

SPECIFICATION

Title of the Invention: DATA PROCESSING SYSTEM

Field of the Invention

[0001]

The invention relates to a data processing system, and in particular, relates to a technology for overlappingly managing, by a plurality of DB servers, business data generated by a plurality of AP servers.

Description of the Related Art

[0002]

In order to prepare for a case of physically damaging a database by large-scale disasters, such as an earthquake, tsunami, and eruption, or by man-made disasters, such as nuclear plant accident or terrorism, a backbone system in a company has previously overlappingly registered business data to a database for backup installed at a remote place.

For example, Patent Literature 1 discloses a technology of, after registering data to a disk device of a main control device, sending the same data to a sub control device installed at a remote place, and requesting registration thereof.

Patent Literature 1: Japanese Patent Laid-Open No. 11-85408

Non Patent Literature 1: Guide of Web system/First Structure of Web Site and J2EE Server

Internet URL:

<http://www.atmarkit.co.jp/fjava/rensai2/websys01/websys01.html>

Search Date: 10th March, 2015

Non Patent Literature 2: Two-phase Commitment

Internet URL:

<http://e-words.jp/w/2%E3%83%95%E3%82%A7%E3%83%BC%E3%82%BA%E3%82%B3%E3%83%9F%E3%83%83%E3%83%88.html>

Search Date: 10th March, 2015

Summary of the Invention

Problems to be solved by the Invention

[0003]

As mentioned above, data is doubly held by the two main and sub control devices. As a consequence, even in the case where an earthquake happens in one area and the disk device is physically broken, data in another surviving disk device is used, thereby ensuring the continuousness of the business processing.

Further, the failure or trouble of a server computer itself is assumed. Therefore, it is desirable to prepare for an unexpected situation by doubling a database server on a routine basis not only in the remote place but also in the same site.

[0004]

Incidentally, when updating processing is executed to a plurality of databases, contradiction is generated between data if a commitment to all databases is not established. Therefore, consistency is kept between databases by usually adopting an

adjustment system called two-phase commitment of an XA interface.

[0005]

With the two-phase commitment, a master server that performs the whole processing first issues an inquiry about whether the commitment can be executed to each DB server as a target. The DB server for which update preparation is finished sends a response indicating "preparation completion", the master server, after checking that all DB servers finish the preparation, issues a notification for starting the commitment, and the databases are rewritten all at once. In the case where abnormality happens in any of the databases during the rewriting, the DB server in which the abnormality happens issues a notification of failure, and the master server issues a notification of processing rescission to all the servers and further issues an instruction to perform "roll back" processing to restore the data (refer to Non-Patent Literature 2).

[0006]

Adoption of such a two-phase commitment makes it possible to ensure the data consistency between the DB servers, and to reliably avoid occurrence of illegal data.

However, it is necessary to frequently repeat exchange of data between the master server and the DB server installed at a remote place. Therefore, high speed processing inevitably sacrificed. Thus, it is effective to business processing, such as ATM transaction, in which a waiting time of several seconds does not matter. However, there is a problem that it is not

applicable to business processing, such as an online trade, in which the delay of less than one second is not allowed.

[0007]

The present invention is devised in the situation, and it is an object to realize a technology for enabling ensuring of high speed processing while presuming securing the same data to a plurality of DB servers.

Means for solving the problem

[0008]

In order to accomplish the object, a data processing system according to claim 1 is a data processing system including a plurality of AP servers and a plurality of DB servers, wherein each of the DB servers includes a table for storing business data common to each other, each table has a limitation for allowing only reference and addition of a record and prohibiting deletion and update thereof, each of the AP servers is connected to each of the DB servers, and has a function for executing common business processing to a request sent from a client terminal and a function for sending business data generated as a result of the processing to each of the DB servers and requesting additional registration to a corresponding table, each piece of the business data is assigned with a unique ID including an identification code for specifying an AP server that has generated the piece of the business data, each of the DB servers further stores an AP-in-charge definition table which defines, for each business processing, an AP server in

charge of specific business processing that requires exclusive control, each of the AP servers executes by itself business processing when the request of the business processing sent from the client terminal does not require exclusive control, and in contrast, when the request requires the exclusive control, refers to the AP-in-charge definition table, specifies an AP server that should take charge of the business processing, and thereafter delegates corresponding processing to the AP server in charge, and the AP server in charge that has received this once stores the delegated business processing to a queue, and thereafter sequentially executes each business processing in the queue according to a FIFO rule.

[0009]

A data processing system according to claim 2 is the system of claim 1, and further, not only a main AP server in charge but also a sub AP server in charge that should take charge of processing when the main AP server in charge does not function is defined in the AP in charge definition table for each business processing.

