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Akagawa et al.

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(54) **COMPUTER SYSTEM AND CONTROL METHOD OF COMPUTER SYSTEM**

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H04L 29/08 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 67/10*** (2013.01)

(58) **Field of Classification Search**
USPC 709/201
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0003077 A1 1/2004 Bantz et al.
2006/0005181 A1 1/2006 Fellenstein et al.
2010/0017592 A1 1/2010 Yamada
2012/0246311 A1 * 9/2012 Kagitani H04L 67/125 709/224
2012/0259983 A1 10/2012 Nakadai
2013/0227127 A1 * 8/2013 Takano G06F 9/5044 709/224

FOREIGN PATENT DOCUMENTS

JP	2004-038972	A	2/2004
JP	2006-048273	A	2/2006
JP	2007-164642	A	6/2007
JP	2008-502967	A	1/2008
JP	2011-164864	A	8/2011
WO	2008/117411	A1	10/2008
WO	2011/074699	A1	6/2011

* cited by examiner

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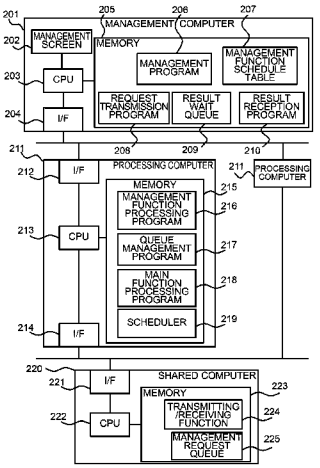
(57) **ABSTRACT**

A computer system includes a plurality of processing computers which switches an execution time of a main function processing and a management function processing in a given time, and a management computer which has a schedule table showing a schedule in which each processing computer may execute the management function processing, and which is capable of instructing the execution of the management function processing to each processing computer, wherein the processing computer notifies a start time an end time of the management function processing to the management computer before starting the management function processing, and the management computer updates the schedule table with the notification, an decides the processing computer that may execute the management function processing, by referring to the schedule table, upon instructing the management function processing to the processing computer.

12 Claims, 13 Drawing Sheets



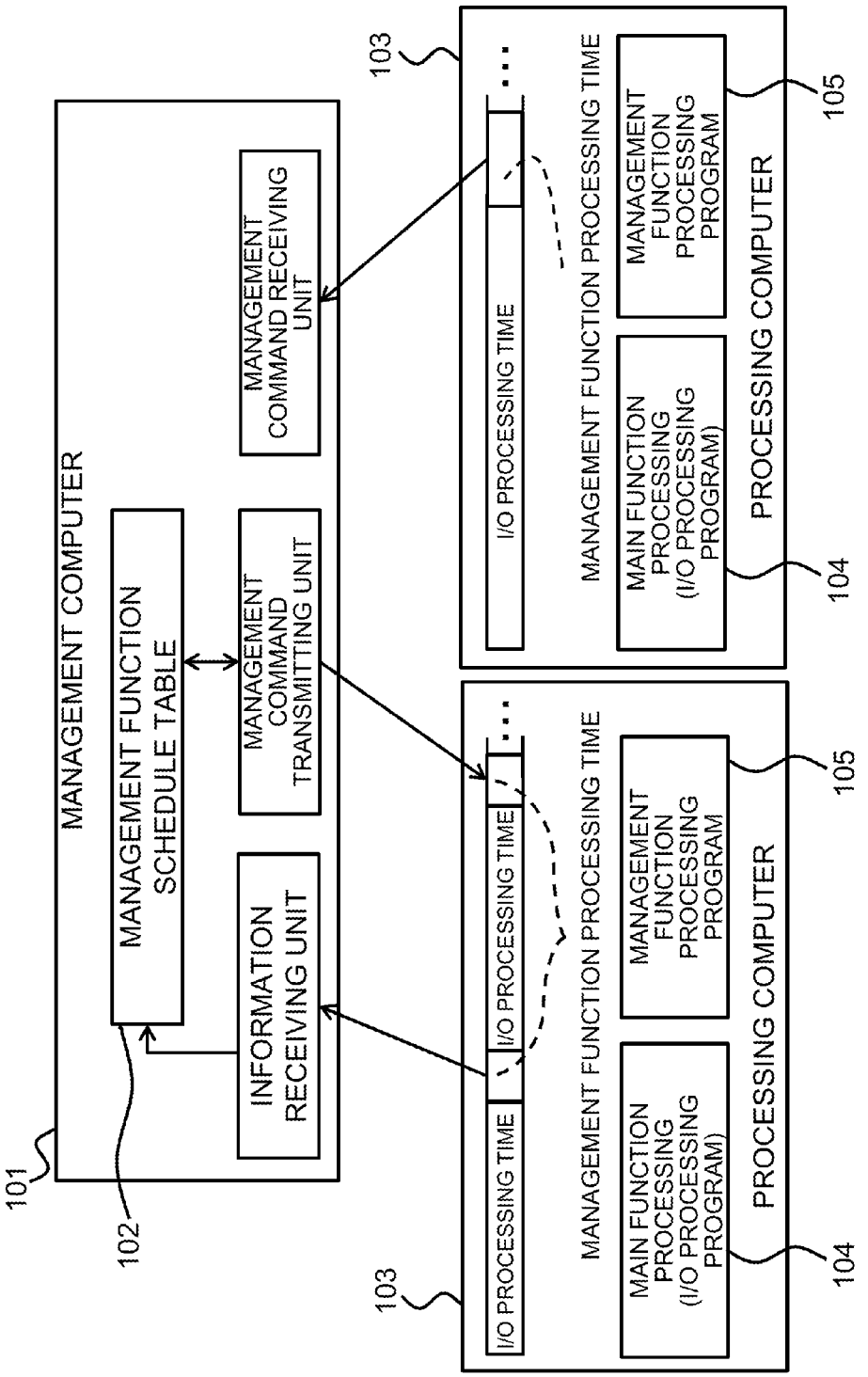

MANAGEMENT COMPUTER
MANAGEMENT FUNCTION SCHEDULE TABLE
INFORMATION RECEIVING UNIT
MANAGEMENT COMMAND TRANSMITTING UNIT
MANAGEMENT COMMAND RECEIVING UNIT
101
102
103
104
105
I/O PROCESSING TIME
MANAGEMENT FUNCTION PROCESSING TIME
MAIN FUNCTION PROCESSING (I/O PROCESSING PROGRAM)
MANAGEMENT FUNCTION PROCESSING PROGRAM
PROCESSING COMPUTER

FIG. 1

FIG. 2

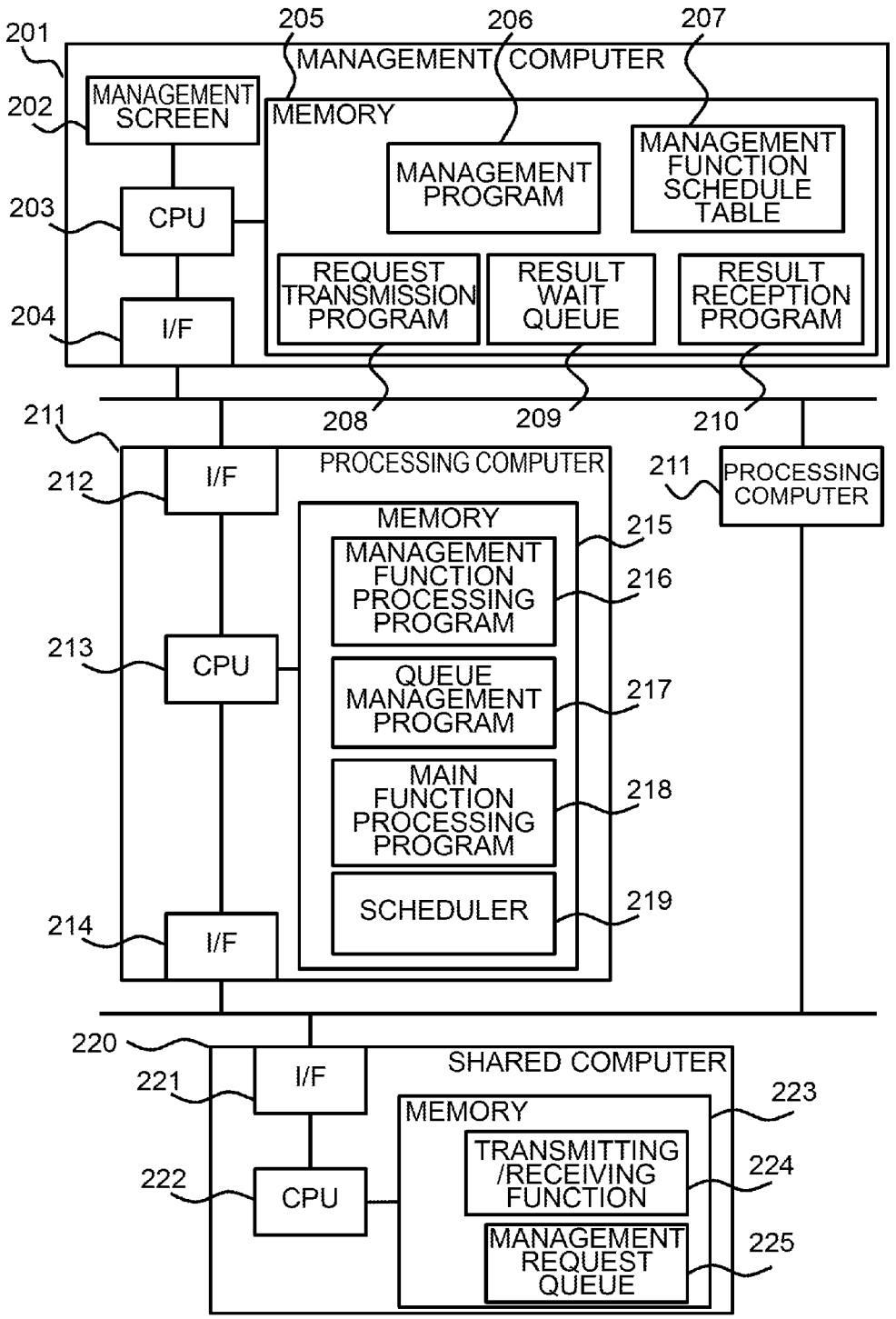
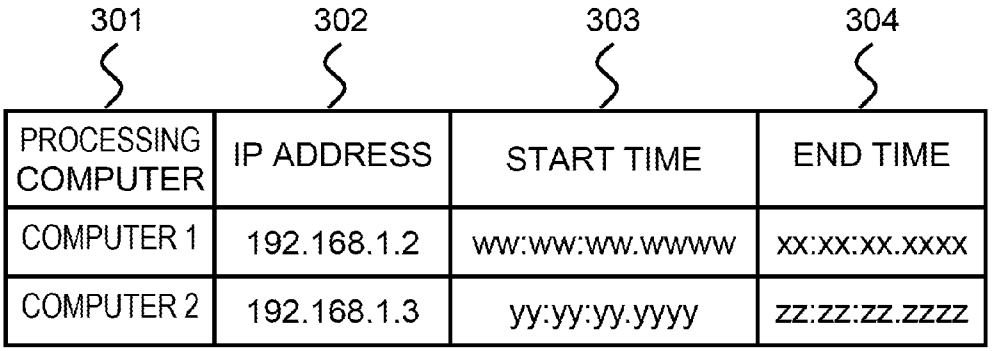

