



- (51) International Patent Classification:
G01R 31/00 (2006.01) *G01R 23/00* (2006.01)
- (21) International Application Number:
PCT/US2015/040986
- (22) International Filing Date:
17 July 2015 (17.07.2015)
- (25) Filing Language: English
- (26) Publication Language: English
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- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

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(54) Title: OPERATING FREQUENCY DETERMINATION

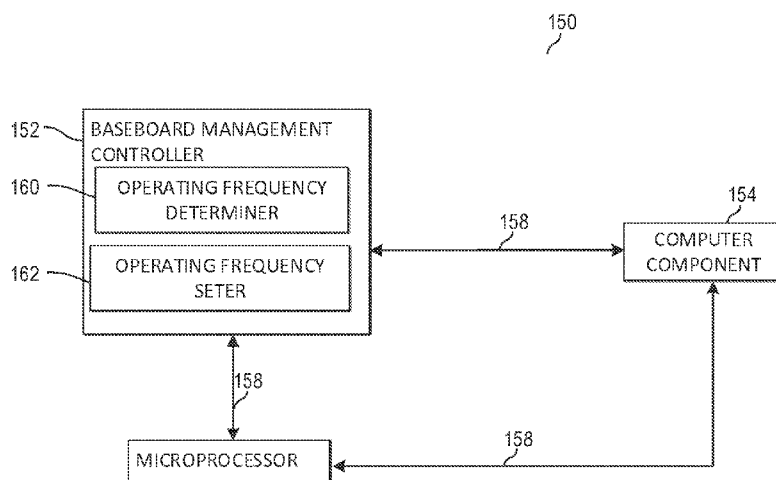


FIG. 1B

(57) Abstract: In one example in accordance with the present disclosure, a method for determining operating frequencies includes receiving a warranty period for a computer component. The method includes determining an operating frequency that will cause a predicted life cycle of the computer component operating at the operating frequency to fall within the warranty period. The method includes setting the computer component to operate at the operating frequency.



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

— *as to the applicant's entitlement to claim the priority of
the earlier application (Rule 4.17(iii))*

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

Published:

— *with international search report (Art. 21(3))*

OPERATING FREQUENCY DETERMINATION

BACKGROUND

[0001] Customers may consider a variety of factors when making a purchasing decision for a server. These factors may vary depending on the customer's operating model as well as a desired total cost of ownership (TCO). While some customers may emphasize the absolute performance of the server when making a purchasing decision, other customers may emphasize the warranty period, while still other customers may desire a balance between both absolute performance and warranty period.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The following detailed description references the drawings, wherein:

[0003] FIG. 1A is a block diagram of an example system for operating frequency determination;

[0004] FIG. 1B is a block diagram of an example computing environment in which operating frequency determination may be useful;

[0005] FIG. 2 is a flowchart of an example method for operating frequency determination;

[0006] FIG. 3 is a flowchart of an example method for operating frequency determination;

[0007] FIG. 4 is a block diagram of an example system for operating frequency determination; and

[0008] FIG. 5 is a block diagram of an example system for operating frequency determination.

DETAILED DESCRIPTION

[0009] Computing devices, such as a server, typically include a variety of computer components, such as a central processing unit (CPU), a graphical processing unit (GPU), a Random Access Memory (RAM), a storage medium, etc. Each computer component is typically designed to work under a default or “stock” setting. For example, an operating frequency of a CPU specifies the operating frequency of the CPU's core(s). Traditionally, a warranty period for a server and the CPU inside of the server guarantees the operation of the CPU at the stock operating frequency.

[0010] Overclocking is a process where a computer component is set to operate at an operating frequency higher than the stock setting. Operating a computer component at an operating frequency higher than the stock setting, however, may cause unpredictability in the operation of the computer component. For example, overclocking may lead to faster deterioration of the computer component and lead to the computer component breaking before the end of the warranty period. Overclocking a computer component typically voids the warranty of the computer component and/or the server. Accordingly, overclocking has traditionally been used in high end consumer enthusiast applications, such as PC gaming, and has been unfit for environments where predictability and reliability are more valued, such as in the server market.