[0010]

A data processing system according to claim 3 is the system of claim 1 or 2, and further, a time stamp when business processing is executed is marked in each piece of the business data, and the AP server, when existing business data needs to be updated, newly generates business data including ascending ID different from the business data, data after correction, and a time stamp at correction time, and substantially updates the

existing business data by additionally registering the business data for updating to a corresponding table provided in each DB server.

[0011]

A data processing system according to claim 4 is the system of claims 1 to 3, and further, the AP server, when the existing business data needs to be deleted, generates business data for data cancellation having a data item that stores ID of the business data as a cancellation target, and substantially deletes the existing business data by additionally registering the business data for data cancellation to a table dedicated for cancellation provided in each DB server.

Effects of the Invention

[0012]

With the data processing system according to claim 1, the business data generated by the AP server is simultaneously sent to a plurality of the DB servers, and is overlappingly registered to the respective tables. Therefore, the maintainability of business data can be improved.

In addition, with respect to registration of business data, when a failure happens, deletion and update that require complicated processing for recovery of data are prohibited. Simply, only by copying shortage data from another DB server and only addition for allowing recovery of data are allowed. Therefore, a strict adjusting system, such as two-phase commitment, does not need to be adopted, and it is possible to

admit registration completion when a reception notification is simply returned from each DB server.

[0013]

Further, a plurality of the AP servers is also prepared. If the business processing does not require exclusive control, each AP server can freely perform processing. Therefore, the processing efficiency of the whole system can be improved with load distribution.

On the other hand, with respect to a part of the business processing that requires exclusive control, processing is consolidated to the preset AP server in an AP in charge definition table, and the processing is performed according to the FIFO rule. Therefore, it is possible to effectively avoid the generation of mutually contradictory data by different AP servers.

Unique ID including an identification code of each AP server is assigned to the business data generated in each AP server. Therefore, even if the business data is separately sent to the DB server from each AP server, IDs are not overlapped and the absolute uniqueness is kept.

[0014]

In the case of the data processing system according to claim 2, the sub AP server in charge is also defined in the AP in charge definition table in addition to the main AP server in charge. Therefore, even if the main AP server in charge is down by some reason, the business processing can be delegated fast to the sub AP server in charge.

[0015]

In the invention, a limitation for prohibiting the deletion and update of records is provided in the table of the DB server. However, by using the system according to claim 3 and 4, it is possible to realize substantial update and deletion of the business data.

Best mode for carrying out the Invention

[0016]

Fig. 1 is a diagram showing the entire configuration of a data processing system 10 according to the invention.

First, in a first data center 12 arranged at Tokyo, a first AP server 14, a first DB server 16, and a second DB server 18 are installed.

Further, in a second data center 20 arranged at Osaka, a second AP server 22, a third DB server 24, and a fourth DB server 26 are installed.

[0017]

The first AP server 14 and the second AP server 22 have the same application program, and have functionality for executing the same business processing in response to a request sent from a client terminal 28 via a communication network 27, such as the Internet.

[0018]

For convenience of illustration, only the first AP server 14 and the second AP server 22 are drawn, but actually, a plurality of AP servers having the same functionality is

installed in the respective data centers, and load can be distributed via a load balancer (not shown).

As mentioned above, provision of a plurality of AP servers in the same data center makes it possible to substitute the remaining AP server in the same data center for any of the AP servers at its scheduled stop time or also at unscheduled stop time without switching to an AP server in another data center, thereby minimizing the down time.

The number of DB servers is also not limited, and three or more DB servers can be installed in each data center.

[0019]

Each of the first DB server 16, the second DB server 18, the third DB server 24, and the fourth DB server 26 has a common table, and each table stores the same data.

Herein, as shown in Fig. 2, each DB server commonly includes a point adding table 50, an addition cancellation table 51, a point application table 52, an application cancellation table 53, and an AP in charge definition table 54.

[0020]

Data items, such as an addition ID, account, a number of points, and a time stamp, are set to the point adding table 50.

Further, data items, such as a cancellation target and a time stamp, are set to the addition cancellation table 51.

Data items, such as an application ID, an account, a number of points, and a time stamp, are set to the point application table 52.

Furthermore, data items, such as a cancellation target

and a time stamp, are set to the application cancellation table 53.

Data items, such as an AP in charge definition ID, an account, a main handling AP, and a sub-handling AP, are set to the AP in charge definition table 54.

Unique identification codes with a surrogate key are stored to the addition ID and the application ID (details will be described later).