201
205
206
207
MANAGEMENT COMPUTER
MANAGEMENT SCREEN
202
MEMORY
MANAGEMENT PROGRAM
MANAGEMENT FUNCTION SCHEDULE TABLE
203
CPU
REQUEST TRANSMISSION PROGRAM
RESULT WAIT QUEUE
RESULT RECEPTION PROGRAM
204
I/F
208
209
210
211
I/F
212
PROCESSING COMPUTER
211
PROCESSING COMPUTER
MEMORY
215
MANAGEMENT FUNCTION PROCESSING PROGRAM
216
213
CPU
QUEUE MANAGEMENT PROGRAM
217
MAIN FUNCTION PROCESSING PROGRAM
218
SCHEDULER
219
214
I/F
220
SHARED COMPUTER
221
I/F
223
MEMORY
TRANSMITTING /RECEIVING FUNCTION
224
222
CPU
MANAGEMENT REQUEST QUEUE
225

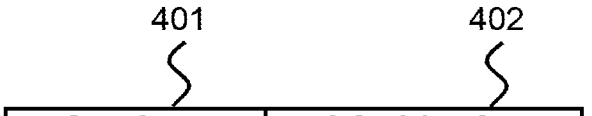
FIG. 3



PROCESSING COMPUTER	IP ADDRESS	START TIME	END TIME
COMPUTER 1	192.168.1.2	ww:ww:ww.wwww	xx:xx:xx.xxxx
COMPUTER 2	192.168.1.3	yy:yy:yy.yyyy	zz:zz:zz.zzzz

207

FIG. 4



REQUEST IDENTIFIER	PROCESSING CONTENT
Req_id1	OBTAIN PERFORMANCE INFORMATION
Req_id2	CHANGE CONFIGURATION

209

FIG. 5

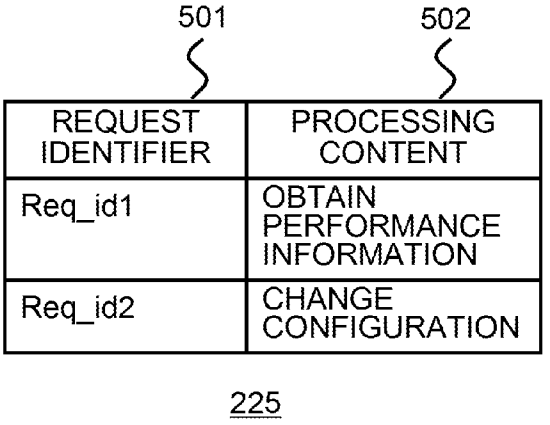

501
502
REQUEST IDENTIFIER
PROCESSING CONTENT
Req_id1
OBTAIN PERFORMANCE INFORMATION
Req_id2
CHANGE CONFIGURATION
225

FIG. 6

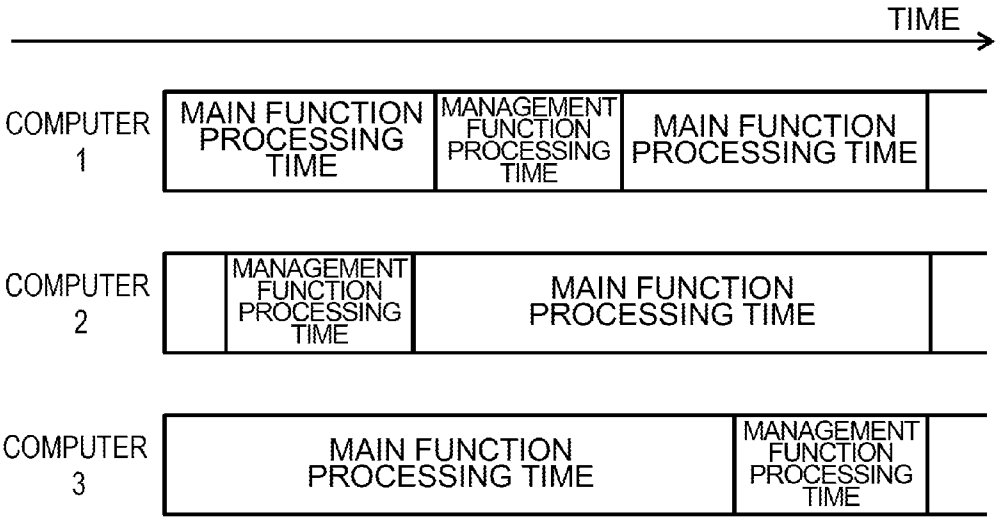

TIME
COMPUTER 1
MAIN FUNCTION PROCESSING TIME
MANAGEMENT FUNCTION PROCESSING TIME
MAIN FUNCTION PROCESSING TIME
COMPUTER 2
MANAGEMENT FUNCTION PROCESSING TIME
MAIN FUNCTION PROCESSING TIME
COMPUTER 3
MAIN FUNCTION PROCESSING TIME
MANAGEMENT FUNCTION PROCESSING TIME

FIG. 7

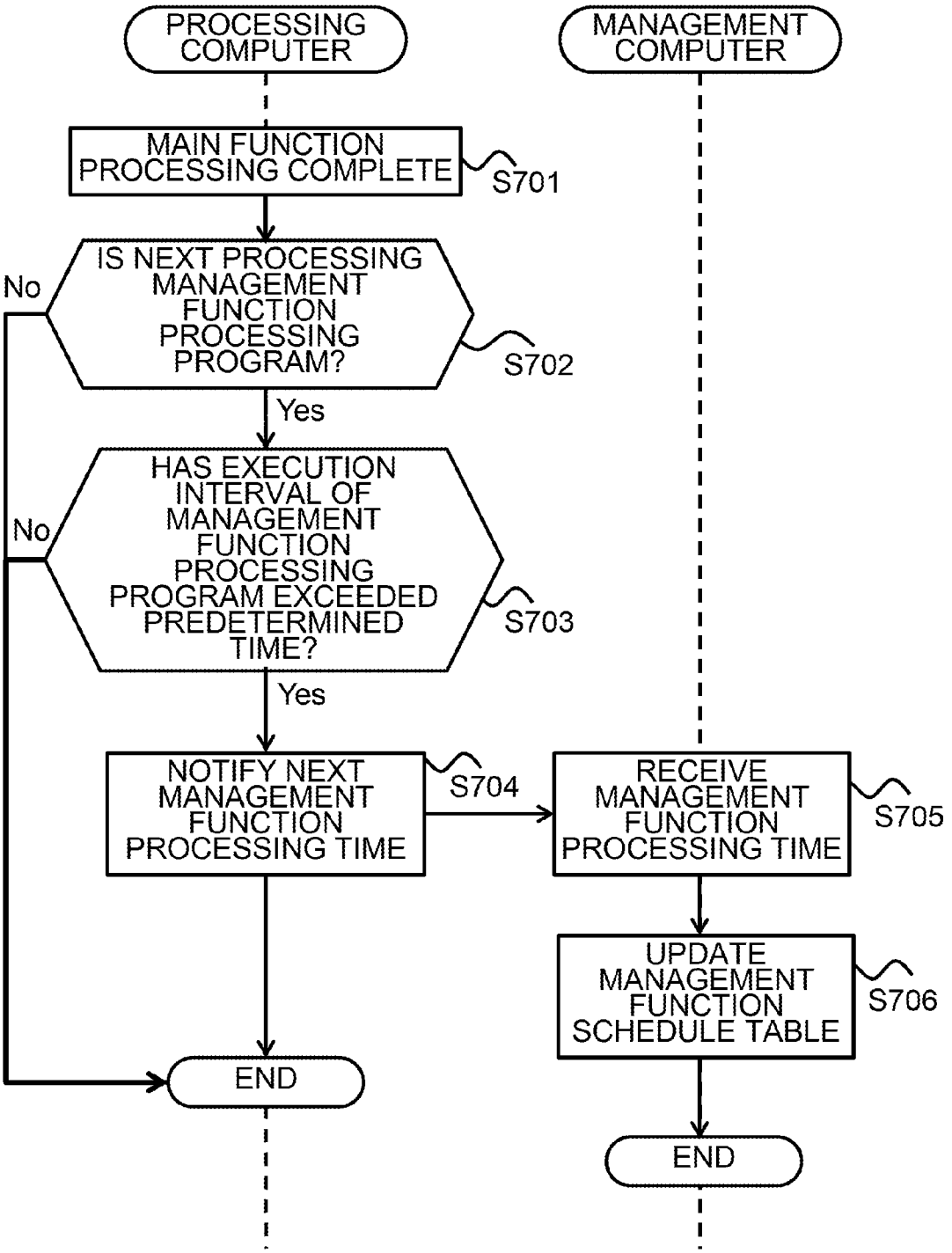

PROCESSING COMPUTER
MANAGEMENT COMPUTER
MAIN FUNCTION PROCESSING COMPLETE
S701
IS NEXT PROCESSING MANAGEMENT FUNCTION PROCESSING PROGRAM?
S702
No
Yes
HAS EXECUTION INTERVAL OF MANAGEMENT FUNCTION PROCESSING PROGRAM EXCEEDED PREDETERMINED TIME?
S703
No
Yes
NOTIFY NEXT MANAGEMENT FUNCTION PROCESSING TIME
S704
RECEIVE MANAGEMENT FUNCTION PROCESSING TIME
S705
UPDATE MANAGEMENT FUNCTION SCHEDULE TABLE
S706
END
END

