to the authentication information that has been input from the information-processing apparatus and the first authentication information and second authentication information it is determined whether the transmission/reception of the first data and second data should be performed with respect to the information-processing apparatus; of the first data and second data, according to the first data and second data with regard to that it has been determined that the transmission/reception of the data should be performed by the data storage device with respect to the information-processing apparatus, calculation process is executed; third data of the first data recorded in the first recording area is recorded in association

with fourth data of the second data recorded in the second recording area; and in case the information-processing apparatus performs data transmission/reception on the third data calculation process is executed with respect to the fourth data. Therefore, without excessively using the recording area, it is possible to ensure the security on the data that are respectively recorded in the first and the second recording area.

In a first information-processing apparatus, first information-processing method, and first program of the present invention, there is controlled the input/output of the data with respect to the data storage device; there is recorded at least one authentication information used for performing the transmission/reception of a prescribed item of data that is included in the data recorded in the data storage device; and in case the data transmission/reception of the data storage device with respect to the information-processing apparatus has been performed there is separately recorded information indicating the contents of the data transmission/reception every authentication information used for the data transmission/reception. Therefore, data transmission/reception with the data storage device can be performed, so that the transactions can be managed every form of authentication.

In a second information-processing apparatus, second information-processing method and second program of the present invention, there are recorded first authentication and second authentication information that are used when the data storage device and another information-processing apparatus perform data transmission/reception therebetween, and code information defining

each of a plurality of data the data storage device stores therein; there is encoded the first authentication information; and there are output to the another information-processing apparatus the first authentication information encoded, the second authentication information, and a prescribed item of the code information. Therefore, without making the first authentication information known, it is possible to supply to the another information-processing apparatus the authentication information that is necessary for providing the commonly accessible service. Thereby, it is possible to realize the co-existence of the specific-accessible service and the commonly accessible service.

In a third information-processing apparatus, third information-processing method, and a third program of the present invention, there is input the first information that regards the data transmission/reception executed by a corresponding one of the other information-processing apparatus with respect to the data storage device; there is produced, according to the first information that has been input, second information regarding the data transmission/reception that corresponds to a plurality of the other information-processing apparatus; and there is output to the corresponding other information-processing apparatus the second information that has been produced. Therefore, the third information-processing apparatus can have input thereto the history of use of the IC card that provides a plurality of services by a plurality of enterprises. Thereby, the third information-processing apparatus can notify the settlement information to a respective relevant one of the enterprises.

Having described preferred embodiments of the present invention with reference to the accompanying drawings, it is to be understood that the present invention is not limited to the above-mentioned embodiments and that various changes and modifications can be effected therein by one skilled in the art without departing from the spirit or scope of the present invention as defined in the appended claims.

Claims:

1 A data storage device operable to communicate with an information-processing apparatus, comprising:

 a first memory having a first storing area and a second storing area,

 the first storing area including first data, which includes second data, and first authentication information with respect to the first data, and

 the second storing area including third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data;

 a data input/output control operable to control (i) data communication between the data storage device and the information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

 a processing unit operable to process the fourth data based on the associated second data when the data input/output control has permitted the information-processing apparatus to manipulated the second data.

2. The data storage device according to claim 1, wherein:

 each of the first and second authentication information includes information indicating whether read-out, write-in,

addition, or subtraction processing with respect to the first data and the third data can be executed; and

the data input/output control is operable to permit one or more of the read-out, write-in, addition, or subtraction processes based on the authentication information input from the information-processing apparatus and at least one of the first and second authentication information.

3. The data storage device according to claim 1, wherein:

each of the first data and the second data includes an application for providing a predetermined service, the application being defined by a corresponding different code; and

the processing unit is operable to determine which of the applications should be executed based on the code contained in the authentication information input from the information-processing apparatus, and to execute that application.

4. The data storage device according to claim 1, further comprising a second memory operable to store information indicative of the data communication between the data storage device and the information-processing apparatus, the information being based on which of the first and second authentication information is used by the data input/output control to control the data communication.

5. A data storage device, comprising: a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith, and the

specific storage area having link data associated with certain of the data stored in the common area such that use of the first authentication information also enables access to the certain data in the common storage area.

6. A data storage device according to claim 5, wherein the data in the common storage area includes an electronic money application that may be used to purchase goods and services from participating entities.

7. A data storage device according to claim 6, wherein an issuing entity may gain access to the specific storage area by way of the first authentication information, but neither the participating entities nor a user of the data storage device may gain access to the specific storage area.