[0021]

The first AP server 14 is connected to the first DB server 16 and the second DB server 18 via a LAN, and is also connected to the third DB server 24 and the fourth DB server 26 installed in the second data center 20 via a communication line 29.

Further, the second AP server 22 is connected to the third DB server 24 and the fourth DB server 26 via the LAN, and is also connected to the first DB server 16 and the second DB server 18 installed in the first data center 12 via the communication line 29.

[0022]

At usual time, the client terminal 28 installed in the east Japan is connected to the first AP server 14 installed in the first data center 12, and the client terminal 28 installed in the west Japan is connected to the second AP server 22 installed in the second data center 20.

[0023]

On the other hand, when a large-scale earthquake happens in the metropolitan area of Tokyo and the first data center 12

is extremely damaged, for example, by changing the setting of a DNS server (not shown), the connection destination of the client terminal 28 installed in the east Japan is switched to the second AP server 22 installed in the second data center 20. Therefore, continuousness of services to a user in the east Japan is ensured.

Similarly, when the second data center 20 is suffered, the connection destination of the client terminal 28 installed in the west Japan is switched to the first AP server 14 installed in the first data center 12.

[0024]

As mentioned above, each data center provides services to the nearby client terminal 28 at normal time. On the other hand, services are also provided to the client terminals 28 throughout Japan at disaster time. Therefore, as mentioned above, each DB server needs to mutually hold data with the same contents on a routine basis.

Further, since a plurality of DB servers having the same data is also installed in the same data center, the AP server can request extraction of data to an arbitrary DB server when referring to data, and the load can be distributed.

[0025]

The number of data centers is not limited to two, preferably, a larger number of data centers are provided to places as much as possible. A plurality of AP servers with the same function is installed in each of the places, and the AP servers are preferably connected to all DB servers installed

in each data center via a communication network.

[0026]

Fig. 3 shows the internal configurations of the first AP server 14 and the second AP server 22, and each includes a business processing unit 30, a surrogate key management unit 32, a data control unit 34, and a plurality of DB connection units 38.

[0027]

The business processing unit 30 executes generation processing and calculation processing of data in response to a request from the client terminal 28, registration processing to the DB server, and the like. A CPU of the AP server is operated in accordance with a dedicated application program, thereby realizing the business processing unit 30.

[0028]

The surrogate key management unit 32 has a function for issuing a surrogate key in response to a request from the business processing unit 30 (details will be described later).

A CPU of the AP server is operated in accordance with a dedicated middleware, thereby realizing the surrogate key management unit 32.

[0029]

The data control unit 34 copies data by the number of times corresponding to the number of DB servers when receiving a command for registering data from the business processing unit 30, and has a function for passing each copied data to the DB connection unit 38. The CPU of the AP server is operated in

accordance with a dedicated middleware, thereby realizing the data control unit 34.

Further, the data control unit 34 also has a function for instructing update of surrogate key management data to the DB connection unit 38 in charge of each DB server installed in the same data center in response to a command of the surrogate key management unit 32 (details will be described later).

[0030]

Each DB connection unit 38 has a function for issuing an SQL statement to the DB server that is assigned in advance to the DB connection unit 38 and instructing additional registration and reference of data. The CPU of the AP server is operated in accordance with a dedicated middleware, thereby realizing the DB connection unit 38.

[0031]

Here, a description will be given of a system for giving a surrogate key in the system 10 based on a flowchart in Fig. 4.

First, the business processing unit 30 in which data needs to be generated as a result of business processing designates a table and requests to issue a surrogate key to the surrogate key management unit 32 (S10). In a case of generating data stored in the point adding table 50, it is requested to issue a surrogate key for 'addition ID'.

[0032]

The surrogate key management unit 32 having received this refers to a surrogate key management table 56 stored in the DB

server installed in the same data center (S12), and notifies the business processing unit 30 of the latest surrogate key related to the point adding table 50 (S14).

[0033]

As shown in Fig. 5, the surrogate key management table 56 includes data items of 'table ID', 'AP server ID', and 'next key value', and manages the latest surrogate key (next key value) with a unit of 'table ID' + 'AP server'.

[0034]

Here, the 'surrogate key' includes a numerical value having a predetermined length (e.g., 32-bit or 64-bit).

Further, an identification code (any of numerical numbers 0 to 9) for specifying the AP server that generates data is set to the last digit (end) of numerical numbers.

[0035]

Specifically, in a last-digit management table 57 of the surrogate keys, a relevance between IDs of the respective AP servers and numerical values 0 to 9 is defined.

Further, in an AP server management table 58 and a data center management table 59, the relevance between each AP server and the data center is defined.