FIG. 8

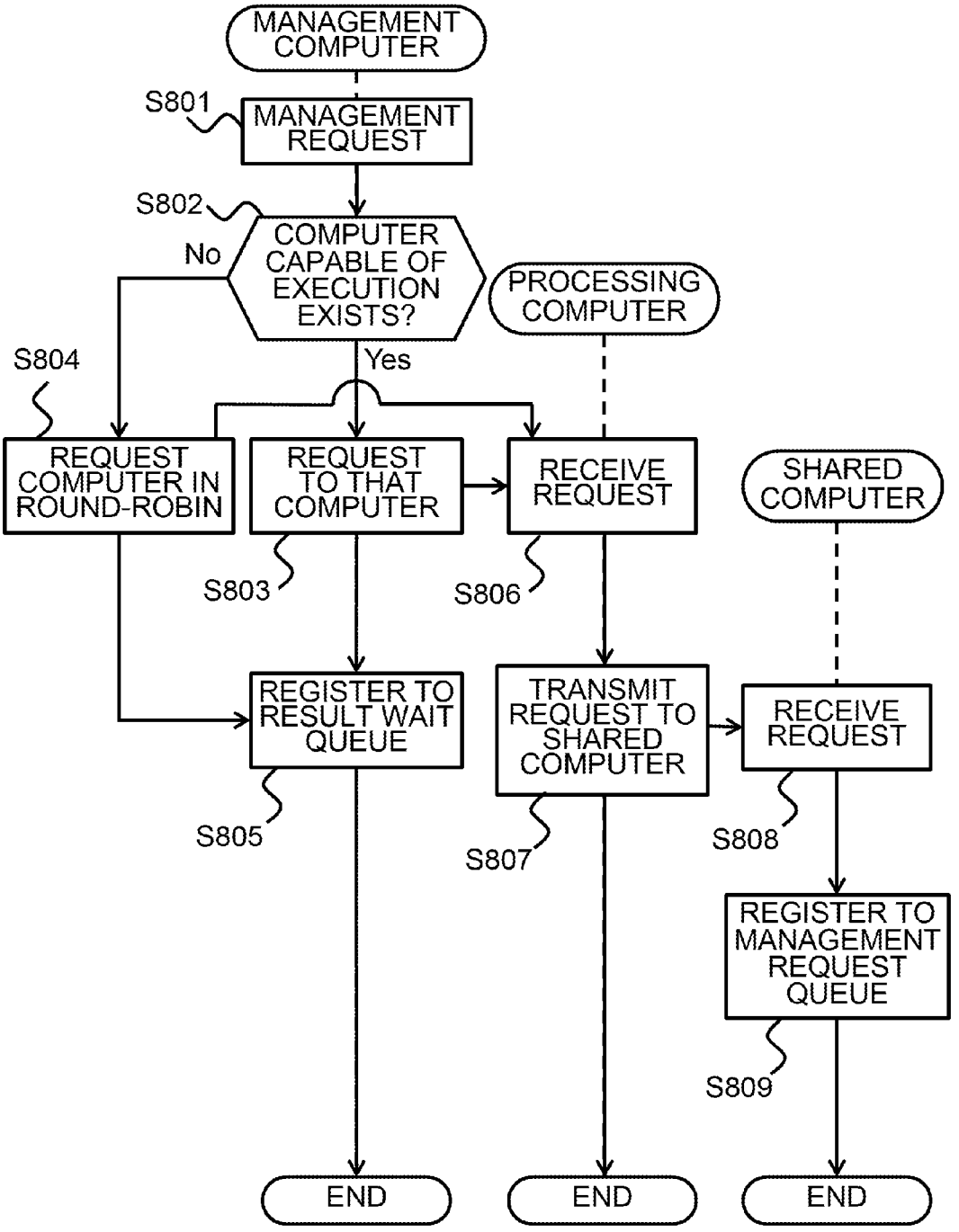

MANAGEMENT COMPUTER
S801
MANAGEMENT REQUEST
S802
COMPUTER CAPABLE OF EXECUTION EXISTS?
No
Yes
PROCESSING COMPUTER
S804
REQUEST COMPUTER IN ROUND-ROBIN
REQUEST TO THAT COMPUTER
RECEIVE REQUEST
SHARED COMPUTER
S803
S806
REGISTER TO RESULT WAIT QUEUE
TRANSMIT REQUEST TO SHARED COMPUTER
RECEIVE REQUEST
S805
S807
S808
REGISTER TO MANAGEMENT REQUEST QUEUE
S809
END
END
END

FIG. 9

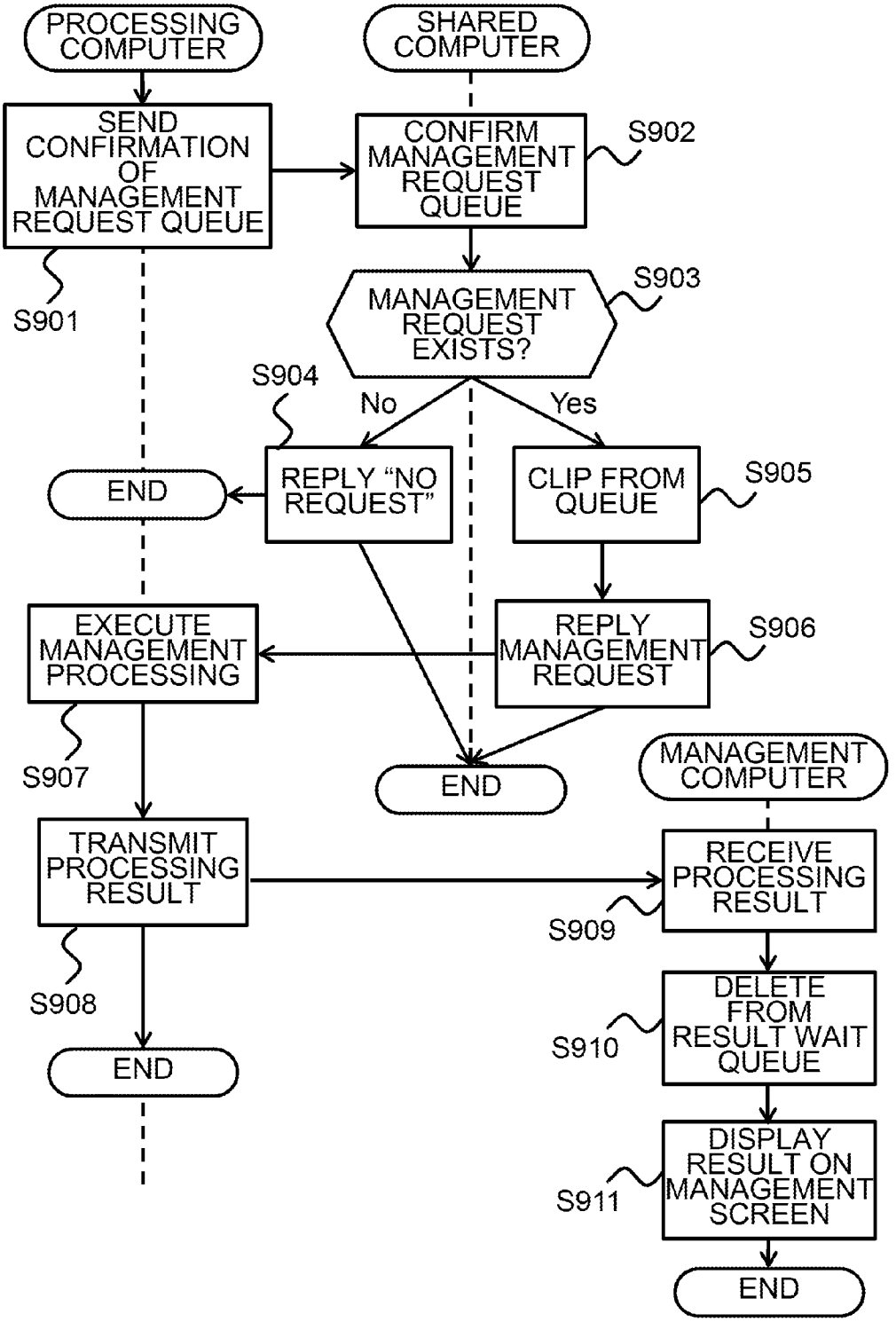

PROCESSING COMPUTER
SHARED COMPUTER
SEND CONFIRMATION OF MANAGEMENT REQUEST QUEUE
CONFIRM MANAGEMENT REQUEST QUEUE
S902
S901
MANAGEMENT REQUEST EXISTS?
S903
S904
No
Yes
END
REPLY "NO REQUEST"
CLIP FROM QUEUE
S905
EXECUTE MANAGEMENT PROCESSING
REPLY MANAGEMENT REQUEST
S906
S907
END
MANAGEMENT COMPUTER
TRANSMIT PROCESSING RESULT
RECEIVE PROCESSING RESULT
S909
S908
DELETE FROM RESULT WAIT QUEUE
S910
END
DISPLAY RESULT ON MANAGEMENT SCREEN
S911
END

FIG.10

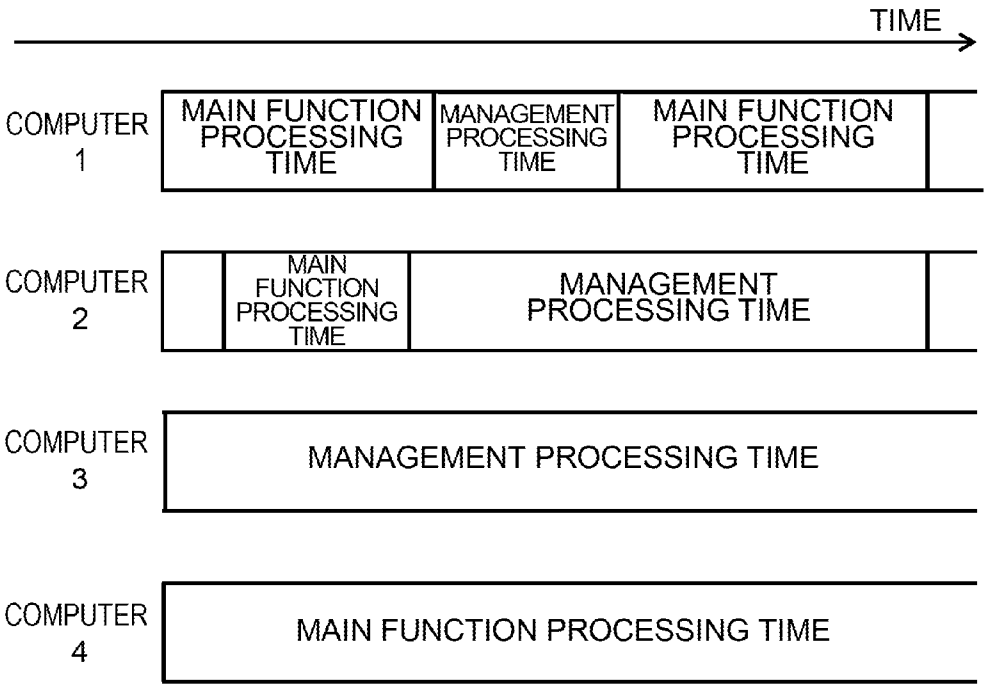


FIG.11

1101 COMPUTER	1102 IP ADDRESS	1103 START TIME	1104 END TIME	1105 MODE
COMPUTER 1	192.168.1.2	ww:ww:ww .wwww	xx:xx:xx .xxxx	MAIN FUNCTION PRIORITIZED
COMPUTER 2	192.168.1.3	yy:yy:yy .yyyy	zz:zz:zz .zzzz	MANAGEMENT FUNCTION PRIORITIZED
COMPUTER 3	192.168.1.4	-	-	MANAGEMENT EXCLUSIVE
COMPUTER 4	192.168.1.5	-	-	MAIN FUNCTION EXCLUSIVE

