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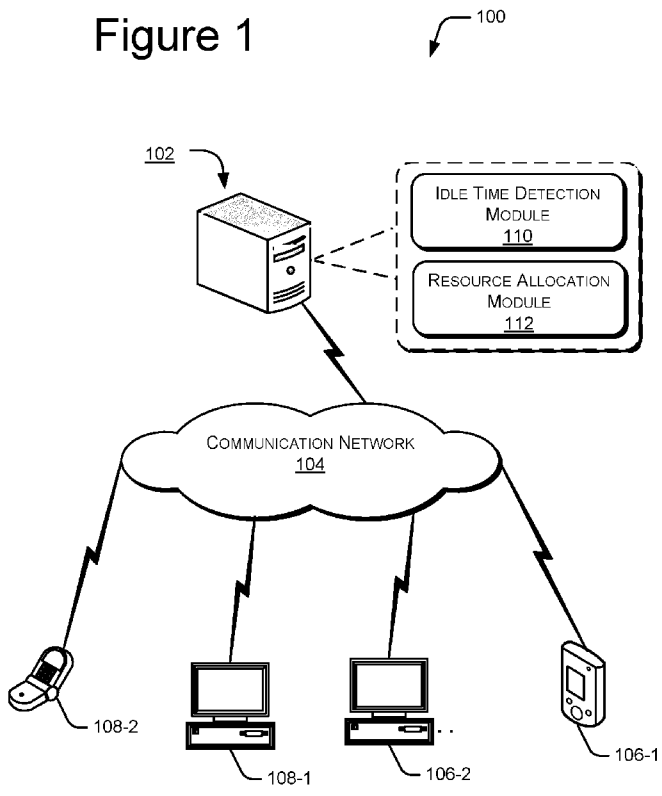
Figure 1



(57) Abstract: The present subject matter discloses systems and methods for allocating resources. The method includes receiving operation data of a resource, allocated to a current user, from a network device. Further, an idle time of the resource is determined based on the operation data. The method further includes comparing a request received for the resource, from one or more requesting users, with activities performed by the current user on the resource and a duration of the idle time. Based on the comparison, the resource can be allocated to one of the requesting users.

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METHODS AND SYSTEMS FOR RESOURCE ALLOCATION

FIELD OF INVENTION

[0001] The present subject matter relates to resource allocation and, particularly but not exclusively, to allocation of resources for sharing the resources between contending users.

BACKGROUND

[0002] In any organization, there are many resources, such as testing labs, conference rooms, and research equipments, that are used for a variety of tasks by multiple users. These resources are generally scarce and therefore need to be shared amongst multiple users for accomplishing the tasks.

[0003] Conventionally, in order to allocate the resources to one or more users, different methods of resource allocation are used. In one of the methods, a resource is allocated to a user for a pre-defined duration of time. During this pre-defined time no other user is allowed to use the resource and requests for the resource from all other users are kept pending. Only after the first user has finished using the resource, the resource is allocated to the next user. Sometimes, the resource may be allocated to a user not on the basis of the order of receiving the request, but on the basis of urgency and priority. In some cases, pre-arranged sharing of the resource may take place. For example, if the user currently using the resource indicates that the resource is sharable, or if a particular user requests the current user for sharing the resource and the current user agrees, the resource may be shared. In another conventional method, a particular resource is allocated to more than one user, each contending for the idle time of the resource, mainly through word of mouth.

SUMMARY

[0004] This summary is provided to introduce concepts related to resource allocation. This summary is not intended to identify essential features of the claimed subject matter nor is it intended for use in determining or limiting the scope of the claimed subject matter.

[0005] In an embodiment, a system for resource allocation is disclosed. The system includes a processor and a memory, coupled to the processor, having an idle time detection module and a resource allocation module. The idle time detection module is configured to determine an idle time of a resource based on at least one of operation data and historical data of the resource. The resource allocation module is configured to allocate the resource to a selected requesting user during the idle time. The resource allocation module selects the selected requesting user from one or more requesting users based on requests received from the one or more requesting users.

[0006] In accordance with another embodiment of the present subject matter, a computer implemented method for allocating resources is described. The computer implemented method includes receiving, from a network device, operation data of a resource allocated to a current user. Based on the operation data, an idle time of the resource is determined. The computer implemented method also includes comparing a request received for allocation of the resource from one or more requesting users with activities performed by the current user on the resource. The method further includes allocating the resource, for the idle time duration, to a selected requesting user from amongst the one or more requesting users based on the comparison.

[0007] In accordance with another embodiment of the present subject matter, a computer readable medium is disclosed. The computer readable medium has a computer program for executing a method for allocating resources. The computer program, when executed, performs acts including determining an idle time of a resource allocated to a current user. Further, a requesting user is selected from one or more requesting users based on the determined idle time and the resource is allocated to the selected requesting user for the idle time duration.

BRIEF DESCRIPTION OF THE FIGURES

[0008] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the figures to reference like features and components. Some embodiments of system and/or methods in

accordance with embodiments of the present subject matter are now described, by way of example only, and with reference to the accompanying figures, in which:

[0009] Figure 1 illustrates a network environment implementing a resource allocation system for idle time detection and resource allocation, according to one embodiment of the present subject matter;

[0010] Figure 2 illustrates the resource allocation system, in accordance with an embodiment of the present subject matter; and

[0011] Figure 3 illustrates a method for idle time detection and resource allocation, in accordance with an embodiment of the present subject matter.

[0012] It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative systems embodying the principles of the present subject matter. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudo code, and the like, represent various processes which may be substantially represented in computer readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

DESCRIPTION OF EMBODIMENTS

[0013] Systems and methods for resource allocation are described herein. In an organization, there are many resources, such as testing labs, conference rooms, and research equipments, which are scarce, and therefore, need to be shared amongst multiple users. Generally, to allocate a resource, for sharing amongst multiple users, the resource is first allocated to a particular user for a particular duration of time. During this time duration, the requests from other users for using the resource are denied. In an example, a resource may have to be shared between multiple users, each waiting for the idle time of the resource. Sometimes, if the user currently using the resource indicates that the resource is sharable or if a particular requesting user contacts the current user for sharing the resource, the resources may be shared amongst the users. However, in such resource allocation methods, an idle time, such as ad-hoc idle time, usually goes unnoticed if the user currently using the resource does not inform the other users waiting for the resource that the resource is free.

[0014] For example, if a testing lab for testing network equipments is to be shared amongst five users, when user 1 is using the testing lab, users 2-5 have to wait for the testing lab to become free. During the testing, user 1 may leave the testing lab for debugging due to which the network equipment may be left idle for 2 hours. However, the users 2-5 would not know this unless user 1 informs them or the lab administrator. This results in wastage of expensive and critical testing lab resources and time of other users, thus resulting in an increase in the cost of the final product under development and leading to a requirement of more resources. It also adds to an overall delay in product development or maintenance. It could also force the users who are contending for the idle time to work during non-preferred hours.