The last-digit management table 57 of the surrogate keys, the AP server management table 58, and the data center management table 59 are also stored into the DB server in the same data center, similarly to the surrogate key management table 56.

[0036]

The surrogate key management unit 32 that has finished the notification of the latest value of the surrogate key to the business processing unit 30 updates a value of each record of the surrogate key management table 56 (S16).

Specifically, the surrogate key management unit 32 sets a 'value obtained by adding one to a numerical value having a part excluding identification code at the last digit among just-before values (the latest value)' to the 'next key value' in the point adding table 50 related to the AP server.

[0037]

However, the updating method of the latest value of the surrogate key is not limited to the 'ascending', and may be 'descending' for setting a 'value obtained by subtracting one from a numerical number having a part excluding the identification code at the last digit among just-before values (the latest value)'. The identification code of the AP server is not also limited to numerical values '0 to 9', and may use other kinds of characters. Further, the identification code may be inserted to the head of the surrogate key.

Furthermore, only a numerical number excluding the identification code of the AP server is stored to the 'next key value' of the surrogate key management table 56, and the surrogate key management unit 32 also can add corresponding identification code to the last digit of the numerical number and issue the result to the business processing unit 30, at the time point of issuing a surrogate key.

[0038]

The business processing unit 30 that has received the latest surrogate key from the surrogate key management unit 32 generates data obtained by setting the surrogate key as ID to a primary key or an external key (S18).

The data is sent to all the DB servers via the data control unit 34 and the DB connection unit 38, and is additionally registered to a corresponding table (point adding table 50) provided in each of the DB servers.

[0039]

As mentioned above, the uniqueness is held to the surrogate key based on a unit of 'AP server x table', and each AP server is linked to a specific data center in the data center management table 59. Therefore, even if the surrogate key is uniquely issued in each AP server, the uniqueness is ensured to the numerical number of the last digit. Since there is no danger that an overlapped surrogate key is issued, the uniqueness of each data is therefore reliably held.

[0040]

Note that a request for issuing the surrogate key issued from the business processing unit 30 of the AP server is stored to a queue once and then further processed according to a FIFO (first-in, first-out) rule. Therefore, there is no danger that the surrogate key with a small value is erroneously issued to the data generated later, and the order is held.

[0041]

The data generated by the business processing unit 30 of each AP server is stored in the table in the DB server as

mentioned above. However, a limitation for prohibiting the deletion and prohibiting the update is imposed in advance to each table.

Briefly, in the system 10, only addition (insert) and reference (select) are permitted to each table.

[0042]

Therefore, in the case where necessity for invalidating the existing data is caused, in place of deleting the record, a new record is added to another table, thereby realizing an equal state.

For example, in order to invalidate the point adding data shown in Fig. 2, addition cancellation data is added to the addition cancellation table 51.

Addition ID of the point adding data to be invalidated is filled in the "cancellation target" of the addition cancellation data. Therefore, the business processing unit 30 sets the point adding data whose addition ID is registered to the addition cancellation table 51 among the point adding data registered to the point adding table 50, as data out-of-counting-target.

[0043]

Similarly, in the case of invalidating the point applying data, the application cancellation data is added to the application cancellation table 53.

Since the application ID of the point applying data to be invalidated is filled in the "cancellation target" of the application cancellation data, the business processing unit 30

sets the point applying data whose application ID is registered to the application cancellation table 53 among the point applying data registered to the point application table 52, as data out-of-counting-target.

[0044]

Further, in the case of requiring correction of the registered data in the system 10, in place of updating the existing record, such a correspondence is performed that a record having data after the correction is newly registered.

For example, in the case of correcting the number of points of the point adding data, addition ID in ascending order different from the addition ID of the point adding data is newly delivered and the point adding data obtained by changing the number of points with the same account is added to the point adding table 50.

Time stamps with precision of millisecond are marked to data before the correction and data after the correction, and addition IDs in different ascending order are added. Therefore, the business processing unit 30 can specify the latest data without failure at counting time.

[0045]

As mentioned above, the same data is stored in each DB server, and each AP server has a function for executing the same business processing. Therefore, services can simultaneously be provided in parallel to a large number of client terminals 28, and the load of the whole system 10 can be distributed.

[0046]

However, depending on contents of the business processing, there is business processing that requires exclusive control between the respective AP servers.

First, the exclusive control is not required for processing for adding points to a user that has purchased products and services. For example, when a plurality of employees in a company simultaneously generates a request for adding a point to an account of the company, even if simultaneous parallel processing is performed in a plurality of the AP servers, any problems are not caused.

Similarly, the exclusive control is not necessary for point balance checking processing to the same account.