207

FIG.12

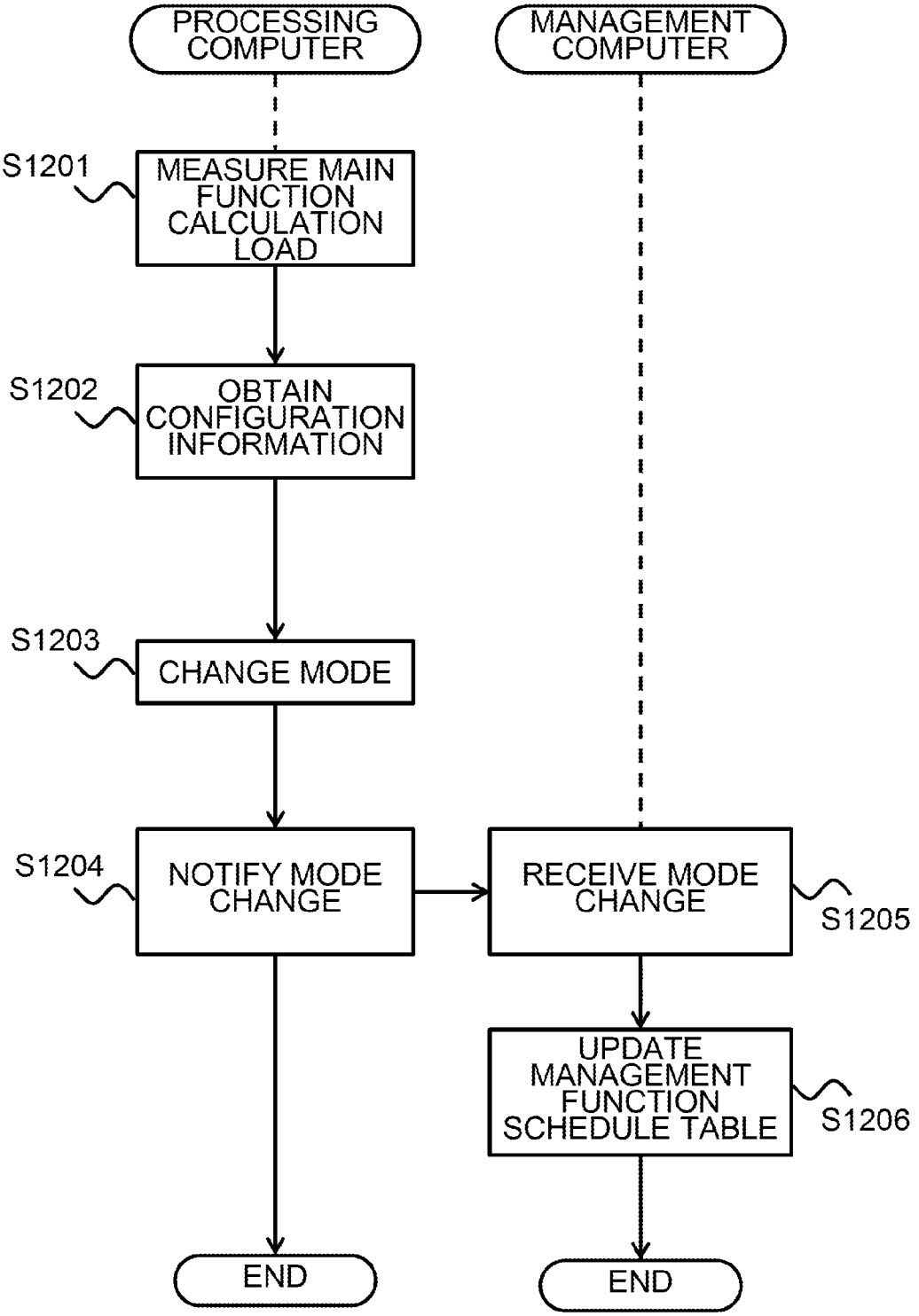

PROCESSING COMPUTER
MANAGEMENT COMPUTER
S1201
MEASURE MAIN FUNCTION CALCULATION LOAD
S1202
OBTAIN CONFIGURATION INFORMATION
S1203
CHANGE MODE
S1204
NOTIFY MODE CHANGE
RECEIVE MODE CHANGE
S1205
UPDATE MANAGEMENT FUNCTION SCHEDULE TABLE
S1206
END
END

FIG. 13

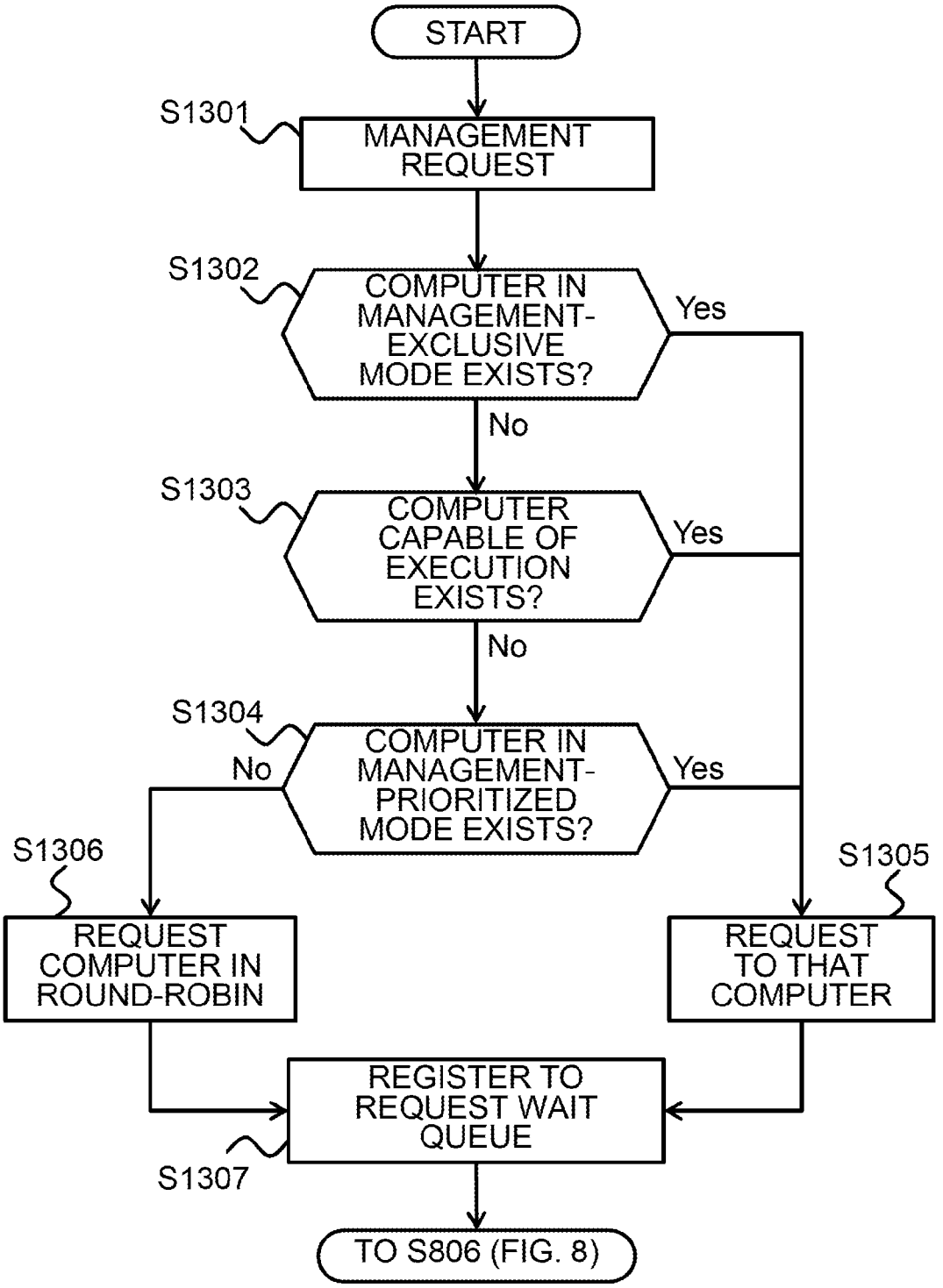

START
S1301
MANAGEMENT REQUEST
S1302
COMPUTER IN MANAGEMENT-EXCLUSIVE MODE EXISTS?
Yes
No
S1303
COMPUTER CAPABLE OF EXECUTION EXISTS?
Yes
No
S1304
COMPUTER IN MANAGEMENT-PRIORITIZED MODE EXISTS?
No
Yes
S1306
REQUEST COMPUTER IN ROUND-ROBIN
S1305
REQUEST TO THAT COMPUTER
REGISTER TO REQUEST WAIT QUEUE
S1307
TO S806 (FIG. 8)