[0015] Other conventional systems for resource allocation use web-based booking tools to allocate resources to one or more users. In case of web-based booking tools, the status of a resource can be seen online. However, even in case of such web-based booking tools, an actual usage of a resource cannot be determined. The status only indicates a time for which the resource was booked by a user and not an actual usage time of the resource. Therefore, the ad-hoc idle time goes unnoticed. In these systems, if the resource is available, any user can book the resource online. If the resource is not available, the user has to personally go and ask for the resource. In certain scenarios, the resource may be allocated to the user based on urgency. In the "testing lab" example mentioned above, in case the testing lab is not available, an interested user may contact the lab administrator and the resource may get allocated only if the resource is free or there is urgency. In some other scenarios, the interested user may track the resource and the resource may be acquired based on word of mouth. For example, a current user may inform the interested user that the resource will be free for certain time duration and the interested user may use the resource during that time.

[0016] However, in such conventional methods of resource allocation, the idle time, for example the ad-hoc idle time, usually goes unnoticed. Those users who are interested in the resource have to mostly rely on word of mouth, which is an inefficient and unreliable way to allocate resources. Also, real-time sharing and allocation of the resources may not be possible. This results in requirement of more resources, thus increasing the costs, such as development and maintenance costs. Also, a lot of time is spent by the users in tracking the resources before finally using them.

[0017] Embodiments of the present subject matter describe methods and systems for resource allocation, including idle time detection and allocation of resources. In one implementation, a user currently using the resource, also referred to as a current user, is registered by providing different inputs, such as an activity planned by the user, an approximate time required to complete the activity, an expected idle time of the resource, requirements and conditions of the current user, and user specific information. The user specific information can include a variety of information, such as email-id and mobile number of the current user. Upon registering the current user, a status of the resource is indicated as occupied for a duration mentioned by the current user. Thereafter, one or more requesting users interested in using that resource during an overlapping time duration are registered by providing information similar to that provided by the current user.

[0018] Subsequently, actual monitoring of the resource or the prediction of the actual usage of the resources takes place to determine an idle time. Thus, even if the current user does not inform an administrator or a requesting user that the resource is idle, background processes running on the resource may be used to determine whether the resource is idle or not. In the example of the testing lab discussed earlier, the background process analyzes the activities performed on the network equipment and determines the CPU utilization, disk utilization, and memory utilization of the processes being used by the current user to run the test scenarios. If the CPU utilization is below the threshold value, the resource is assumed to be idle. In one implementation, the idle time may also be predicted by analyzing the historical data of the resource or the current user. For example, in case of the testing lab, if the current user is performing a call processing test, the historical data on call processing is fetched and analyzed to predict the idle time of the resource, i.e., past scenarios are analyzed to determine the actual idle time. In some cases, based on the historical data, actual time required for using the resource by the current user and the requesting user may also be determined.

[0019] On determination of the idle time, the requests of the requesting users are analyzed to allocate the resource for the idle time. In one implementation, the requests may be analyzed and compared sequentially. For example, a request of the first requesting user may be analyzed first, followed by an analysis of a request of a second requesting user, and so on. In another implementation, the requests may be analyzed and compared based on a parameter, such as priority.

[0020] Further, the requests of the requesting users are analyzed and compared with the information provided by the current user to determine whether the resource can be allocated to a certain requesting user. For example, if the resource is idle for some time, the time required by the requesting users along with the activities planned by the requesting users are compared with the idle time of the resource, activities performed by the current user, and the conditions specified by the current user to allocate the resource to a certain requesting user. For example, time required by the first requesting user is compared with the idle time. Also, activities planned by the first requesting user can be compared with the activities performed by the current user and the conditions specified by the current user. If the activities planned by the first requesting user do not affect the activities performed by the current user, the resource is allocated to the first requesting user. If the activities planned by the first requesting user affect the activities of the current user, the resource is not allocated to the first requesting user and the request of the second requesting user is analyzed instead.

[0021] In one implementation, before allocating a resource to a requesting user, a health of the resource is also determined. The health of the resource refers to the usability of the resource. Upon identifying that the resource is in good health, the current user is requested to confirm whether the resource can be allocated to the requesting user. If the current user allows the allocation of the resource, the resource is allocated to the requesting user. If the current user rejects the allocation of the resource to the requesting user, pending requests from other requesting users may be analyzed. In one implementation, the requesting user whose request is rejected may again be identified as a requesting user, and the rejected requesting user may again be added to a queue of requesting users.

[0022] After selecting the requesting user to whom the resource may be allocated, and the health of the resource, the resource can be allocated and a message can be sent to the selected requesting user regarding the allocation. In an implementation, the settings, such as the runtime conditions required by the selected requesting user and as permitted by the current user, are provided to the selected requesting user before allocating the resource.

[0023] The idle time detection and resource allocation achieved according to the present subject matter considerably reduces the time spent by the requesting user in determining whether the resource is available or not, and allows for sharing of resources

during idle time, even ad-hoc idle time. Also, the user can get the required settings before starting to use the resource. As a result, the resources are efficiently used, resulting in cost saving and less wastage of resources.

[0024] It should be noted that the description and figures merely illustrate the principles of the present subject matter. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the present subject matter and are included within its spirit and scope. Furthermore, all examples recited herein are principally intended expressly to be only for pedagogical purposes to aid the reader in understanding the principles of the present subject matter and the concepts contributed by the inventor(s) to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions. Moreover, all statements herein reciting principles, aspects, and embodiments of the present subject matter, as well as specific examples thereof, are intended to encompass equivalents thereof.

[0025] It will also be appreciated by those skilled in the art that the words during, while, and when as used herein are not exact terms that mean an action takes place instantly upon an initiating action but that there may be some small but reasonable delay, such as a propagation delay, between the initial action and the reaction that is initiated by the initial action. Additionally, the word “connected” is used throughout for clarity of the description and can include either a direct connection or an indirect connection.

[0026] Figure 1 illustrates a network environment 100 implementing a resource allocation system 102, in accordance with an embodiment of the present subject matter. The resource allocation system 102 can be implemented in any network environment comprising a variety of network devices, including routers, bridges, servers, computing devices, storage devices, etc. The resource allocation system 102 can be implemented as a variety of computing devices, such as a laptop computer, a desktop computer, a notebook, a workstation, a mainframe computer, and a server.

[0027] In one embodiment, the resource allocation system 102 is configured to detect and allocate an idle time of a resource to a requesting user. The resource allocation system 102 includes an idle time detection module 110 and a resource allocation module 112. The

idle time detection module 110 detects an idle time of the resource and the resource allocation module 112, based on the idle time, may allocate the resource to one or more requesting users.

[0028] The resource allocation system 102 is connected through a communication network 104 to current user devices 106-1, 106-2, ..., 106-N, collectively referred to as current user devices 106, and requesting user devices 108-1, 108-2,....,108-N, collectively referred to as requesting user devices 108. The current user devices 106 and the requesting user devices 108 (collectively refereed as the user devices 106 and 108) may include computing devices, such as a laptop computer, a desktop computer, a notebook, a mobile phone, a personal digital assistant, a workstation, and a mainframe computer. The user devices 106 and 108 facilitate interaction of current users and requesting users, respectively, with the resource allocation system 102, either directly or through the communication network 104.