On the other hand, on a scene for purchasing a product by using the points stored in the account, the number of stored points is limited. Therefore, in the case of simultaneously requesting the point application in parallel, the exclusive control needs to be executed.

[0047]

Hereinbelow, a description will be given of an exclusive control system after explaining a general processing procedure in the case of applying the system 10 to a point management business according to a schematic diagram in Fig. 6 and flowcharts in Figs. 7 to 10.

First, when a user purchases a product at a shop and presents a point card, an account (card number) of the point card and the number of points (a number of added points) generated by the product purchase are sent to the second AP

server 22 from a client terminal 28A in the shop.

[0048]

The business processing unit 30 of the second AP server 22 that has received the point addition request (S10 in Fig. 7) receives issuing of addition ID from the surrogate key management unit 32, and thereafter generates the point adding data (S12).

Next, the business processing unit 30 requests to additionally register the point adding data to the first DB server 14 to the fourth DB server 26 via each DB connection unit 38 (S14).

The first DB server 14 to the fourth DB server 26 that have received this add the point adding data to the respective point adding tables 50 at once.

[0049]

Subsequently, the business processing unit 30 calculates the point balance of the user (S16).

Specifically, all pieces of the point adding data associated with the account are obtained from any of the DB servers (S16-01 in Fig. 8), and addition ID is extracted from each point adding data (S16-02).

Subsequently, the addition ID is sent to an arbitrary DB server, and corresponding addition cancellation data is obtained (S16-03).

Then, except for the point adding data to which the addition cancellation data is registered, the numbers of points of the remaining and valid pieces of point adding data are summed

up (S16-04), and thereby the number of adding points of the user is fixed.

[0050]

Subsequently, all pieces of the point applying data associated with the account are obtained from any of the DB servers (S16-05), and the application ID is extracted from each point applying data (S16-06).

Subsequently, the application ID is sent to an arbitrary DB server, and corresponding application cancellation data is obtained (S16-07).

Then, except for the point applying data to which the application cancellation data is registered, the numbers of points of the remaining and valid pieces of point applying data are summed up (S16-08), and thereby the number of applying points of the user is fixed.

[0051]

Subsequently, all valid applying points are subtracted from all valid adding points (S16-09), and thereby the point balance at the current timing is fixed.

The point balance is sent to the client terminal (S18 in Fig. 7), and is printed onto a receipt.

[0052]

On the other hand, when a user desires to apply the points at the shop, an account (card number) of the point card and the number of applying points corresponding to the price of the purchased product are sent to the second AP server 22 from a client terminal 28B.

[0053]

The business processing unit 30 of the second AP server 22 that has received the point applying request (S30 in Fig. 9) refers to the AP in charge definition table in any of the DB servers, and specifies the AP server in charge of the point applying processing of the account (S32). Then, when the AP server itself is accidentally specified as the main AP server in charge, the point applying processing, which will be described later, is executed as it is. However, when another AP server (e.g., first AP server 14) is specified as the AP server in charge, a request (account, the number of applying points, etc.) is transferred to the corresponding AP server, and the point applying processing is delegated (S34).

[0054]

The first AP server 14 that has received the delegation of the processing stores this request to queue of the FIFO once (S36), and sequentially executes the point applying processing (S38).

The point applying processing specifically follows the following procedure.

First, the first AP server 14 calculates the point balance of the account with the similar procedure (S38-01 in Fig. 10).

[0055]

Subsequently, the point applying data is generated within the range of the point balance (S38-02).

For example, when the point balance at the current timing is over the number of applying points at this timing, the

business processing unit 30 receives the issuing of the application ID from the surrogate key management unit 32, and thereafter generates the point applying data (application ID, account, the number of points, and time stamp).

Then, additional registration of the point applying data is requested to all the DB servers (S38-03).

On the other hand, when the point balance is lower than the number of applying points at this timing, the business processing unit 30 generates the point applying data corresponding to the number of remaining points, and requests the additional registration thereof to all the DB servers. Consequently, the point balance of the account is zero.

[0056]

The first AP server 14 that has completed the delegated point applying processing notifies the second AP server 22 of a processing result (the number of applying points and the point balance) (S40 in Fig. 9).

[0057]

The business processing unit 30 of the second AP server that has received this sends a processing result to the client terminal 28B (S42).

That is, when the point can be applied for the total purchased amount, such a fact and the point balance are notified to the client terminal 28B.

On the other hand, when the point is applied only for a part of the purchased amount, such a fact and the amount of shortage money are notified to the client terminal 28B. In this

case, the shortage is settled with cash at the shop.