FIG.14

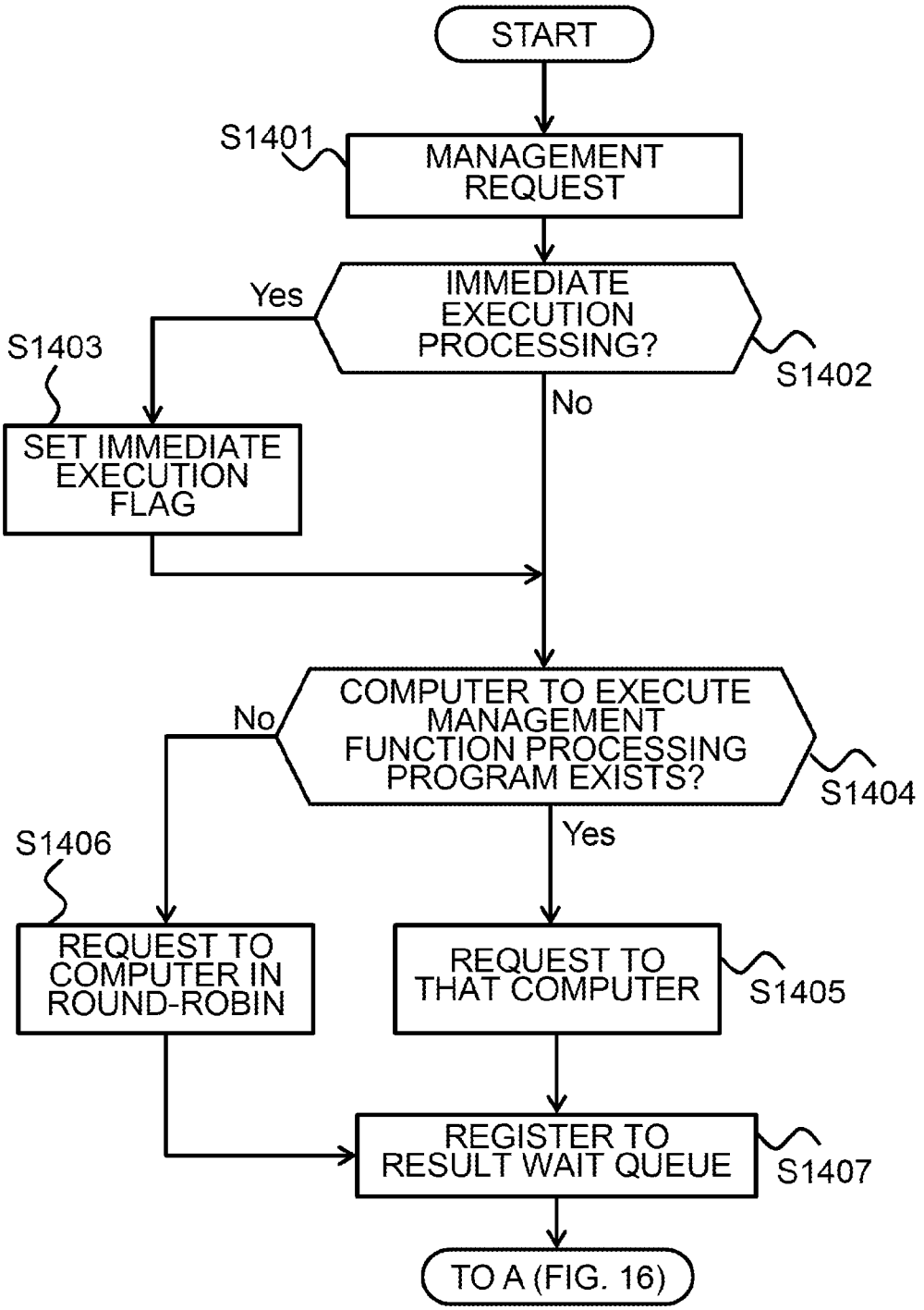

START
S1401
MANAGEMENT REQUEST
IMMEDIATE EXECUTION PROCESSING?
Yes
No
S1402
S1403
SET IMMEDIATE EXECUTION FLAG
COMPUTER TO EXECUTE MANAGEMENT FUNCTION PROCESSING PROGRAM EXISTS?
No
Yes
S1404
S1406
REQUEST TO COMPUTER IN ROUND-ROBIN
REQUEST TO THAT COMPUTER
S1405
REGISTER TO RESULT WAIT QUEUE
S1407
TO A (FIG. 16)

FIG.15

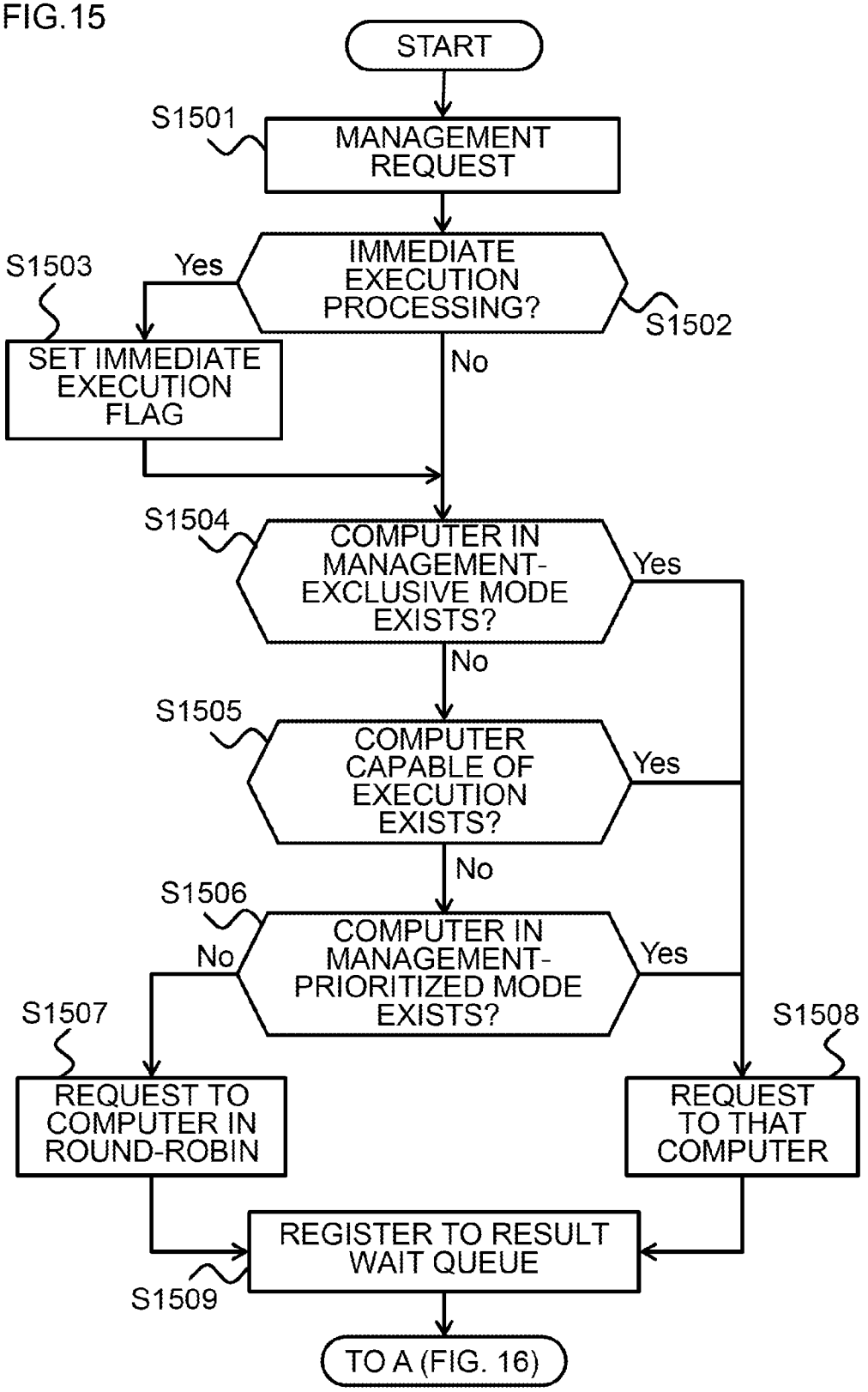
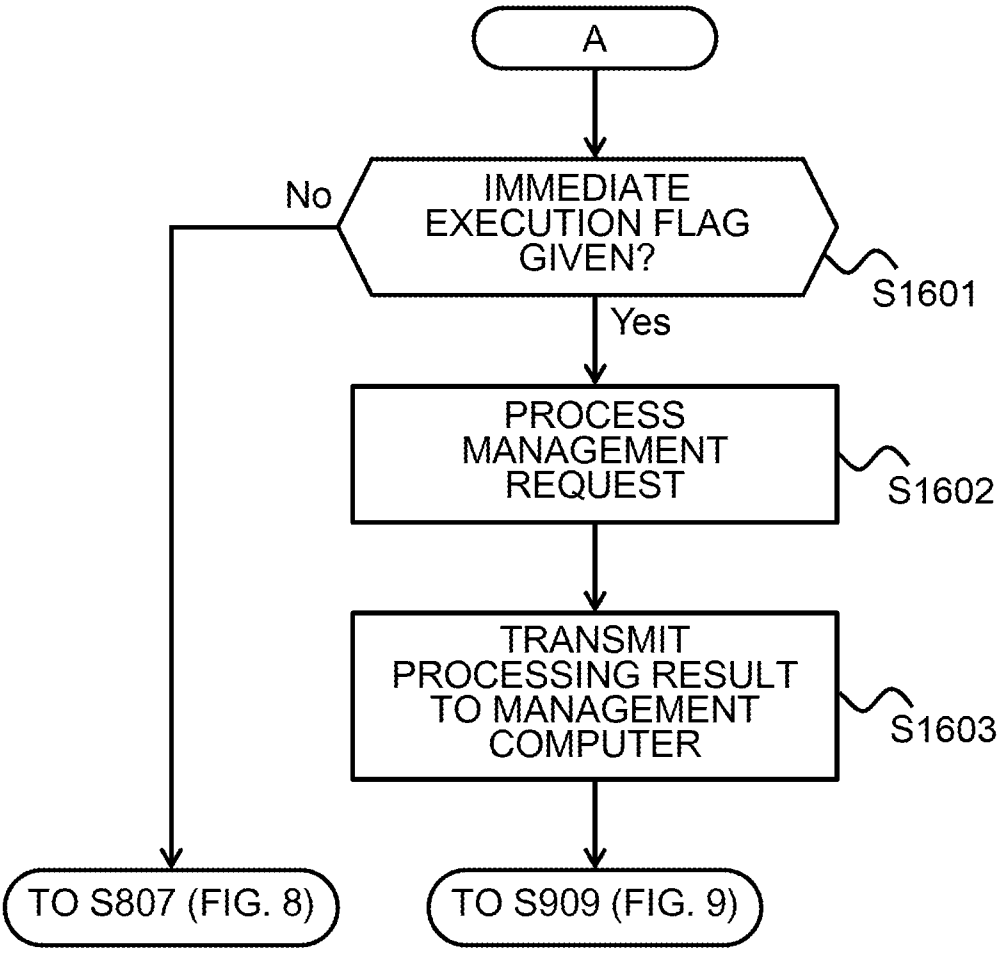

START
S1501
MANAGEMENT REQUEST
S1503
Yes
IMMEDIATE EXECUTION PROCESSING?
S1502
SET IMMEDIATE EXECUTION FLAG
No
S1504
COMPUTER IN MANAGEMENT-EXCLUSIVE MODE EXISTS?
Yes
No
S1505
COMPUTER CAPABLE OF EXECUTION EXISTS?
Yes
No
S1506
No
COMPUTER IN MANAGEMENT-PRIORITIZED MODE EXISTS?
Yes
S1507
S1508
REQUEST TO COMPUTER IN ROUND-ROBIN
REQUEST TO THAT COMPUTER
REGISTER TO RESULT WAIT QUEUE
S1509
TO A (FIG. 16)

FIG.16


A
IMMEDIATE EXECUTION FLAG GIVEN?
No
Yes
S1601
PROCESS MANAGEMENT REQUEST
S1602
TRANSMIT PROCESSING RESULT TO MANAGEMENT COMPUTER
S1603
TO S807 (FIG. 8)
TO S909 (FIG. 9)

COMPUTER SYSTEM AND CONTROL METHOD OF COMPUTER SYSTEM

TECHNICAL FIELD

The present invention relates to a technique for improving performance of a management computer in a distributed processing technique.

BACKGROUND ART

Recently, a distributed processing technique of processing computing with high-speed, by disposing a plurality of computers in parallel, is becoming popular. In the distributed processing technique, a technique of deciding the computer which executes the computing is important, and, for example in PTL1, a technique of calculating a combination in which a communication load between a device stored with data as a target of the processing and a computer which executes the computing becomes minimum, in order to decide the computer which executes the computing, is disclosed.

CITATION LIST

Patent Literature

[PTL 1] WO2011/074699

SUMMARY OF INVENTION

Technical Problem

In the conventional technique, it is necessary for a management computer to decide the computer which executes the computing, by obtaining a connecting relationship of an arrangement of all the data that must be processed and all of the processing computers or communication load thereof. Therefore, a problem is that a high specification is required for the management computer.

One of the aims of the present invention is, in view of the above-mentioned problem, to provide a computer system which decides the processing computer which executes the computing effectively, and a control method thereof.

Solution to Problem

Of the inventions disclosed in the present application, a representative example will be explained below.