[0029] The communication network 104 may be wireless or wired network, or a combination thereof. The communication network 104 can be a combination of individual networks, interconnected with each other and functioning as a single large network, for example, the Internet or an intranet. The communication network 104 may be any public or private network, including a local area network (LAN), a wide area network (WAN), the Internet, an intranet, and a virtual private network (VPN), and may include a variety of network devices, such as routers, bridges, servers, computing devices, and storage devices.

[0030] In one implementation, the resource allocation system 102 receives a request for a resource which is allocated to a current user, from one or more requesting users. The resource allocation system 102 may allocate the resource to a requesting user, if the resource is found to be idle. For the purpose, the idle time detection module 110 detects the idle time of the resource. In one implementation, the idle time detection module 110 receives usage data, also referred to as operation data, from one or more network devices (not shown in the figure) communicatively coupled to the resource allocation system 102. The network devices provide the operation data from, for example, one or more background processes or sensors monitoring the resource usage. In one implementation, the network devices are a part of the resource. In another implementation, the network devices are connected to the resource, for example, through the communication network 104. Based on the operation data, the idle time

detection module 110 detects the idle time of the resource. In another implementation, the idle time detection module 110 may also predict the idle time of the resource based on historical data of the resource and of the current user using the resource.

[0031] In one implementation, the idle time detection module 110 detects that the resource is idle, if the resource is currently not allocated to any user and is free to be used. In another implementation, the idle time detection module 110 detects that the resource is idle if the resource is allocated to the current user, but the current user has not used the resource for a pre-defined time duration. Consider an example of a testing lab. In order to determine the actual usage of the testing lab and the equipments in the testing lab, the idle time detection module 110 analyzes activities performed on one or more equipments by the current user. Suppose the current user is performing a call processing testing on a radio network controller (RNC), say RNC 1, between 10am and 4pm, the idle time detection module 110 may determine the CPU utilization during the testing, using operation data of RNC 1 monitored by, for example, a background process. This data may be provided to the idle time detection module 110 through a network device. If the CPU utilization is below a specified threshold value, the idle time detection module 110 may determine that RNC 1 is idle.

[0032] In yet another implementation, the idle time detection module 110 is also configured to predict the idle time of the resource. In the example of the testing lab, if the current user has executed an automated test on the RNC 1, between 10 am and 4 pm, the idle time detection module 110 may analyze historical data based on automated testing. The idle time detection module 110 may determine that, subsequent to the execution of an automated test, the testing lab may be idle, even if the desired back up of the data takes place for the automated test, i.e., after 2 pm the lab would be idle. After predicting the idle time, the idle time detection module 110 may also confirm from the current user whether the resource will actually be idle for the duration of idle time predicted by the idle time detection module 110.

[0033] Subsequently, the idle time detection module 110 determines the total duration of the idle time. In one implementation, the idle time detection module 110 analyzes the historical data or statistical data, or both to predict the approximate duration of the idle time. Statistical data is used to determine the idle time by analyzing the historical information on the type of activity planned. For example if the current user is performing a call processing

test, the idle time can be analyzed based on the typical amount of time taken in the past by different users for a similar activity and the expected idle time can be determined accordingly. In an implementation, the duration of the idle time may also be provided by the current user. In the above example, consider a case where RNC 1 is currently idle, i.e., the CPU utilization is below the specified threshold. The idle time detection module 110 analyzes the historical data of the current user to determine the time and total duration for which the current user typically takes a break. If the current user takes a break for 2 hours, this duration can be predicted as the duration of the idle time. The idle time detection module 110 may also analyze the historical data on a call processing testing and determine the duration of the idle time for the test scenario. Based on the historical data, the duration of the idle time is predicted.

[0034] In one implementation, upon predicting the duration of the idle time, the idle time detection module 110 may also enquire from the current user whether the resource will actually be idle for that duration. In another implementation, if the current user has finished working on the resource, the resource may be assumed to be free and can be allocated to the requesting user. For example, the idle time detection module 110 may determine whether the current user has finished testing on RNC 1. In one example, background processes may be used to determine whether the processes that were running on RNC 1 have been completed and there are no processes currently in use. This can be used as an indication that the current user has completed using RNC 1. In such a case, RNC 1 is considered to be idle and available for allocation to the requesting user.

[0035] Further, the resource allocation module 112 analyzes the requests received from the requesting users. In one implementation, the resource allocation module 112 may analyze the request on the principal of first-in-first-out (FIFO), i.e., the first request is given the highest preference. However, other methods of request scheduling may be used, i.e., on the basis of priority or urgency. In the above example, the resource allocation module 112 may analyze the request of the first requesting user which may be for Operation & Maintenance (O&M) testing on RNC 1. The request may include information, such as equipment required for testing, software version, time required for executing the test, and specific requirements. The requesting users interact with the resource allocation module 112 through requesting user devices 108.

[0036] After analyzing the requests from the requesting users, the resource allocation module 112 compares the requests received from the requesting users with the activities performed by the current user and the condition specified by the current user. If the activities requested by the requesting user do not affect the activities of the current user, the resource allocation module 112 determines that the resource can be allocated. The resource allocation module 112 may determine that the request from the first requesting user does not affect the activities performed by current user based on the conditions specified by the current user, and therefore the resource can be allocated to first requesting user. For example, if current user is performing call processing functions on RNC 1 using software version A from 10am to 4pm. Also, during the registration the current user may have specified that the software version should not be changed for the duration of test. Suppose the idle time is detected between 1pm and 2pm. If the first requesting user wants to execute O&M on RNC 1 for 1 hour, with software version B, the resource allocation module 112 will reject the request, as the current user had specified that software version should not change. If the second requesting user wants to execute O&M on RNC 1 for 1 hour with software version A, the resource allocation system 112 will accept the request as the conditions specified by the current user are met.

[0037] Further, the resource allocation module 112 determines the health of the resource, i.e., whether the resource is in a condition to be allocated or not. After determining the health, the resource allocation module 112 may request the current user to confirm whether the resource can be allocated or not. If the current user allows the resource to be allocated, the resource allocation module 112 sends a notification to the requesting user. The notification can be sent through different modes, such as an email, a Short Message Service (SMS), or an automated voice call.

[0038] Figure 2 illustrates components of the resource allocation system 102 for idle time detection and allocation, in accordance with an embodiment of the present subject matter. Examples of the resource allocation system 102 include, but are not limited to, computing device, such as mainframe computers, workstations, personal computers, desktop computers, minicomputers, servers, multiprocessor systems, and laptops; and a cellular communicating device, such as a personal digital assistant, a smart phone, and a mobile phone. The resource allocation system 102, hereinafter referred to as the system 102, includes

one or more processor(s) 202, interface(s) 204, and a memory 206 coupled to the processor 202.

[0039] The processor 202 can be a single processing unit or a number of units, all of which could also include multiple computing units. The processor 202 may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor 202 is configured to fetch and execute computer-readable instructions and data stored in the memory 206.