[0058]

As mentioned above, at a stage of the point applying processing that requires exclusive control, the authority of processing is delegated from the second AP server 22 to the first AP server 14. In the first AP server 14, the point applying processing is executed according to the FIFO rule. Therefore, even if a point applying request related to the same account is sent from a client terminal 28C to the first AP server 14 at approximately the same period, competitive requests are adjusted according to the FIFO (first-in, first-out) rule. Therefore, generation of illegal processing (actually, although the point balance is zero, the point application is performed, for example) can be effectively avoided.

[0059]

On the other hand, in the case of point adding processing to the same account or processing for calculating the point balance, parallel processing is performed by a plurality of the AP servers. Therefore, the efficiency with distribution processing can be improved.

[0060]

Note that, not only the main AP in charge but also the sub AP in charge is stored in the AP in charge definition table 54. Therefore, if the AP server designated to the main AP in charge is down, the authority can be delegated to the sub AP server in charge immediately.

If there is a fear because of only preparation for the

sub AP server in charge, a lower AP server such as sub sub-AP server in charge may be preset.

The AP in charge definition table 54 is held in all the DB servers. Therefore, if any of the DB servers is temporarily down, the AP server can specify the main AP server in charge or the like from another DB server.

[0061]

In order to make the exclusive control effective, in an application program for the business processing unit, it is necessary to define in advance processing (point applying processing) that requires the exclusive control and unnecessary processing (point adding processing, the point balance checking processing, or the like) that does not require the exclusive control.

Further, specific information (URL, etc.) of the main AP in charge and the sub AP in charge is defined for every account (or for every account group) in the AP in charge definition table 54.

[0062]

However, as described above, the invention is not limited to a system in which a type (point applying processing) of the business processing that requires the exclusive control is defined in the application program, and a corresponding relation between a processing target (account) and the AP server is defined on the AP in charge definition table 54 side.

[0063]

For example, as will be mentioned below, with respect to

a plurality of types of the business processing, required exclusive control is defined in the application program. Further, the main AP server in charge and the sub AP server in charge can be set for each type of the business processing in the AP in charge definition table.

[Setting on Application Program Side]

Required exclusive control processing -> A processing,
B processing, C processing

[Setting on AP in charge definition table Side]

A processing -> Main AP in charge, server a1, sub AP in charge, server a2

B processing -> Main AP in charge, server b1, sub AP in charge, server b2

C processing -> Main AP in charge, server c1, sub AP in charge, server c2

[0064]

In the above, the point management business is shown as an example. However, similar exclusive control can also be applied to another business processing.

For example, in the case of application to a stock management system, as shown in Fig. 11, an arrival table 60, an arrival cancellation table 61, a shipping table 62, a shipping cancellation table 63, and an AP in charge definition table 64 are provided in each DB server.

[0065]

Data items, such as an arrival ID, a product code, the number of products, and a time stamp are set to the arrival table

60.

Further, data items, such as a cancellation target and a time stamp are set to the arrival cancellation table 61.

Data items, such as a shipping ID, the product code, the number of products, and a time stamp are set to the shipping table 62.

Furthermore, data items, such as a cancellation target and a time stamp are set to the shipping cancellation table 63.

Data items, such as an AP in charge definition ID, a product code, a main AP in charge, and a sub AP in charge are set to the AP in charge definition table 64.

Unique identification codes using a surrogate key are stored in the arrival ID and the shipping ID.

[0066]

Herein, when an arrival request of the product is received from the client terminal 28, the arrival data may be simply added to the arrival table 60. Since the exclusive control is not necessary, processing authority is also admitted to any AP server.

Further, also when a checking request of the number of stocks is received from the client terminal 28, the number of stocks can be calculated by "the number of non-cancellation arrival - the number of non-cancellation shipping". Therefore, the exclusive control between the AP servers is not necessary.

[0067]

On the other hand, when an order (shipping) request of the product is sent from the client terminal 28, the order of

the number of stocks or more cannot be received. Therefore, the exclusive control is required between the AP servers.

Specifically, at the stage at which the order request of the product is generated, processing authority is delegated to the AP server in charge of shipping processing of the product (product code).

[0068]

The main AP server in charge that has received this stores the order request to the queue of the FIFO once, and executes processing in earlier order.

That is, the business processing unit 30 of the main AP server in charge, after calculating the stocks of the product related to the product code included in the order request, generates corresponding shipping data if the number of products included in the order request is within the range of stocks, and requests additional registration to the shipping table 62 to all the DB servers. Thereafter, a processing result is notified from the AP server as the consignment destination to the AP server as the consignment source.