[0011] Warranty periods have traditionally been determined based on general characteristics of a class of computer component rather than the characteristics of an individual computer component. For example, a given factory may produce “model A” CPUs and each model A CPU may have a warranty period of three years. In a simple example scenario, the factory may produce three specific of model A processors in one day: CPU 1, CPU 2 and CPU 3. Accordingly, each of these processors may have a warranty period of three years. However, the given warranty period does not consider the characteristics of each individually manufactured processor. Due to slight variations in the materials used in the production of the CPUs, each of CPU 1, CPU 2 and CPU 3 may have a different life cycle.

[0012] Because of variations in individual computer components as well as the unpredictability of overclocking, an individualized approach to determining the

individual characteristics and durability of each individual component may allow for a more accurate prediction of the life cycle of a computer component as well as a more accurate prediction of the effect of overclocking on the computer component.

[0013] Systems for operating frequency determination allow customers to select requirements for a computer component, such as a desired warranty period and/or a desired performance level. Based on the selected requirements, an operating frequency may be selected and legally guaranteed by the seller to operate reliability within the selected warranty period. Moreover, detailed analysis of the individual computer component may allow for a more accurate life cycle of the computer component to be predicted and guaranteed. For example, on-die electrical and thermal stress probes may be used to predict the life cycle of a specific computer component instead of generalized approach described above. The processor warranty period for an individual computer component may then be calculated based on predictive life cycle for that individual computer component.

[0014] Example operating frequency determination systems may include receiving a warranty period for a computer component. The method may also include determining an operating frequency for the computer component that will cause a predicted life cycle of the computer component operating at the operating frequency to fall within the warranty period. The method may further include setting the computer component to operate at the operating frequency.

[0015] FIG. 1A is a block diagram of an example operating frequency determination system 110 for operating frequency determination. In the example shown in FIG. 1A, system 500 may comprise various components, including a requirements receiver 112, an operating frequency determiner 114, electrical stress determiner 116, thermal stress determiner 118, environment predictor 120, life cycle predictor 122, operating frequency setter 126 and/or other components. Any of the various components of operating frequency determination system 110 may also be part of a firmware of a baseboard management controller, such as the baseboard management controller 152 described below in reference to FIG. 1B. According to various implementations, operating frequency determination system 110 may be implemented in hardware and/or a combination of hardware and programming that configures hardware. Furthermore, in FIG. 1A and other Figures described herein, different numbers of components or entities than depicted may be used. As is illustrated with respect to FIG. 5, the hardware of the

various components of operating frequency determination system 110, for example, may include one or both of a processor and a machine-readable storage medium, while the instructions are code stored on the machine-readable storage medium and executable by the processor to perform the designated function.

[0016] Requirements receiver 112 may receive requirements for the computing device and/or a component of the computing device. The requirements receiver 112 may receive a warranty period for a computer component. The warranty period may define a desired period that a performance of the computer component will be guaranteed. The requirements receiver 112 may receive a performance level for the computer component. The performance level may define a desired level of performance of the computer component. Performance levels may correspond to any computer component and may be represented as numbers, descriptions, etc. For example, the performance level may represent a desired clock speed of a CPU. As another example, the performance level may be a category such as "high performance," "medium performance," etc. The performance level categories may correspond to range of operating frequencies. The warranty period and/or performance level may be received from a customer, a sales representative, etc.

[0017] Operating frequency determiner 114 may determine an operating frequency for the computer component. For example, the operating frequency may specify the operating frequency of the CPU core(s), the operating frequency of the GPU core(s), the memory clock frequency of a RAM module, etc. The operating frequency may be the highest frequency that the processor can operate at and maintain a predicted life cycle that is within the warranty period. The operating frequency may meet the performance level for the component (e.g., as discussed herein with respect to requirements receiver 112). The operating frequency may overclock or underclock the computer component. As discussed above, computer components are typically designed to work under certain default or stock settings. Overclocking is a process where a computer component is set to operate at an operating frequency higher than the stock setting. Underclocking is a process where a computer component is set to operate at an operating frequency lower than the stock setting.