[0040] Functions of the various elements shown in the figures, including any functional blocks labeled as "processor(s)", may be provided through the use of dedicated hardware as well as hardware capable of executing software in association with appropriate software. When provided by a processor, the functions may be provided by a single dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term "processor" should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor (DSP) hardware, network processor, application specific integrated circuit (ASIC), field programmable gate array (FPGA), read only memory (ROM) for storing software, random access memory (RAM), and non volatile storage. Other hardware, conventional and/or custom, may also be included.

[0041] The I/O interfaces 204 may include a variety of software and hardware interfaces, for example, interface for peripheral device(s), such as a keyboard, a mouse, an external memory, and a printer. Further, the I/O interfaces 106 may enable the system 102 to communicate with other computing devices, such as a personal computer, a laptop, and like.

[0042] The memory 206 may include any computer-readable medium known in the art including, for example, volatile memory such as static random access memory (SRAM) and dynamic random access memory (DRAM), and/or non-volatile memory, such as read only memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes. The memory 108 also includes module(s) 208 and data 210.

[0043] The module(s) 208 include routines, programs, objects, components, data structures, etc., which perform particular tasks or implement particular abstract data types. The module(s) 208 further include a registration module 212, the idle time detection module 110, the resource allocation module 112, and other module(s) 218. The idle time detection module 110 includes an analysis module 214 and a prediction module 216. The other module(s) 218 may include programs or coded instructions that supplement applications and functions of the system 102.

[0044] On the other hand, the data 210, amongst other things, serves as a repository for storing data processed, received, and generated by one or more of the module(s) 208. The data 210 includes, for example, user data 220, historical data 222, operation data 224, and other data 226. The other data 226 includes data generated as a result of the execution of one or more modules in the other module(s) 208.

[0045] In one embodiment, the system 102 is configured to detect the idle time of the resource and allocate the resource to a requesting user for the idle time. To determine the idle time of a resource, the user currently using the resource, also referred to as current user, and users requesting for the usage of that resource, also referred to as requesting users, are registered with the system 102. For the purpose, the registration module 212 registers the current user of a resource and requesting users of the resource. The current user can register through the current user device 106 and the requesting users can register through requesting user device 108.

[0046] In one implementation, in order to register the current user, the registration module 212 requests different inputs from the current user. In one example, the different inputs can include activity planned on the resource, approximate time required to complete the activity, expected idle time, specific requirements of the current user, and other user-specific information, such as department, email-id, and mobile number. The inputs provided by the current user, also referred to as first user data, are stored as part of user data 220. Consider an example of a testing lab where the current user interested in using the testing lab provides usage related information, such as call processing testing to be performed by the current user on a network equipment 1 using software version A. The registration module 212 may request the current user to provide information on time required to complete the activity

and expected idle time, i.e., the time duration for which the current user will not use the resource. The current user, on receiving the request, provides the information that the lab is required from 10 am to 4 pm and the expected idle time is from 1 pm to 3 pm. The registration module 212 may also request the current user to specify the requirements and may also specify if there any conditions that need to be considered for the time duration for which the resource is booked. For example, the current user may specify that software version, i.e., version A and the binary code should not be changed for the test duration, i.e., between 10am and 4pm. The current user may also enter details, such as the department, email-id and mobile number to complete the registration process. The registration module 212 stores the information provided by the current user, referred to as first user data, in the user data 220.

[0047] Upon registration, the registration module 212 updates the status of the resource as 'occupied' for the duration of time specified by the current user. In one implementation, the registration module 212 provides information regarding activities performed by the current user and the time duration for which the resource would be occupied. Next, the registration module 212 registers the requesting users and similar information is requested from the requesting users as already received from the current user. The information from the requesting users, referred to as second user data, is also stored as part of the user data 220. The terms first user data and the second user data have been used to refer to the user data 220 of the current user and the requesting users, respectively.

[0048] Subsequent to the registration of one or more requesting users, the idle time of the resource is determined by the idle time detection module 102. For this purpose, the idle time detection module 102 includes the analysis module 214 and the prediction module 216. In one implementation, if the resource is not allocated to any user, the resource is assumed to be free. In another implementation, the analysis module 214 monitors operation data 224 of the resource in real time to determine whether the resource is idle. Thus even if the current user does not inform that the resource is free, the analysis module 214 through, for example, the background processes running on the resource can determine the idle time of the resource. In another implementation, the prediction module 216 predicts the idle time of the resource based on the user data 220 and the historical data 222.

[0049] In the above example, the analysis module 214 analyzes the CPU utilization, disk utilization, memory utilization, and other parameters, to determine the idle time. If the CPU utilization is below a specified threshold value, the resource is assumed to be idle. In another implementation, the prediction module 216 can predict the idle time of the resource. For example, the prediction module 216 analyzes the activities planned by the current user to predict the idle time based on the historical data 222. In the example of the testing lab, suppose the current user has booked the lab from 10am to 4pm for executing an automated call processing test on the network equipment 1. The prediction module 216, by analyzing the historical data 222 of call processing tests, predicts that the lab would be only required for 4 hours and therefore, the lab would be free after 2pm. The remaining time, i.e. from 2 pm to 4 pm, can be recorded as the predicted idle time of the resource. In another example, in case of the testing lab, the current user may plan to run O&M for 2 hours followed by call processing for 4 hours. The prediction module 216 predicts that O&M test scenario related resources will be free after 2 hours, therefore this time can be allocated to a suitable requesting user Therefore, equipment required for O&M are identified as idle and can be allocated to one of the requesting users. After predicting the idle time, the prediction module 216 may also request the current user to confirm whether the resource would actually be idle for the predicted time. In the above example, after predicting that the lab would be idle after 2pm, the prediction module 216 may also request the current user to confirm whether the lab would be idle after 2pm.

[0050] In one implementation, the current user can also override the background processes running on the resource. In such a case, the current user may inform the system 102 when the idle time starts. In one implementation, the current user may interact with the system 102 through a computing device, for example, by sending an e-mail to inform that the resource is idle. Once the idle time detection module 110, determines the idle time of the resource either on the basis of actual monitoring of the operation data 224 or through prediction based on historical data 222, the prediction module 216 determines the duration of the idle time by analyzing the historical data 222. In the “testing lab” example presented earlier, if a user is executing a call processing test on the network equipment 1, an idle time can be detected based on the background processes running on the resource. The prediction module 216 then analyzes the historical data 222 on call processing test and the current user

using the testing lab. Suppose the current user takes a break for 2 hours, then this time may be predicted as the total duration of the idle time. The prediction module 216 also analyzes the historical data on call processing scenario to predict the duration of idle time.

[0051] Subsequently, the resource allocation module 112 analyzes the requests of the requesting users to determine whether the resource can be allocated or not. For the purpose, the resource allocation module 112 compares the requests of the requesting users with the activities performed by the current user and the conditions specified by the current user during the registration process to determine whether the resource can be allocated or not. For the purpose, the registration information of the requesting users stored in user data 220 is analyzed.