A computer in a representative embodiment of the present invention is a computer system including a plurality of processing computers that switch an execution time of a main function processing and a management function processing in a given time period, and a management computer which has a schedule table showing a schedule in which each processing computer may execute the management function processing, and which is capable of instructing the execution of the management function processing to each processing computer, wherein the processing computer notifies a start time and an end time of the management function processing to the management computer before starting the management function processing, and the management computer updates the schedule table with the notification, and decides the processing computer that may execute the management function processing, by referring to the schedule table, upon instructing the management function processing to the processing computer.

Advantageous Effects of Invention

According to the present invention, an advantageous effect that the processing computer is capable of executing the management function processing, even when receiving a management request during a main function processing time, and the management computer is not required to strictly manage the schedule of the processing computer, so that the specification of the resource requested to the management computer may be suppressed low, may be obtained.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a block configuration diagram illustrating an outline of an embodiment.

FIG. **2** is a block diagram illustrating a configuration of a computer in Embodiment 1 through Embodiment 3.

FIG. **3** is a block diagram illustrating an example of a management function schedule table in Embodiment 1.

FIG. **4** is a block diagram illustrating an example of a result wait queue in Embodiment 1 through Embodiment 3.

FIG. **5** is a block diagram illustrating a management request queue in Embodiment 1 through Embodiment 3.

FIG. **6** is a block diagram illustrating a time-sharing processing mode of a processing computer in Embodiment 1.

FIG. **7** is a flowchart illustrating a procedure, in Embodiment 1, in which management computer updates the management function schedule table, based on a notification from the processing computer.

FIG. **8** is a flowchart illustrating a procedure, in Embodiment 1, in which the processing computer which received a request for a management function processing from the management computer receives the request and registers the same to the management request queue in a shared computer.

FIG. **9** is a flowchart illustrating a procedure, in Embodiment 1, in which the processing computer executes the management function processing which is registered in the management request queue in the shared computer.

FIG. **10** is a block diagram illustrating a time-sharing processing mode of the processing computer in Embodiment 2.

FIG. **11** is a block diagram illustrating an example of the management function schedule table in Embodiment 2.

FIG. **12** is a flowchart illustrating a procedure, in Embodiment 2, in which the management computer updates the management function schedule table, based on the notification from the processing computer.

FIG. **13** is a flowchart illustrating a procedure, in Embodiment 2, in which the management computer transmits the request for the management function processing to the processing computer.

FIG. **14** is a flowchart illustrating a procedure, in Embodiment 3, in which the management computer transmits the request for the management function processing to the processing computer under the configuration of Embodiment 1.

FIG. **15** is a flowchart illustrating a procedure, in Embodiment 3, in which the management computer transmits the request for the management function processing to the processing computer under the configuration in Embodiment 2.

FIG. **16** is a flowchart illustrating a procedure, in Embodiment 3, in which the processing computer executes the management function processing.

DESCRIPTION OF EMBODIMENTS

Hereinafter, as modes for carrying out the present invention, Embodiment 1 through Embodiment 3 will be explained with reference to the drawings.

As a start, explanation will be given on an outline of a basic function related to each Embodiment, using a block configuration diagram shown in FIG. **1**.

A processing computer **103** alternatively executes by time-sharing, a main function processing (I/O processing) program **104** which executes a main function processing (herein, an I/O processing is selected as a representative processing), and a management function processing program **105** which executes a management function processing (for example, a processing of changing a configuration of the processing computer **103** and the like). A management computer **101** includes a table **102** (hereinafter referred to as "management function schedule table **102**") which manages a time (a schedule) when the management function processing program **105** that a plurality of the processing computers **103** each has is operating.

The main function processing (I/O processing) program **104** determines, when the main function processing (the I/O processing) ends, whether or not the program to be executed next is the management function processing program **105**. If the program to be executed next is the management function processing program **105**, then the main function processing (I/O processing) program **104** notifies a start time and an end time of the operation of the management function processing program **105** to the management computer **101**. The management computer **101** receiving the notice updates the management function schedule table **102** according to the content of the notification.

When the management computer **101** receives a request for the management function processing from an administrator, the management computer **101** refers to the management function schedule table **102**, and transmits the request for the management function processing to the processing computer **103** in which the management function processing program **105** is operating at a current time. The processing computer **103** receiving the request executes the management function processing, if the management function processing program **105** is operating at the time of receipt, and executes the management function processing when the management function processing program **105** is operated next if the management function processing program **105** is not currently operating.

Since it is not necessary for the management computer to strictly manage the schedule of the processing computer, the present invention is preferable specifically in a system configured to have a large number of the processing computers, in an environment where the management computer with sufficient performance for managing the processing schedule of all processing computers is not provided.

FIG. **2** is a block diagram illustrating a configuration of a computer system in Embodiment 1 through Embodiment 3.

Before starting explanation of each constituent element, correspondence with the block configuration diagram in FIG. **1** will be explained. The management computer **101**, the management function schedule table **102**, the processing computer **103**, the main function processing (I/O processing) program **104** and the management function processing program **105** in FIG. **1** respectively corresponds in series to a management computer **201**, a management function schedule table **207**, a processing computer **211**, a main function processing program **218** and a management function processing program **216** of FIG. **2**.

The management computer **201** is configured from a management screen **202** for a user to manipulate the management computer **201**, a CPU **203**, an interface **204** for connecting with the processing computer **211**, and a memory **205**.

The memory **205** is configured from a management program **206** which executes each program on the memory **205**, according to the manipulation content of the user from the management screen **202**, the management function schedule table **207** which stores the schedule of the management function processing in each processing computer **211**, a request transmission program **208** which transmits the request for the management function processing to the processing computer **211**, a request wait queue **209** for waiting the management function processing requested by the request transmission program **208**, and a result reception program **210** for receiving the processing result. Further, other program, not shown, for manipulating the result wait queue **209** is stored in the memory **205**.

In the following embodiments, a processing of the management computer **201** activating the program and manipulating the result wait queue **209** using the CPU **203** may sometimes be referred simply to as "the management computer **201** manipulates the result wait queue **209**". Further, a program, not shown, for communicating with the processing computer **211** is stored to the memory **205**. A processing of the management computer **201** activating this program and communicating with the processing computer **211** using the CPU **203** may sometimes be referred simply to as "the management computer **201** communicates with the processing computer **211**".

The processing computer **211** is configured from an interface **212** for connecting with the management computer **201**, a CPU **213**, an interface **214** for connecting with a shared computer **220**, and a memory **215**.

The memory **215** is configured from the management function processing program **216** for processing the management function, a queue management program **217** for manipulating a management request queue **225** that the shared computer **220** has, the main function processing program **218** for processing the main function, such as the I/O processing explained above, and a scheduler **219** which manages the execution time of all the programs. The computer system in each embodiment is configured from one or more processing computers **211**.

The shared computer **220** is configured from an interface **221** for connecting with the processing computer **211**, a CPU **222**, and a memory **223**.

The memory **223** is configured from a transmitting/receiving function **224** for communicating with the processing computer **211**, and the management request queue **225** for storing a management request issued by the management computer **201**. Further, the memory **223** is stored with a program, not shown, for manipulating the management request queue **225**. In the following embodiments, a processing of the shared computer **220** activating this program and manipulating the management request queue **225** using the CPU **222** may sometimes be referred simply to as "the shared computer **220** manipulates the management request queue **225**".

As a network which connects the management computer **201**, the processing computer **211** and the shared computer **220**, a Local Area Network (hereinafter referred to as "LAN"), or a Storage Area Network (hereinafter referred to as "SAN") are suitably used.

In the following embodiments, as is shown in FIG. **2**, explanation will be given on a computer system configured from a plurality of computers. However, the processing realized by these computers may be realized in one computer. In such case, the management computer **201** is to be read as a Baseboard Management Controller (hereinafter referred to as "BMC") in the one computer, the processing computer **211** is

to be read as a microprocessor, and the shared computer **220** is to be read as a shared memory which is shared by all of the microprocessors. Further, as a network which connects the BMC, the microprocessor, and the shared memory, the LAN or a PCI Express (registered trademark) are suitably used.

Embodiment 1

Embodiment 1 is an embodiment in which the management computer **201** decides the processing computer **211** which executes the management function processing, taking into consideration the schedule of the processing executed by each processing computer **211**, and receives the result of the management function processing.

FIG. **3** illustrates an example of the management function schedule table **207** in Embodiment 1. The management function schedule table **207** at least has an identifier **301** of each processing computer **211**, and a start time **303** and an end time **304** of a management function processing time in each processing computer **211**. Further, in a case where each processing computer **211** and the management computer **201** are connected by an Internet Protocol (hereinafter referred to as "IP") network, then the management function schedule table **207** may have an IP address **302** of each processing computer **211**.

FIG. **4** illustrates an example of the result wait queue **209** that the management computer **201** has. The result wait queue **209** is a queue for managing the request to which the result of the processing is not replied from the processing computer **211**, after the request transmission program **208** requests the management function processing to the processing computer **211**. The result wait queue **209** at least has a request identifier **401** of the management function processing, and a column **402** which indicates a processing content of each request.

FIG. **5** illustrates an example of the management request queue **225** that the shared computer **220** has. The management request queue **225** is a queue for managing the request to which the processing is not executed, after the request for the management function processing is received by the processing computer **211**. The management request queue **225** at least has a request identifier **501** of the management function processing, and a column **502** which indicates a processing content of each request. Here, the management request queue **225** illustrated in FIG. **5** has a same configuration in Embodiment 2 and Embodiment 3 to be explained later.

FIG. **6** illustrates that the processing computer **211** processes two functions (the main function and the management function) by time-sharing. A main function processing time is a time in which a function processing program as a main purpose of the processing computer **211** (the main function processing program **218**) is operating. As a processing content of the main function processing program **218**, for example in a case where the processing computer **211** is a storage device, an I/O processing of the data corresponds thereto. Further, in a case where the processing computer **211** is a computer for scientific computing, then an arithmetic processing for the scientific computing corresponds to the processing content.

A management function processing time is a time in which a program for management of the processing computer **211** (the management function processing program **216**) is operating. As a processing content of the management function processing program **216**, for example, a communication processing with the management computer **201**, a processing for changing a configuration of the processing computer **211**, a processing for changing an account of an administrator, and the like, correspond thereto.

Each processing computer **211** (computers **1** through **3** in FIG. **6**) has different processing time for the two functions that are allocated in a time-sharing matter. By processing the two functions using time-sharing, even when the management request from the management computer **201** is received outside the management function processing time, the management request may be processed, when the next management function processing time arrives.

FIG. **7** is a flowchart illustrating a procedure in which the management computer **201** updates the management function schedule table **207**, based on a notification from the processing computer **211**, in Embodiment 1.

When the main function processing program **218** which the processing computer **211** is executing ends (S**701**), the main function processing program **218** refers to the scheduler **219**, and confirms whether or not the next operating program is the management function processing program **216** (S**702**).

In a case where the next processing is not the management function processing program **216** (S**702**: No), then the processing computer **211** ends without performing notification to the management computer **201**.

On the other hand, in a case where the next processing is the management function processing program **216** (S**702**: Yes), then the management function processing program **216** confirms whether or not an executing interval exceeds a predetermined time (S**703**).