[0018] The operating frequency may maximize the performance of the processor or extend the life of the processor. For example, the operating frequency that maximizes the performance of the processor may be the highest frequency under

which the processor can operate reliably. Alternatively, the operating frequency may be a lower or a lowest frequency under which the processor can operate. A higher operating frequency may be appropriate when high performance is desired and a lower warranty period is acceptable. A lower operating frequency may be appropriate when a higher warranty period is desired.

[0019] Electrical stress determiner 116 may determine a predicted electrical stress of the computer component. The electrical stress may be an indicator of a silicon durability of the computer component. The electrical stress may correspond to a current setting and/or a voltage setting of the computer component. The electrical stress may be measured from an on-die silicon leakage and/or thermal probe, off-die sensor, etc.

[0020] Thermal stress determiner 118 may determine a predicted thermal stress of the computer component and an effect of the computer component operating under the predicted thermal stress on the predicted life cycle of the computer component. The thermal stress may correspond to a current setting and/or a voltage setting of the computer component. The thermal stress may correspond to a temperature setting of the computer component. The thermal stress may be measured from an on-die thermal probe, off-die sensor, etc.

[0021] Environment predictor 120 may determine a predicted environment of the computer component and an effect of the computer component operating under the predicted environment on the predicted life cycle of the computer component. The predicted environment may include operating details of other computer components used in the computer (speed of the RAM, frequency of the GPU, etc.), the amount of time that the computer component and/or computer will be operated (ten hours per day/4 days a week, 24 hours a day/seven days a week, etc.) at what specific speed the computer component and/or computer will be operated, the physical environment that the computer will be placed in (temperature, humidity, etc.), etc.

[0022] Life cycle predictor 122 may predict a life cycle of the computer component based on the computer component operating at the operating frequency (e.g., as discussed herein with respect to operating frequency determiner 114). The life cycle of the computer component may be the length of time that the computer component will reliably operate and/or reliably operate at the operating frequency. Life cycle predictor 122 may predict that a life cycle of the computer component operating at the

operating frequency is within the warranty period. As described above, each individual computer component may have a unique life cycle based on the specific characteristics of the computer component, such as a silicon durability, caused by manufacture of the computer component. Life cycle predictor 122 may take these unique characteristics of the computer component into consideration when determining the predicted life cycle of the computer component. For example, the predicted life cycle of a CPU may be three years, based on the durability of the silicon used in the manufacture of the CPU.

[0023] Life cycle predictor 122 may make life cycle predictions based on statistical data, on-die probes, etc. Life cycle predictor 122 may predict the life cycle of the computer component based on the electrical stress (e.g., as discussed herein with respect to electrical stress determiner 116). Life cycle predictor 122 may predict the life cycle of the computer component based on the thermal stress (e.g., as discussed herein with respect to thermal stress determiner 118). Life cycle predictor 122 may determine an effect of operation under the predicted operating environment on the computer component (e.g., as discussed herein with respect to environment predictor 120) and predict the life cycle of the computer component based on the effect of operating under the predicted operating environment.

[0024] Operating frequency setter 124 may set the computer component to operate at the operating frequency. Operating frequency setter 124 may cause a baseband controller to set the operating frequency of the computer component.

[0025] FIG. 1B is an example environment 150 in which various examples in which operating frequency determination may be useful. Environment 150 may include various components including a baseboard management controller 152, a computer component 154 and an additional microprocessor 156. The baseboard management controller 154 may be a microcontroller embedded on a motherboard of a computer. Although Fig. 1B illustrates a baseband management controller, the techniques described herein can be implemented within any microcontroller used for management. As discussed above, the computer component 154 may be a CPU, a GPU, a RAM, etc.

[0026] The baseboard management controller 152 may communicate requests to and/or receive responses from the computer component 154 via a communication interface 158. The baseboard management controller 152 may communicate requests to and/or receive responses from the microprocessor 156 via the communication

interface 158. The microprocessor 156 may communicate requests to and/or receive responses from the computer component 154 via the communication interface 158. Example communication interfaces 158 include a system management bus (SMBUS), Peripheral Component Interconnect (PCI) and the Direct Media Interface (DMI) released by the INTEL CORPORATION.