[0052] In one implementation, if the current user has finished performing the activities on the resource, the resource allocation module 112 allocates the resource to a requesting user. For the purpose, the idle time of the resource may be determined by analyzing the operation data 224 of the resource. The allocation can be done either on the basis of the order of the request made or on the basis of priority and urgency. In another implementation, if the resource is idle only for a particular duration of time, the resource allocation module 112 compares the time required by the requesting users with the duration of the idle time. The resource allocation module 112 also compares the activities planned by the requesting users and the activities performed by the current user, keeping in consideration the condition specified by the current user during the registration. If the activities planned by the requesting user do not affect the activities of the current user for the duration of idle time, the resource may be allocated. If the activities planned by the requesting user affect the working of the current user, the resource may not be allocated and the request may be denied. In an implementation, the resource allocation module 112 may inform the respective requesting user on the denial of the request. In another implementation, the request of the requesting user, whose request is earlier denied, may again be analyzed with other requesting users.

[0053] In the example of the testing lab, in order to allocate the resource, the resource allocation module 112 fetches the first user data from the user data 220. Based on the user data 220, the resource allocation module 112 determines that the current user is performing call processing activities on the network equipment 1 using software version X. Also, the

current user had specified during registration that the software version and the binary code should not be changed during the test scenario, i.e., between 10am and 4pm. Further, the idle time determined by the idle time detection module 110 is between 1pm and 3pm.

[0054] In order to allocate the resource to a certain requesting user during the idle time, the resource allocation module 112 compares the requests of the requesting users, for example, in the order of FIFO, with the activities performed by current user along with the duration idle time. For example, if a first requesting user wants to continuously use the testing lab for 4 hours, his or her request will be denied as the idle time is only 2 hours. Likewise, if upon analyzing a request from a second requesting user, the resource allocation module 112 determines that the second requesting user wants to use the lab for 2 hours with the software version Y, the resource allocation module 112 may also deny the request of the second requesting user as the current user had specified during registration that the software version should not be changed. Further, if upon analyzing a request of a third requesting user, the resource allocation module 112 determines that the third requesting user wants to use the lab for two hours with software version X but the testing scenario requires binary code to be changed, the request will again be denied as the condition specified by the current user are affected with the request of the third requesting user. The resource allocation module 112 keeps on scanning the requests until a certain requesting user is found whose request does not affect the activities of the current user and taking into consideration the conditions specified by the current user. Consider that a fourth requesting user wants to use the lab for 4 hours, but not continuously, with software version X and without changing the binary code. The resource allocation module 112 determines that the fourth requesting user can be allocated the testing lab.

[0055] Before, allocating the resource to the selected user, the resource allocation module 112 determines the health of the resource. In an implementation, the resource allocation module 112 determines whether the resource is in a condition to be allocated or not. In the above example, before allocating the testing lab to the fourth requesting user, the resource allocation module 112 determines the health of the testing lab, i.e., whether all the equipment required for the testing have the required version of the software, and whether all the equipments are in working condition. In an implementation, if the testing lab is in usable state, the testing lab can be allocated to the fourth requesting user. In another implementation,

if the time required to bring the lab in usable state is 1.5 hrs, the lab will not be allocated to the fourth requesting user as the idle time is only 2 hours.

[0056] Upon determining that the resource is in a condition to be allocated, before notifying the selected requesting user, the resource allocation module 112 seeks confirmation from the current user on allocation of the resource. If the current user allows the resource to be allocated, the resource allocation module 112 notifies the selected requesting user on the allocation of the resource. In the above example, the resource allocation module 112 informs the fourth requesting user on the allocation of the resource. If the current user denies the allocation of the resource to the fourth requesting user the resource allocation module 112 informs the fourth requesting user on the rejection of the request.

[0057] In an implementation, if the current user rejects the allocation of the resource, the resource allocation module 112 enquires the current user whether the selected requesting user should not be allocated the resource or resource not be allocated to any requesting user during the idle time. If the current user specifies that the selected requesting user should not be allocated the resource, the resource allocation module 112 analyzes the other pending requests and also schedules the request of the requesting user, which is currently rejected, along with the other pending requests. If the current user specifies that the resource should not be allocated, the resource allocation module 112 waits for the current user to finish its activities and then allocates the resource to the requesting users.

[0058] After, seeking confirmation from the current user, the resource allocation module 112 notifies the selected requesting user on the allocation of the resource and provides the desired setting to the requesting user, i.e., the required version of the software, resources, etc. In one implementation, the resource allocation module 112 sends an e-mail to the requesting user. In another, implementation the resource allocation module 112 informs the requesting user through an SMS. In yet another implementation, the resource allocation module 112 may generate an automated voice call on the selected requesting user's mobile.

[0059] The present system 102, thus, provides an efficient way of determining the idle time, for example ad-hoc idle time, of the resource and allocating the resource during the idle time. This results in effective utilization of the idle time. Real time analysis of the resource allows effective determination of the idle time. Also, the time spent by the requesting users in

determining the availability of the resource is saved. The system 102 also provides the setting required to perform the activities on the resource to the selected requesting user beforehand.

[0060] Figure 3 illustrates a method 300 for idle time detection and allocation of a resource, in accordance with an embodiment of the present subject matter. The order in which the method 300 is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the methods, or alternative methods. Additionally, individual blocks may be deleted from the methods without departing from the spirit and scope of the subject matter described herein. Furthermore, the methods can be implemented in any suitable hardware, software, firmware, or combination thereof.

[0061] A person skilled in the art will readily recognize that steps of the method can be performed by programmed computers. Herein, some embodiments are also intended to cover program storage devices, for example, digital data storage media, which are machine or computer readable and encode machine-executable or computer-executable programs of instructions, wherein said instructions perform some or all of the steps of the described methods. The program storage devices may be, for example, digital memories, magnetic storage media, such as a magnetic disks and magnetic tapes, hard drives, or optically readable digital data storage media. The embodiments are also intended to cover both communication network and communication devices configured to perform said steps of the exemplary methods.

[0062] Referring to Figure 3, illustrating the method 300, at block 302, a current user is registered. For example, registration module 212 requests the current user to provide information, such as resource required, activities planned on the resource, restrictions put by the current user, time required to complete the activities, expected idle time, condition specified by the current users, e-mail id, and a mobile number. The information provided by the current user is stored as user data 220.

[0063] At block 304, a resource is allocated to the current user. For example, based on the information provided by the current user during registration, the resource allocation system 102 allocates the resource that is not in use to the current user.

[0064] At block 306, status of the resource is updated. For example, the registration module 212 updates the status of the resource allocated to the current user as 'occupied'. In one implementation, the registration module 212 also updates the information on the resource, such as a time required to perform the activity, an expected idle time, and name of the current user.

[0065] At block 308, requests from one or more requesting users for the resource are received. In one implementation, the registration module 212 receives the request from the one or more requesting users for the resource which is currently allocated to the current user. The registration module 212 registers the requesting users by requesting information similar to that obtained from the current user.

[0066] At block 310, idle time of the resource is monitored. For example, the idle time detection module 110 determines the idle time of the resource. In one implementation, the analysis module 214 monitors the operation data 224 to determine the idle time. For example, in case of the testing lab, the analysis module 214 monitors the CPU utilization or memory utilization. If the CPU utilization is below a specified threshold, the resource is assumed to be idle. In another implementation, the prediction module 216 predicts the idle time of the resource based on the historical data 222.