8. A data storage device according to claim 7, wherein the electronic money application in the common storage area is linked to certain of the data in the specific storage area such that the issuing entity may affect the electronic money application by way of the first authentication information without requiring use of the second authentication information.

9. A method, comprising:

storing first data, which includes second data, and first authentication information with respect to the first data, in a first memory of a data storage device, the first memory having a first storing area and a second storing area;

storing third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data, in the second storing area of the first memory;

controlling (i) data communication between the data storage device and an information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

processing the fourth data based on the associated second data when the information-processing apparatus has manipulated the second data.

10. The method according to claim 9 , wherein:

each of the first and second authentication information includes information indicating whether read-out, write-in, addition, or subtraction processing with respect to the first data and the third data can be executed; and

the method further includes executing one or more of the read-out, write-in, addition, or subtraction processes based on the authentication information input from the information-processing apparatus and at least one of the first and second authentication information.

11. The method according to claim 9 , wherein:

each of the first data and the second data includes an application for providing a predetermined service, the application being defined by a corresponding different code; and

the method further includes determining which of the applications should be executed based on the code contained in the authentication information input from the information-processing apparatus, and executing that application.

12. The method according to claim 9, further comprising storing information indicative of the data communication between the data storage device and the information-processing apparatus in a second memory of the data storage device, the information being based on which of the first and second authentication information is used by the data input/output control to control the data communication.

13. A storage medium including a software program stored thereon that is capable of controlling a processor of a data storage device to perform steps, comprising:

storing first data, which includes second data, and first authentication information with respect to the first data, in a first memory of the data storage device, the first memory having a first storing area and a second storing area;

storing third data, which includes fourth data, the fourth data being associated with the second data, and second authentication information with respect to the third data, in the second storing area of the first memory;

controlling (i) data communication between the data storage device and an information-processing apparatus, and (ii) manipulation of at least one of the first data and the third data by the information-processing apparatus, based on authentication information from the information-processing apparatus, and at least one of the first and second authentication information; and

processing the fourth data based on the associated second data when the information-processing apparatus has manipulated the second data.

14. The storage medium according to claim 13, wherein:

each of the first and second authentication information includes information indicating whether read-out, write-in, addition, or subtraction processing with respect to the first data and the third data can be executed; and

the steps further including executing one or more of the read-out, write-in, addition, or subtraction processes based on the authentication information input from the information-processing apparatus and at least one of the first and second authentication information.

15. The storage medium according to claim 13, wherein:

each of the first data and the second data includes an application for providing a predetermined service, the application being defined by a corresponding different code; and

the steps further include determining which of the applications should be executed based on the code contained in the authentication information input from the information-processing apparatus, and executing that application.

16. The storage medium according to claim 13, further comprising storing information indicative of the data communication between the data storage device and the information-processing apparatus in a second memory of the data storage device, the information being based on which of the first and second authentication information is used by the data input/output control to control the data communication.

17. An information-processing apparatus operable to perform data communication with a data storage device, comprising:

a data input/output control operable to control data communication with the data storage device;

a first memory operable to store respective authentication information, which may be used for enabling communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

a second memory operable to store information indicative of the data communication between the information-processing apparatus and the data storage device, the information being organized in association with the respective authentication information.

18. The information-processing apparatus according to claim 17, further comprising:

a selector operable to select certain of the information stored in the second memory based on a particular one of the respective authentication information; and

an output control operable to control the output of the selected information to one or more other information-processing apparatus.

19. The information-processing apparatus according to claim 18, further comprising an encoder operable to encode at least some of the authentication information used in connection with the data communication between the information-processing apparatus and the data storage device, wherein the output control is further operable to control the output of the encoded authentication information to the one or more other information-processing apparatus.

20. The information-processing apparatus according to claim 19, wherein:

the second memory is further operable to store code information indicative of the data stored in the data storage device; and

the output control is further operable to control the output of the code information to the one or more other information-processing apparatus.

21. The information-processing apparatus according to claim 20, wherein:

the data storage device includes: a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith;

the encoder is operable to encode the first authentication information used in connection with the data communication between the information-processing apparatus and the data storage device; and

the output control is operable to control the output of the code information concerning the data stored in the specific storage area of the data storage device to the one or more other information-processing apparatus.

22. A method, comprising:

controlling data communication between an information-processing apparatus and a data storage device;

using respective authentication information stored in a first memory of the information-processing apparatus to enable communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

storing information indicative of the data communication between the information-processing apparatus and the data storage device in a second memory of the information-processing apparatus, the information being organized in association with the respective authentication information.