Further, when the stock of the product is lower than the number of orders, the AP server as the consignment destination notifies the AP server as the consignment source of a result of stock shortage without generating shipping data.

[0069]

Also in this case, in order to make the exclusive control effective, it is necessary to define in advance processing (order reception processing) that requires the exclusive

control and processing (arrival reception processing and stock checking processing) that does not require the exclusive control, in an application program for the business processing unit 30.

Further, as software or digital book sold in download format, attention does not need to be paid to the number of stocks, depending on a sales target.

In this case, it is defined whether or not the exclusive control is required for every target product (for every product code) even if processing is the same order reception processing.
[0070]

Each DB server of the system 10, when having received data to be added from the DB connection unit 38 and stored the data to a self-memory thereof, sends a notification of reception completion to the DB connection unit 38, and thereafter stores a corresponding record to the table provided in an external storage device, such as a hard disk or an SSD.
[0071]

The notification of reception completion sent from the DB server is collected to the data control unit 34 via each DB connection unit 38.

When the notification of reception completion is returned from all the DB connection units 38, the data control unit 34 outputs the notification of registration completion to the business processing unit 30.
[0072]

When the notification of registration completion is

received from the data control unit 34, the business processing unit 30 recognizes the data as a reading target.

Contrarily saying, the business processing unit 30 sets the data as a target out-of-reading until the notification of registration completion is returned, and thus such a danger is avoided that the registration timing in each DB server is offset and illegal data is read.

[0073]

However, when the notification of reception completion is not returned from any of the DB servers after passage of a predetermined time, the data control unit 34 admits that a communication fault or a machine trouble is caused, and shifts the DB server to an off-line mode.

Specifically, the DB server is temporarily disconnected from the system 10, and is shifted to an operation mode based on only the remaining DB servers.

That is, when a notification of reception completion is received from all the DB servers other than the disconnected DB server, a notification of registration completion is output to the business processing unit 30 from the data control unit 34, and registration data is a reading target.

[0074]

During the term, the disconnected DB server is inspected and a necessary recovery countermeasure is performed. For example, when it is determined that the notification of registration completion is not received due to a failure of a communication device, the DB server is set to a write mode (in

a state of only permitting the writing of data and prohibiting the reference of the data) after replacement to a new communication device. Then, differential data is copied from another DB server installed in the data center.

[0075]

Then, when the storage data reaches the latest state, the DB server is set to a read/write mode (in a state of permitting the writing and reference of data), and is reconnected to the system 10.

Thereafter, the data control unit 34 restarts the sending and reception of the data via the DB connection unit 38 in charge of the DB server.

[0076]

In the case of the system 10, as mentioned above, the rule that only the addition of each business data is permitted and the deletion and update thereof are not admitted is applied. Therefore, the recovery of the data is extremely easy.

That is, when it is premised that the deletion and update of the data are permitted, it is necessary to sequentially reproduce the addition, deletion and update of the data from a predetermined timing based on the updating history information held by the DB server in order to recover the data, and this takes a long time and large load. Further, it is necessary to provide a system for reliably storing a update log on the DB server side.

[0077]

On the other hand, when it is premised that only the

addition of data is permitted like the system 10 and the deletion and update are prohibited, the data registered to another normal DB server is compared with the data registered to the DB server in which a failure is caused, and simply shortage data may be copied. Thus, it is not necessary to consider the order (after/before relationship) of data.

[0078]

Further, in the system 10, when the data sent from the DB connection unit 38 is stored to a memory of the DB server as mentioned above, the notification of reception completion is issued to the AP server from the DB server. Therefore, the business processing unit 30 can set the data to a reading target in an extremely short time.

[0079]

With the conventional common sense, the memory is a volatile storage unit so that data is lost when power supply stops, and a completion notification is to be returned when the data is stored to a non-volatile storage unit (hard disk, etc.).

On the other hand, in the case of the system 10, even if data is damaged in one DB server, following is possible only by simply copying shortage data from an adjacent DB server. Therefore, the wait until the data is stored to the hard disk or the like is not necessary.

[0080]

Further, since the recovery of the data is easy, when the same data is stored to a plurality of DB servers, a conventional troublesome procedure called 'two-phase commitment' is not

required. Simply, the registration is requested to each DB server. When a notification of reception completion is returned from the each DB server, the data can be read (realization of so-called auto-commitment).

As a consequence, exchange of messages between the AP server and the DB server is extremely reduced, and the whole processing speed can be improved.