[0067] At block 312, a determination is made as to whether the resource is idle or not. If the resource is not idle, the control flows to block 310 and the idle time of the resource is monitored. In case it is determined that the resource is idle, which is the 'Yes' path, the control flows to block 314 and the requests of the requesting user are processed, for example, the requests are processed to allocate the idle time of the resource to a certain requesting user. In one implementation, the prediction module 216 analyzes the historical data 222 to predict the duration of the idle time.

[0068] At block 314, pending requests from the requesting users are processed. In one implementation, if the current user is not using the resource, the resource allocation module 112 selects a requesting user for using the resource. In another implementation, if the resource is idle only for a certain time duration, the resource allocation module 112 compares the activities planned by the requesting user with activities of the current user along with idle time

and the condition specified by the current user to determine whether the resource can be allocated or not.

[0069] At block 316, a requesting user is selected from the one or more requesting users. Based on the comparison, as described in step 314, a particular requesting user is selected. For example, if the activities planned by the requesting user do not affect the activities performed by the current user, the requesting user is selected to use the resource by the resource allocation module 112. In an implementation, after identifying the selected requesting user, a health of the resource is determined. If the resource is in a usable health, the resource allocation module 112 identifies that the resource can be allocated, else the requests from the requesting user are denied. In another implementation, the resource allocation module 112, after selecting a particular requesting user for the resource, may also determine whether the selected requesting user has any additional requirements. For example, if the selected requesting user requires additional resources, the resource allocation module 112 may determine the availability of the other resource. If the resources are available, the resource allocation module 112 may provide the resources to the selecting requesting user.

[0070] At block 318, confirmation from the current user for the allocation of the resource is requested. Before notifying the selected requesting user about the allocation of the resource, the current user is requested to confirm that the resource can eb allocated. If the current user confirms the allocation of the resource, which is the 'YES' path, the control flows to block 320. If the current user rejects the allocation of the resource, which is the 'No' path, the control flows to block 322.

[0071] At block 320, the resource is allocated to the selected requesting user. For example, the resource allocation module 112 notifies the selected requesting user on the allocation of the resource. In one example, the resource is allocated for the duration of the idle time and on expiration of the idle time the resource allocation module 112 again allocates the resource to the current user. In another example, if the current user has completed the activities planned on the resource, then upon expiration of the allocation of the resource to the selected requesting user, the status of the resource is indicated as idle. In an implementation, the notification to the selected requesting can be through the e-mail. In another

implementation, the notification can be through a Short Message Service (SMS) or automated voice call on the selected requesting user's mobile phone.

[0072] From the "NO" path of block 318, at block 322, the request of the selected requesting user is rejected. If the current user rejects the allocation of the resource to the selected requesting user, described at block 318, the selected user is notified on the rejection of the request. For example, the resource allocation module 112 notifies the selected requesting user that the resource cannot be allocated. Thereafter, the control flows back to block 314 and other pending requests are processed. The rejected request may also go back to the pending requests. In one implementation, the current user may reject the allocation of the resource to any requesting user. In such a case the resource allocation module 112 may stop processing the requests from the requesting users.

[0073] Although implementations for allocation of a resource have been described in language specific to structural features and/or methods, it is to be understood that the appended claims are not necessarily limited to the specific features or methods described. Rather, the specific features and methods are disclosed as exemplary implementations for allocation of resources.

WE CLAIM:

1. A system (102) for resource allocation, the system (102) comprising:

a processor (202); and

a memory (206) coupled to the processor (202), the memory (206) comprising,

an idle time detection module (110) configured to determine an idle time of a resource based on at least one of an operation data and a historical data of the resource; and

a resource allocation module (112) configured to allocate the resource to a selected requesting user during the idle time, wherein the selected requesting user is selected from one or more requesting users based on requests received from the one or more requesting users.

2. The system (102) as claimed in claim 1, further comprising a registration module (212) configured to register a current user of the resource and the one or more requesting users.

3. The system (102) as claimed in claim 1, wherein the idle time detection module (110) comprises an analysis module (214) configured to monitor the operation data to identify the idle time of the resource, and wherein the operation data is indicative of usage of the resource.

4. The system (102) as claimed in claim 1, wherein the idle time detection module (110) comprises a prediction module (216) configured to predict the idle time of the resource based on the historical data.

5. The system (102) as claimed in claim 1, wherein the resource allocation module (112) is further configured to determine health of the resource.

6. The system (102) as claimed in claim 1, wherein the resource allocation module (112) is further configured to request a current user to confirm the allocation of the resource to the selected requesting user.

7. A computer implemented method for allocating resources, the method comprising:

receiving operation data of a resource allocated to a current user, wherein the operation data is received from a network device;

determining an idle time of the resource based on the operation data;

comparing a request received for allocation of the resource from one or more requesting users with activities performed by the current user on the resource a duration of the idle time; and

allocating the resource to a selected requesting user from amongst the one or more requesting users during the idle time, based on the comparison.

8. The computer implemented method as claimed in claim 7, further comprising notifying the selected requesting user on allocation of the resource, wherein the notifying is performed through at least one of an e-mail, a Short Message Service and a voice call.

9. The computer implemented method as claimed in claim 7, wherein the determining further comprises analyzing historical data to determine a duration of the idle time.

10. The computer implemented method as claimed in claim 7, wherein the comparing further comprises:

comparing a first user data of the current user with a second user data of the one or more requesting users, wherein the first user data comprises conditions specified by the current user for the allocation of the resource; and

comparing a time duration requested by the one or more requesting users with the duration of the idle time.

11. A computer-readable medium having embodied thereon a computer program for executing a method for allocating resources, the method comprising:

determining an idle time of a resource allocated to a current user;

selecting a requesting user from one or more requesting users based on the determined idle time; and

allocating the resource to the selected requesting user for the idle time.

12. The computer-readable medium as claimed in claim 11, further comprising notifying the selected requesting user about the allocation of the resource, wherein the notifying is performed through at least one of an e-mail, a Short Message Service and a voice call.

13. The computer-readable medium as claimed in claim 11, wherein the determining further comprises analyzing at least one of operation data and historical data to determine the idle time.

14. The computer-readable medium as claimed in claim 13, further comprising analyzing the historical data to determine a duration of the idle time.

15. The computer-readable medium as claimed in claim 11, wherein the selecting further comprises:

comparing a first user data of the current user and a second user data of the one or more requesting users; and

comparing a duration of the idle time of the resource and a duration of time for the allocation of the resource requested by the one or more requesting users.