In a case where the executing interval of the management function processing program **216** did not exceed the predetermined time (S**703**: No), then the processing computer **211** ends without performing a notification to the management computer **201**.

On the other hand, in a case where the execution interval of the management function processing program **216** exceeds the predetermined time (S**703**: Yes), then the main function processing program **218** refers to the scheduler **219** for a time allocated to the management function processing program **216**, sets a time in which a changing time of the program is added to the end time of the main function processing program **218** as the start time of the management function processing time, and sets a time in which the time allocated for the management function processing program **216** is added to the start time as the end time of the management function processing time, and notifies the start time and the end time to the management computer **201** (S**704**). Here, the steps from S**702** to S**704** may be executed not by the main function processing program **218**, but by a notification program not shown.

The management computer **201** receives the notification (S**705**), and updates, in a row in the management function schedule table **207** which corresponds to the processing computer **211** transmitting the notification, the start time **303** by the start time identified in the received notification, and the end time **304** by the end time identified in the received notification, respectively (S**706**).

FIG. **8** is a flowchart illustrating a procedure in which the processing computer **211**, which received a request for the management function processing from the management computer **201**, receives the request and registers the same to the management request queue **225** in the shared computer **220**, in Embodiment 1.

First, the management computer **201** receives the request for the management function processing, from a user via the management screen **202** (S**801**).

Subsequently, the management program **206** checks whether or not there is a processing computer **211** corresponding to a condition that the start time **303** is older than the current time, and the end time **304** is newer than the current

time (that is, capable of executing), by referring to the management function schedule table **207** (S**802**).

In a case where there is no processing computer **211** corresponding to the condition (S**802**: No), then the management program **206** applies an identifier with respect to the management function processing, and requests the management function processing to an arbitral processing computer **211** (S**804**). As a selecting algorithm of the arbitral processing computer **211**, a round-robin is suitable. On the other hand, in a case where there is the processing computer **211** corresponding to the condition (S**802**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing by executing the request transmission program **208** to the processing computer **211** (S**803**).

Subsequently, the management program **206** registers the request to the result wait queue **209** (S**805**). Specifically, an entry in which the identifier generated in S**803** or S**804** is stored in the request identifier **401**, and the content of the management function processing is stored in the column **402**, is newly generated, and the same is added to the result wait queue **209**.

The processing computer **211** receives the request from the management program **206** in the step of S**803** or S**804** (S**806**), executes the queue management program **217**, and transmits the request to the shared computer **220** (S**807**).

Subsequently, the shared computer **220** receives the request (S**808**), and registers the request to the management request queue **225** via the transmitting/receiving function **224** (S**809**). Specifically, an entry in which the identifier generated in S**803** or S**804** is stored in the request identifier **501**, and the content of the management function processing is stored in the column **502**, is newly generated, and the same is added and recorded to the management request queue **225**.

FIG. **9** is a flowchart illustrating the procedure, in Embodiment 1, in which the processing computer **211** executes the management function processing registered in the management request queue **225** of the shared computer **220**.

First, the processing computer **221** in which the management function processing time arrived, executes the management function processing program **216**. The management function processing program **216** executes the queue management program **217**, and confirms whether or not an unprocessed entry exists in the management request queue **225**, to the shared computer **220** (S**901**).

Subsequently, the shared computer **220** confirms the management request queue **225** (S**902**), and determines the existence of the unprocessed processing request (entry) (S**903**). In a case where no unprocessed entry exists (S**903**: No), then the shared computer **220** replies accordingly ("no request") to the processing computer **211** via the transmitting/receiving function **224** (S**904**), and the processing computer **211** starts the main function processing program **218** without actuating the management function processing program **216**.

On the other hand, in a case where the unprocessed entry exists (S**903**: Yes), then the shared computer **220** clips the entry from the management request queue **225** (S**905**), and replies the content of the entry to the processing computer **211** via the transmitting/receiving function **224** (S**906**).

The management function processing program **216** of the processing computer **211** receiving the content of the entry executes the processing content **502** stored in the entry (S**907**), and transmits the identifier **501** of the processing and the result of the processing to the management computer **201** (S**908**).

The management computer **201** receives the result of the processing with the result reception program **210**, and executes the management program **206** (S**909**). The management program **206** searches for the entry corresponding to the identifier **501** in the result wait queue **209**, and deletes the entry (S**910**).

Lastly, the management program **206** displays the result of the processing to the management screen **202** (S**911**).

With the procedure explained above, it becomes possible to process the management function requested by the user with the processing computer **211**, and the user may confirm the processing result. As is explained in FIG. **6**, even when the processing computer **211** receives the management request during the main function processing time, the processing computer **211** may execute the management function processing program **216**. Therefore, it is not necessary for the management computer **201** to strictly manage the schedule of the processing computer **211**, so that a specification of resources such as a CPU (Central Processing Unit) and RAM (Random Access Memory) and the like that are required to the management computer **201** may be suppressed low.

Embodiment 2

Embodiment 2 is an embodiment in which, in addition to Embodiment 1, each processing computer **211** has a mode, and each processing computer **211** changes the schedule of the processing which is implemented based on the mode, and the management computer **201** decides the processing computer **211** performing the request for the management function processing taking the mode into consideration.

The memory **215** of the processing computer **211** in Embodiment 2 has, in addition to the programs that the memory **215** in Embodiment 1 has, a main function load monitor and a mode switch program.

FIG. **10** is a block diagram illustrating a relation between a mode of the processing computer **211** and a time-sharing processing mode in Embodiment 2. The computer **1** indicates that the computer is in a main function prioritized mode, and in this mode, the scheduler **219** allocates a longer time for the main function processing time compared to the management function processing time, and makes the CPU **213** execute the same. The computer **2** indicates that the computer is in a management prioritized mode, and in this mode, the scheduler **219** allocates a longer time for the management function processing time compared to the main function processing time, and makes the CPU **213** execute the same. The computer **3** indicates that it is in a management exclusive mode, and in this mode, the scheduler **219** allocates the management function processing time only, and makes the CPU **213** execute the same. The computer **4** indicates that it is in a main function exclusive mode, and in this mode, the scheduler **219** allocates the main function processing time only, and makes the CPU **213** execute the same. Here, all these modes are examples, and the scheduler **219** of each processing computer **211** may not have all the modes, or may have other modes.

FIG. **11** illustrates an example of the management function schedule table **207** in Embodiment 2. In Embodiment 2, in addition to columns **1101** through **1104** corresponding to the management function schedule table **207** of Embodiment 1 illustrated in FIG. **3**, the management function schedule table **207** has a column **1105** showing a mode of each computer. Further, for a start time **1103** and an end time **1104** corresponding to the computer of the management exclusive mode or the main function exclusive mode (the computer **3** and the computer **4**), there is no need to store the data in the table, so that a hyphen is input thereto in FIG. **11** as an example.

FIG. **12** illustrates a flow chart in which the processing computer **211** notifies the changed content to the manage-

ment computer **201**, and the management computer **201** updates the management function schedule table **207**, when the processing computer **211** changed its mode.

First, a main function load monitor of the processing computer **211** measures a load of the main function processing (S**1201**). As an example of a measurement method, a method of measuring a length of a queue of the request that the main function must process, or a method of predicting an amount of the request that the main function must process in the future from a history of past requests, may be given.

Subsequently, the mode switch program studies the configuration of the processing computer **211** (S**1202**). For example, in a case where the processing computer **211** is a storage device, and if no path for accessing a storage area for storing data of users is allocated to the processing compute **211**, then no I/O processing of the data with respect to the processing computer **211** is generated. Therefore, it may be set to the management exclusive mode.

Subsequently, the mode switch program changes the mode based on the measurement result of the load of the main function processing and the study result of the configuration, and notifies the same to the scheduler **219** (S**1203**).

Subsequently, the mode switch program notifies the mode after change to the management computer **201** (S**1204**).

The management computer **201** receives this notification (S**1205**), and executes the management program **206**. Of the management function schedule table **207**, the management program **206** updates a mode **1105** of the row corresponding to the processing computer **211**, to the mode notified from the processing computer **211** (S**1206**).

FIG. **13** illustrates a flowchart in which the management program **206** requests the management function processing to the processing computer **211**, based on the management function schedule table **207** having the mode **1105**.

First, the management computer **201** receives the request for the management function processing from the user via the management screen **202** (S**1301**).

Subsequently, the management computer **201** activates the management program **206**. The management program **206** checks whether there is the processing compute **211** of the management exclusive mode, by referring to the management function schedule table **207** (S**1302**). In a case where there is the processing computer **211** of the management exclusive mode (S**1302**: Yes), then the management program **206** applies an identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1305**).

In a case where there is no processing computer **211** of the management exclusive mode (S**1302**: No), the management program **206** checks whether there is a processing computer **211** corresponding to a condition that the start time **303** is older than the current time and the end time **304** is newer than the current time (that is, capable of executing), by referring to the management function schedule table **207** (S**1303**). In a case where there is the processing computer **211** corresponding to the condition (S**1303**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1305**).

In a case where there is no processing computer **211** corresponding to the condition (S**1303**: No), then the management program **206** checks whether there is the processing computer **211** of the management prioritized mode, by referring to the management function schedule table **207** (S**1304**). If there is the processing computer **211** of the management prioritized mode (S**1304**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1305**).

In a case where there is no processing computer **211** of the management prioritized mode (S**1304**: No), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to an arbitral processing computer **211** (S**1306**). As a selecting algorithm of the arbitral processing computer **211**, a round-robin is suitable.

Subsequently, the processing computer **211** executes the management function processing program **216**, and the management function processing program **216** registers the request to the result wait queue **209** (S**1307**).

The processing after this step is the same as the processing after S**806** illustrated in the flow chart of FIG. **8** and the processing of FIG. **9** of Embodiment 1.

With the above-mentioned procedure, it becomes possible to process the management function requested by the user with the processing computer **211**, and the user may confirm the processing result by the management screen **202** of the management computer **201**. The management computer **201** requests the management function processing preferentially to the processing computer **211** of the management exclusive mode or the management prioritized mode, so that it becomes possible to shorten the processing time of the management function processing with respect to the user.

Further, in the above, explanation is given on a case where both the management exclusive mode and the management prioritized mode are provided. However, it is not always necessary to have both modes, and the present invention may be applied to a case where only one of the modes is provided. In a case where only the management exclusive mode is provided, the determination processing of S**1304** of FIG. **13** will be omitted, and in a case where only the management prioritized mode is provided, the determination processing of S**1302** of FIG. **13** will be omitted.

Embodiment 3

Embodiment 3 is an embodiment in which, in addition to Embodiment 1 or Embodiment 2, the processing computer **211** which received the request for the management function processing executes the management function processing, without intervention of the management request queue **225**.

FIG. **14** through FIG. **16** illustrate the processing procedure (flowchart) of the management computer **201** and the processing computer **211**, in a case where the user requests an immediate execution of the management function processing.

FIG. **14** is a flowchart illustrating a processing procedure for executing the above-mentioned processing, in addition to Embodiment 1.