[0081]

Since the business processing unit 30 marks the time stamp to the various business data (point adding data, addition cancellation data, point applying data, application cancellation data and the like) with precision of millimeter, a value of the surrogate key reaches MAX. Even in the case of re-issuing (recycling) the ID overlapped to the issued ID, the business processing unit 30 compares the time stamps, thereby enabling determination of new or old data.

[0082]

In the above, the example is shown of arranging a plurality of AP servers and a plurality of DB servers in a plurality of data centers. However, the invention is not limited to this.

That is, effective application is also possible in the case where, under environment where a plurality of AP servers and a plurality of DB servers are installed in one data center and each AP server is connected to all the DB servers via the network, each AP server uniquely performs parallel processing of the business processing without the exclusive control and processing authorities of the business processing that requires

the exclusive control are concentrated to the preset AP server.

Brief Description of Drawings

[0083]

[Fig. 1] Fig. 1 is a diagram of the whole configuration of a data processing system according to the invention.

[Fig. 2] Fig. 2 is a diagram showing an example of a table stored in each DB server.

[Fig. 3] Fig. 3 is a block diagram showing internal configurations of a first AP server and a second AP server.

[Fig. 4] Fig. 4 is a flowchart showing an issuing procedure of a surrogate key.

[Fig. 5] Fig. 5 is a diagram showing a structure of a surrogate key management table or the like.

[Fig. 6] Fig. 6 is a flowchart showing a processing procedure in the case of applying the system to a point management business.

[Fig. 7] Fig. 7 is a flowchart showing a procedure of point adding processing.

[Fig. 8] Fig. 8 is a flowchart showing a sequence of balance calculation processing.

[Fig. 9] Fig. 9 is a flowchart showing a processing procedure related to exclusive control between AP servers.

[Fig. 10] Fig. 10 is a flowchart showing a procedure of point applying processing.

[Fig. 11] Fig. 11 is a diagram showing another example of a table stored in each DB server.

Explanation of references

[0084]

- 10: data processing system
- 12: first data center
- 14: first AP server
- 16: first DB server
- 18: second DB server
- 20: second data center
- 22: second AP server
- 24: third DB server
- 26: fourth DB server
- 27: communication network
- 28: client terminal
- 29: communication line
- 30: business processing unit
- 32: surrogate key management unit
- 34: data control unit
- 38: DB connection unit
- 50: point adding table
- 51: addition cancellation table
- 52: point application table
- 53: application cancellation table
- 54: AP in charge definition table
- 56: surrogate key management table
- 57: last-digit management table of surrogate key
- 58: AP server management table

59: data center management table
60: arrival table
61: arrival cancellation table
62: shipping table
63: shipping cancellation table
64: AP in charge definition table

CLAIMS

[Claim 1] A data processing system comprising a plurality of AP servers and a plurality of DB servers, wherein

each of the DB servers includes a table for storing business data common to each other, each table has a limitation for allowing only reference and addition of a record and prohibiting deletion and update thereof,

each of the AP servers is connected to each of the DB servers, and has a function for executing common business processing to a request sent from a client terminal and a function for sending business data generated as a result of the processing to each of the DB servers and requesting additional registration to a corresponding table,

each piece of the business data is assigned with a unique ID including an identification code for specifying an AP server that has generated the piece of the business data,

each of the DB servers further stores an AP-in-charge definition table which defines, for each business processing, an AP server in charge of specific business processing that requires exclusive control,

each of the AP servers executes by itself business processing when the request of the business processing sent from the client terminal does not require exclusive control, and in contrast, when the request requires the exclusive control, refers to the AP-in-charge definition table, specifies an AP server that should take charge of the business processing, and

thereafter delegates corresponding processing to the AP server in charge, and

the AP server in charge that has received this once stores the delegated business processing to a queue, and thereafter sequentially executes each business processing in the queue according to a FIFO rule.

[Claim 2] The data processing system according to claim 1, wherein

not only a main AP server in charge but also a sub AP server in charge that should take charge of processing when the main AP server in charge does not function is defined in the AP in charge definition table for each business processing.

[Claim 3] The data management system according to claim 1 or 2, wherein a time stamp when business processing is executed is marked in each piece of the business data, and

wherein the AP server, when existing business data needs to be updated,

newly generates business data including ascending ID different from the business data, data after correction, and a time stamp at correction time, and

substantially updates the existing business data by additionally registering the business data for updating to a corresponding table provided in each DB server.

[Claim 4] The data processing system according to any of

claims 1 to 3, wherein the AP server, when the existing business data needs to be deleted,

generates business data for data cancellation having a data item that stores ID of the business data as a cancellation target, and

substantially deletes the existing business data by additionally registering the business data for data cancellation to a table dedicated for cancellation provided in each DB server.