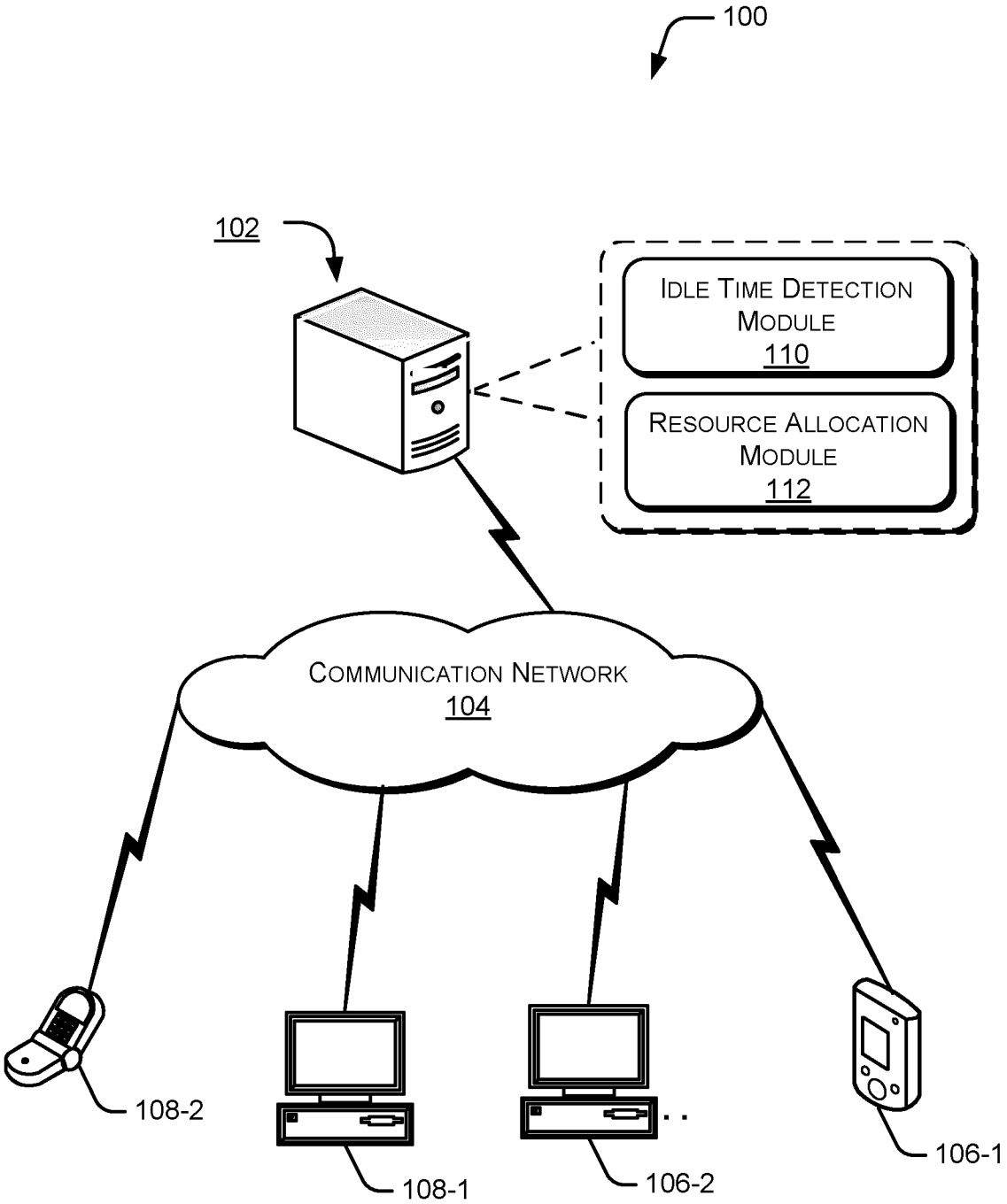
100
102
IDLE TIME DETECTION MODULE 110
RESOURCE ALLOCATION MODULE 112
COMMUNICATION NETWORK 104
108-2
108-1
106-2
106-1

Figure 1

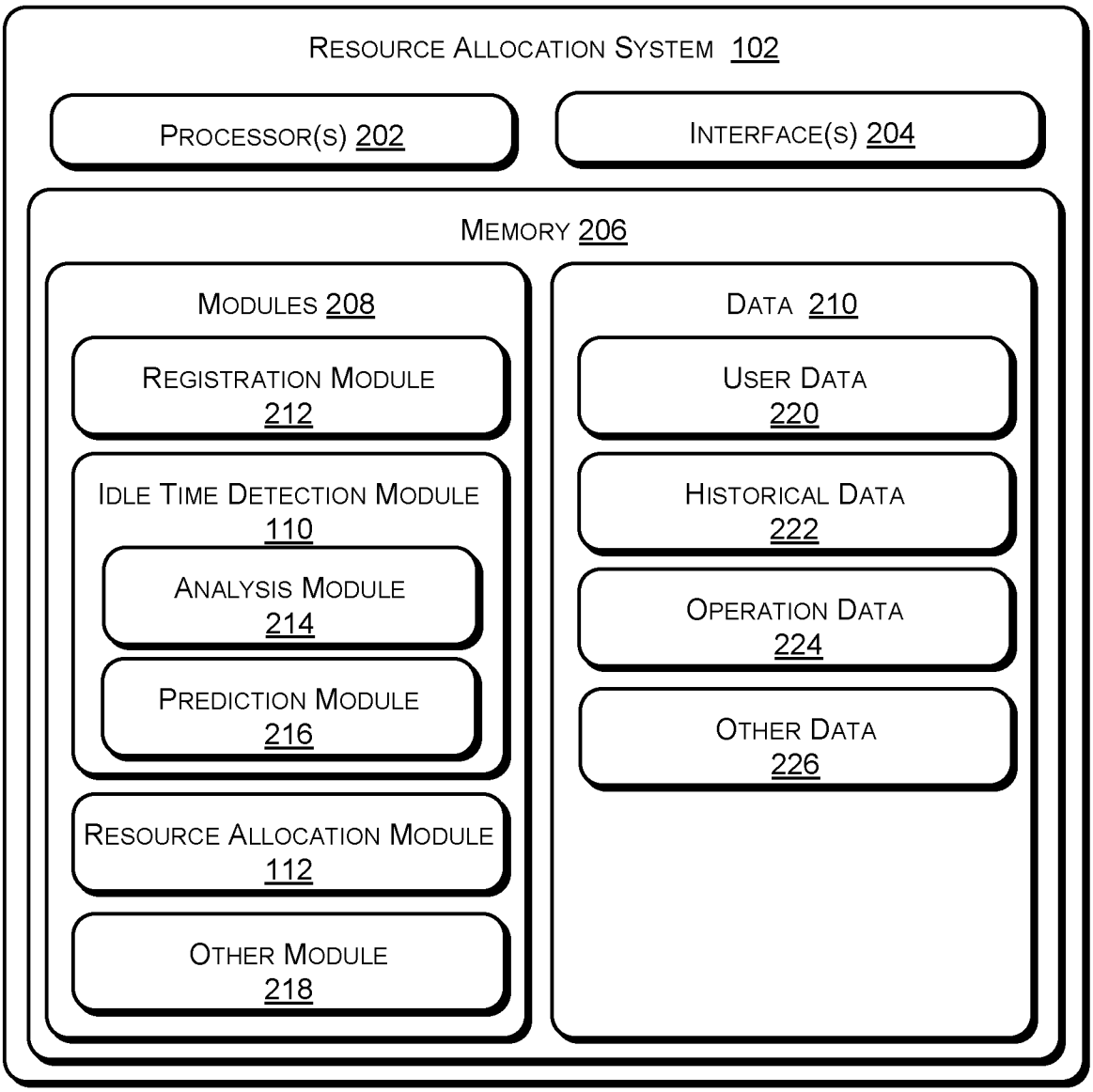
RESOURCE ALLOCATION SYSTEM 102
PROCESSOR(S) 202
INTERFACE(S) 204
MEMORY 206
MODULES 208
REGISTRATION MODULE 212
IDLE TIME DETECTION MODULE 110
ANALYSIS MODULE 214
PREDICTION MODULE 216
RESOURCE ALLOCATION MODULE 112
OTHER MODULE 218
DATA 210
USER DATA 220
HISTORICAL DATA 222
OPERATION DATA 224
OTHER DATA 226