23. The method according to claim 22, further comprising:

selecting certain of the information stored in the second memory based on a particular one of the respective authentication information; and

outputting the selected information to one or more other information-processing apparatus.

24. The method according to claim 23, further comprising:

encoding at least some of the authentication information used in connection with the data communication between the information-processing apparatus and the data storage device; and

controlling the output of the encoded authentication information to the one or more other information-processing apparatus.

25. The method according to claim 24, further comprising:

storing code information in the second memory, the code information indicative of the data stored in the data storage device; and

controlling the output of the code information to the one or more other information-processing apparatus.

26. The method according to claim 25, wherein:

the data storage device includes: a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith; and

the method further includes encoding the first authentication information used in connection with the data communication between the information-processing apparatus and the data storage device, and

controlling the output of the code information concerning the data stored in the specific storage area of the data storage device to the one or more other information-processing apparatus.

27. A storage medium including a software program stored thereon that is capable of controlling a processor of an information-processing apparatus to perform steps, comprising:

controlling data communication between the information-processing apparatus and a data storage device;

using respective authentication information stored in a first memory of the information-processing apparatus to enable communication of data corresponding to the respective authentication information from among data stored in the data storage device; and

storing information indicative of the data communication between the information-processing apparatus and the data storage device in a second memory of the information-processing apparatus, the information being organized in association with the respective authentication information.

28.. The storage medium according to claim 27 , further comprising:

selecting certain of the information stored in the second memory based on a particular one of the respective authentication information; and

outputting the selected information to another information-processing apparatus.

29. The storage medium according to claim 28 , further comprising:

encoding at least some of the authentication information used in connection with the data communication between the information-processing apparatus and the data storage device; and

controlling the output of the encoded authentication information to the one or more other information-processing apparatus.

30. The storage medium according to claim 29 , further comprising:

storing code information in the second memory, the code information indicative of the data stored in the data storage device; and

controlling the output of the code information to the one or more other information-processing apparatus.

31. The storage medium according to claim 30, wherein:

the data storage device includes: a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the

common storage area being accessible by way of second authentication information associated therewith; and

the steps further include encoding the first authentication information used in connection with the data communication between the information-processing apparatus and the data storage device, and

controlling the output of the code information concerning the data stored in the specific storage area of the data storage device to the one or more other information-processing apparatus.

32. A data communication system, comprising:

a data storage device including a memory having a specific storage area and a common storage area, data in the specific storage area being accessible by way of first authentication information associated therewith, and data in the common storage area being accessible by way of second authentication information associated therewith, and the specific storage area having link data associated with certain of the data stored in the common area such that use of the first authentication information also enables access to the certain data in the common storage area; and

an information-processing apparatus operable to (i) communicate with the data storage device by way of presenting authentication information thereto, and (ii) access the certain data stored in the common storage area through the link data of the specific storage area by presenting the first authentication information to the data storage device.

33. A data communication system according to claim 32, wherein the data in the common storage area includes an

electronic money application that may be used to purchase goods and services from participating entities.

34. A data communication system according to claim 33, wherein an issuing entity may gain access to the specific storage area by way of the first authentication information, but neither the participating entities nor a user of the data storage device may gain access to the specific storage area.

35. A data communication system according to claim 34, wherein the electronic money application in the common storage area is linked to certain of the data in the specific storage area such that the issuing entity may affect the electronic money application by way of the first authentication information without requiring use of the second authentication information.

DATA STORAGE DEVICE AND DATA STORAGE METHOD, INFORMATION-PROCESSING
APPARATUS AND INFORMATION-PROCESSING METHOD, AND PROGRAM

ABSTRACT OF THE DISCLOSURE

A specific-accessible service and a commonly accessible service can co-exist while ensuring the security with respect thereto. It is assumed that a common area of a company A's issued IC card has registered therein an electronic value corresponding to 1000 yen and a specific area thereof has registered therein a specific-accessible service point of 50 (corresponding to 50 yen). With respect to the commonly accessible electronic value and specific-accessible service point that are registered in the enterpriser A's issued IC card, addition and subtraction can be both executed using a specific key A registered in the company A's terminal apparatus. However, in each of the respective co-operating companies' terminal apparatus, with respect to the commonly accessible electronic value, only subtraction processing is possible using a common key registered therein. But, to the processing that is executed with respect to the specific-accessible service point registered in the specific area, that terminal apparatus has no accessing right.

Fig. 16