First, the management computer **201** receives the request for the management function processing from the user via the management screen **202** (S**1401**).

Subsequently, the management computer **201** activates the management program **206**, and the management program **206** determines whether or not the request for the management function processing is a request for the immediate execution (S**1402**). Whether or not the request is the request for the immediate execution may be designated by the user using the management screen **202** in S**1401**, or may be determined by the management program **206** based on the content of the management function processing.

For example, in a set-up operation for starting operation of the processing computer **211**, it is not necessary for the processing computer **211** to execute the main function processing program **218**. Therefore, by the administrator designating

the immediate execution, it becomes possible to shorten the processing time of the management function necessary for the set-up operation. Further, in a case where a malfunction occurred in the processing computer **211**, a configuration may be adopted in which the management program **206** designates the immediate execution to a process of obtaining a log recording information of the malfunction and the like, in order to achieve prompt recovery from the malfunction by shortening the processing time.

In a case where the request is the request for the immediate execution (S**1402**: Yes), then the management program **206** adds a flag indicating the immediate execution to the request (S**1403**). In a case where it is not the request for the immediate execution (S**1402**: No), then the process immediately proceeds to the next step S**1404**.

Subsequently, the management program **206** checks whether there is a processing computer **211** corresponding to a condition that the start time **303** is older than the current time and the end time **304** is newer than the current time (that is, capable of executing), by referring to the management function schedule table **207** (S**1404**).

In a case where there is no processing computer **211** corresponding to the condition (S**1404**: No), then the management program **206** applies an identifier with respect to the management function processing, and requests the management function processing to an arbitral processing computer **211** (S**1406**). As a selecting algorithm of the arbitral processing computer **211**, a round-robin is suitable. In a case where there is the processing computer **211** corresponding to the condition (S**1404**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1405**).

Subsequently, the processing computer **211** registers the request to the result wait queue **209** (S**1407**). The processing after this step will be explained later using FIG. **16**.

FIG. **15** is a flowchart illustrating the processing procedure in which the processing computer **211** receiving the request for the management function processing executes the management function processing, without intervention of the management request queue **225**, in addition to Embodiment 2.

First, the management computer **201** receives the request for the management function processing from the user via the management screen **202** (S**1501**).

The management computer **201** activates the management program **206**, and the management program **206** determines whether or not the earlier request is the request for the immediate execution (S**1502**). In a case where it is the request for the immediate execution (S**1502**: Yes), then the management program **206** adds the flag indicating the immediate execution to the request (S**1503**).

Subsequently, the management program **206** checks whether there is the processing computer **211** of the management exclusive mode, by referring to the management function schedule table **207** (S**1504**). In a case where there is the processing computer **211** of the management exclusive mode (S**1504**: Yes), then the management program **206** applies an identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1508**).

In a case where there is no processing computer **211** of the management exclusive mode (S**1504**: No), then the management program **206** checks whether there is a processing computer **211** corresponding to a condition that the start time **303** is older than the current time and the end time **304** is newer than the current time (that is, capable of executing), by referring to the management function schedule table **207** (S**1505**). In a case where there is the processing computer **211** corresponding to the condition (S**1505**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1508**).

In a case where there is no processing computer **211** corresponding to the condition (S**1505**: No), then the management program **206** checks whether there is the processing computer **211** of the management prioritized mode, by referring to the management function schedule table **207** (S**1506**). In a case where there is the processing computer **211** of the management prioritized mode (S**1506**: Yes), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to the processing computer **211** (S**1508**).

In a case where there is no processing computer of the management prioritized mode (S**1508**: No), then the management program **206** applies the identifier with respect to the management function processing, and requests the management function processing to an arbitral processing computer **211** (S**1507**). As a selecting algorithm of the arbitral processing computer **211**, a round-robin is suitable.

Subsequently, the processing computer **211** executes the management function processing program **216**, and the management function processing program **216** registers the request from S**1507** or S**1508** to the result wait queue **209** (S**1509**).

Further, as is shown at the end of the explanation of Embodiment 2, the present invention is applicable to a case where only one mode of the management exclusive mode or the management prioritized mode is provided. In a case where only the management exclusive mode is provided, the determination processing of S**1506** will be omitted, and in a case where only the management prioritized mode is provided, the determination processing of S**1504** will be omitted.

After the processing of S**1407** (FIG. **14**) or S**1509** (FIG. **15**), the processing will be those illustrated in the flowchart of FIG. **16**. The management function processing program **216** of the processing computer **211** receiving the request from the management program **206**, confirms whether or not the immediate execution flag is applied to the request from S**1407** or S**1509** (S**1601**).

In a case where the immediate execution flag is applied (S**1601**: Yes), then the management function processing program **216** executes the processing content requested (S**1602**), and transmits the identifier **401** and the result of the processing to the management computer **201** (S**1603**). The processing after this step is similar to the processing after S**909** illustrated in the flowchart of FIG. **9** in Embodiment 1. That is, in a case where the immediate execution flag is applied, the management function processing program **216** of the processing computer **211** executes the processing content requested, without activating the queue management program **217** and the main function processing program **218**. By doing so, the request of the management function processing with the immediate execution flag applied is not stored in the management request queue **225**.

In a case where the immediate execution flag is not applied (S**1601**: No), then the processing after this step is similar to the processing after S**807** illustrated in the flowchart of FIG. **8** in Embodiment 1.

With the procedure explained above, it becomes possible to immediately execute the management function processing, and compared to the case of Embodiment 1 or Embodiment 2, the use may recognize the result of the processing faster.

Therefore, with respect to the management request having urgency, such as the set-up operation upon starting operation or the countermeasures to malfunction, it becomes possible to achieve even faster correspondence.

REFERENCE SIGNS LIST

101, **201** Management computer
202 Management screen
203 CPU
204 Interface
205 Memory
206 Management program
102, **207** Management function schedule table
208 Request transmission program
209 Request wait queue
210 Request reception program
103, **211** Processing computer
212 Interface
213 CPU
214 Interface
215 Memory
105, **216** Management function processing program
217 Queue management program
104, **218** Main function processing program
219 Scheduler
220 Shared computer
221 Interface
222 CPU
223 Memory
224 Transmitting/receiving function
225 Management request queue

The invention claimed is:

1. A computer system comprising:
a plurality of processing computers having a first processing means for executing a main function processing and a second processing means for executing a management function processing which is requested from a management computer, and
the management computer having a storage area for storing a start time and an end time of an operation of the second processing means of the plurality of the processing computers;
wherein the plurality of the processing computers notify the start time and the end time of the operation of the second processing means to the management computer, and
the management computer updates the start time and the end time that are stored in the storage area to the notified start time and the end time, and requests the management function processing to the processing computer which has the second processing means in which a time requesting the management function processing falls within a time frame of the start time and the end time that are stored in the storage area,
further comprising a shared computer connected to the plurality of the processing computers,
wherein the shared computer stores the request for the management function processing that the plurality of the processing computers receive from the management computer, and
the plurality of the processing computers obtain the request of the management function processing that the shared computer stores and execute the same with the second processing means possessed by the processing computers.

2. The computer system according to claim **1**,
wherein at least one of the plurality of the processing computers has a setting means for setting a mode for prioritizing the processing by the first processing means or a mode for prioritizing the processing by the second processing means, and
the management computer stores the mode of the plurality of the processing computers in the storage area, updates the mode stored in the storage area upon receiving a notification of a mode setting by the setting means, and requests the management function processing to the processing computer in the mode for prioritizing the processing by the second processing means.

3. The computer system according to claim **1**,
wherein at least one of the plurality of the processing computers has a mode making the processing by the second processing means exclusive, and
the management computer requests the management function processing with top priority to the processing computer in the mode making the processing by the second processing means exclusive.

4. The computer system according to claim **3**,
wherein the plurality of the processing computers change the mode, based on a load amount which must be processed as the main function processing, or a configuration of the processing computer.

5. The computer system according to claim **1**,
wherein, in a case where the request for the management function processing received from the management computer designates an immediate execution, the plurality of the processing computers execute the second processing means without activating the first processing means.

6. The computer system according to claim **1**,
wherein, in a case where the request of the management function processing received from the management computer designates an immediate execution, the plurality of the processing computers execute the second processing means, without storing the request in the shared computer, and without activating the first processing means.

7. A control method of a computer system configured from
a plurality of processing computers having a first processing means for executing a main function processing and a second processing means for executing a management function processing which is requested from a management computer, and
the management computer having a storage area for storing a start time and an end time of an operation of the second processing means of the plurality of the processing computers;
wherein the plurality of the processing computers have a first step of notifying the start time and the end time of the operation of the second processing means to the management computer, and
the management computer has
a second step of updating the start time and the end time that are stored in the storage area to the start time and the end time notified in the first step,
a third step of determining whether or not the time requesting the management function processing falls within a time frame of the start time and the end time that are stored in the storage area, and
a fourth step of requesting the management function processing to the processing computer having the second processing means that is determined to fall within the time frame in the third step,

wherein the computer system further comprises a shared computer connected to the plurality of the processing computers,

the shared computer has a fifth step of storing the request for the management function processing that the plurality of the processing computers receive from the management computer, and

the plurality of the processing computers have a sixth step of acquiring the request for the management function processing that the shared computer stores and execute the same with the second processing means possessed by the processing computer.

8. The control method of the computer system according to claim **7**,

wherein at least one of the plurality of the processing computers has a setting step of setting a mode for prioritizing the processing by the first processing means or a mode for prioritizing the processing by the second processing means, and

the management computer has

a storing step of storing the mode of the plurality of the processing computers in the storage area,

an updating step of updating the mode stored in the storage area upon receiving a notification of a mode setting by the setting mode, and

a processing requesting step of requesting the management function processing to the processing computer in the mode for prioritizing the processing by the second processing means.

9. The control method of the computer system according to claim **7**,

wherein at least one of the plurality of the processing computers has a changing step of changing a mode for prioritizing the processing by the first processing means, a mode for prioritizing the processing by the second processing means, and a mode for making the processing by the second processing means exclusive, and

the management computer has

an updating step of updating the mode stored in the storage area upon receiving a notification of a mode change by the changing step,

a first processing requesting step of requesting the management processing function with top priority to the processing computer in the mode making the processing by the second processing means exclusive, and

a second processing requesting step of requesting the management function processing also to the processing computer in the mode for prioritizing the processing by the second processing means.

10. The control method of the computer system according to claim **9**,

wherein the changing step changes the mode, based on a load amount which must be processed as the main function processing, or a configuration of the processing computer.

11. The control method of the computer system according to claim **7**,

wherein the plurality of the processing computers has an immediate executing step of executing the second processing means without activating the first processing means, upon receiving the request from the management computer, in a case where the request for the management function processing designates an immediate execution.

12. The control method of the computer system according to claim **7**,

wherein the plurality of the processing computers has an immediate executing step of executing the second processing means without storing the request in the shared computer and without activating the first processing means, upon receiving the request from the management computer, in a case where the request for the management function processing designates an immediate execution.

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