Figure 2

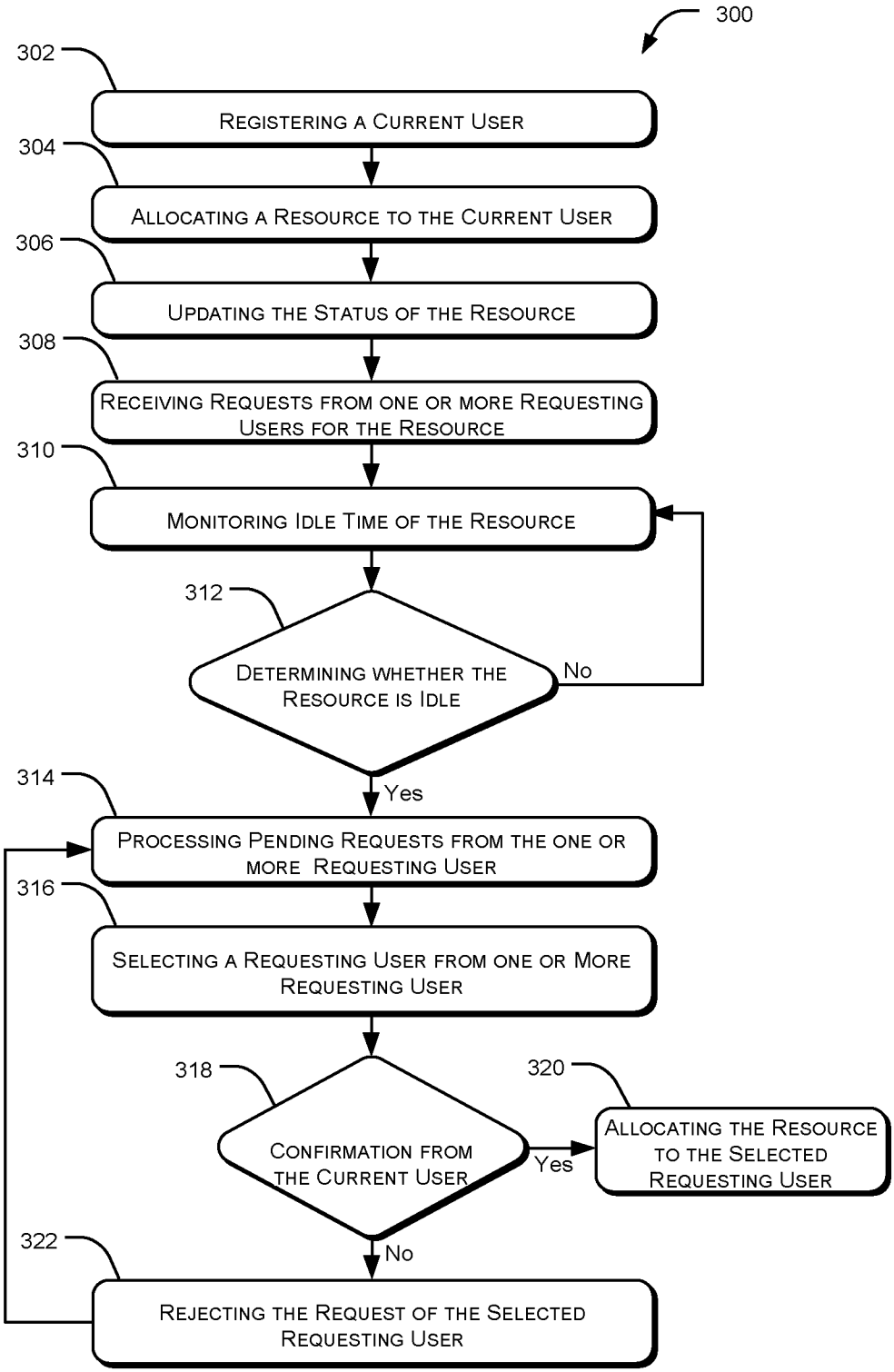
300
302
REGISTERING A CURRENT USER
304
ALLOCATING A RESOURCE TO THE CURRENT USER
306
UPDATING THE STATUS OF THE RESOURCE
308
RECEIVING REQUESTS FROM ONE OR MORE REQUESTING USERS FOR THE RESOURCE
310
MONITORING IDLE TIME OF THE RESOURCE
312
DETERMINING WHETHER THE RESOURCE IS IDLE
No
Yes
314
PROCESSING PENDING REQUESTS FROM THE ONE OR MORE REQUESTING USER
316
SELECTING A REQUESTING USER FROM ONE OR MORE REQUESTING USER
318
CONFIRMATION FROM THE CURRENT USER
320
Yes
ALLOCATING THE RESOURCE TO THE SELECTED REQUESTING USER
No
322
REJECTING THE REQUEST OF THE SELECTED REQUESTING USER

Figure 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/061824

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/56
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 912 232 B1 (DUFFIELD NICHOLAS G [US] ET AL) 28 June 2005 (2005-06-28) column 1, line 64 - column 2, line 13 column 10, paragraph 47 - column 13, paragraph 60	1-15
X	WO 2006/021223 A1 (ERICSSON TELEFON AB L M [SE]; HUNDSCHEIDT FRANK [NL]; HLIBICIUC ALEXAN) 2 March 2006 (2006-03-02) page 6, paragraph 2 page 11, paragraph 4 - page 18, paragraph 1	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 July 2012	27/07/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Itani, Maged

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/061824

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/110887 A1 (BEAUJEAN CHRISTOPHE [FR] ET AL) 6 May 2010 (2010-05-06) paragraph [0031] paragraph [0057] paragraph [0066] paragraph [0081] paragraph [0086] - paragraph [0088] -----	1-15
A	US 2007/076728 A1 (RIEGER REMI [US] ET AL) 5 April 2007 (2007-04-05) paragraph [0059] - paragraph [0061] paragraph [0075] paragraph [0129] - paragraph [0134] -----	1-15
A	EP 1 944 922 A1 (ALCATEL LUCENT [FR]) 16 July 2008 (2008-07-16) paragraph [0019] - paragraph [0022] paragraph [0027] paragraph [0037] - paragraph [0047] -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/061824

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