[0027] The baseboard management controller 154 may include a firmware with an operating frequency determiner 160 and/or operating frequency setter 162. Operating frequency determiner 160 may determine an operating frequency for the computer component. Operating frequency determiner 160 may be similar to the operating frequency determiner 114 described above in reference to FIG. 1A. Operating frequency setter 162 may set the operating frequency of the computer component. Operating frequency setter 162 may be similar to the operating frequency setter 124 described above in reference to FIG. 1A.

[0028] FIG. 2 is a flowchart of an example method 200 for a determining operating frequencies. Method 200 may be described below as being executed or performed by a system, for example, system 110 of FIG. 1A, system 400 of FIG. 4 or system 500 of FIG. 5. Other suitable systems and/or computing devices may be used as well. Method 200 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of the system and executed by at least one processor of the system. Alternatively or in addition, method 200 may be implemented in the form of electronic circuitry (e.g., hardware) or in a firmware executing by a processor. For example, the steps of method 200 may be performed by a firmware of a management controller, such as the baseboard management controller 152 described above in reference to FIG. 1B. The steps of method 200 may be executed substantially concurrently or in a different order than shown in FIG. 2. Method 200 may include more or less steps than are shown in FIG. 2. The steps of method 200 may, at certain times, be ongoing and/or may repeat.

[0029] Method 200 may start at step 202 and continue to step 204, where the method may include receiving a warranty period for a computer component, the warranty period defining a desired period that a performance of the computer component will be guaranteed. The warranty period may be received from a customer planning to purchase the computer component. The method 200 may also include receiving a performance level. The performance level may define a desired level of performance

of the computer component. Performance levels may correspond to any computer component and may be represented as numbers, descriptions, etc. For example, the performance level may represent a desired clock speed of a CPU. As another example, the performance level may be a category such as "high performance," "medium performance," etc.

[0030] At step 206, the method may include determining an operating frequency for the computer component that will cause a predicted life cycle of the computer component operating at the operating frequency to fall within the warranty period. The operating frequency may maximize the performance of the processor. The operating frequency may be the highest frequency that the computer component can operate at and maintain a predicted life cycle within the warranty period. The operating frequency may overclock the computer component higher than a manufacturer default frequency. The operating frequency may underclock the computer component lower than a manufacturer default frequency. As discussed above, computer components are typically designed to work under certain default or stock settings. Overclocking is a process where a computer component is set to operate at an operating frequency higher than the stock setting. Underclocking is a process where a computer component is set to operate at an operating frequency lower than the stock setting.

[0031] At step 208, the method may include setting the computer component to operate at the operating frequency. The computer component may be set to operate at the operating frequency by a baseboard management controller. In some examples, data concerning the warranty period and performance level of the computer component may be tracked during the life of the computer component. The data may be used to determine the remaining warranty period for the computer component as well as to update the predicted life and performance level of the computer component. The data may be useful when the computer component is used in equipment that is leased, rented, resold, etc. to determine how much warranty period and performance is left for the computer component during the lease period, rental period, sale period, etc. The data may also be used in determining future warranty periods for the computer component when a lease or rental period has expired. Method 200 may eventually continue to step 210, where method 200 may stop.

[0032] FIG. 3 is a flowchart of an example method 300 for a determining operating frequencies. Method 300 may be described below as being executed or performed by a

system, for example, system 110 of FIG. 1A, system 400 of FIG. 4 or system 500 of FIG. 5. Other suitable systems and/or computing devices may be used as well. Method 300 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of the system and executed by at least one processor of the system. Alternatively or in addition, method 300 may be implemented in the form of electronic circuitry (e.g., hardware) or in a firmware executed by a processor. For example, the steps of method 300 may be performed by a firmware of a baseboard management controller, such as the baseboard management controller 152 described above in reference to FIG. 1B. The steps of method 300 may be executed substantially concurrently or in a different order than shown in FIG. 3. Method 300 may include more or less steps than are shown in FIG. 3. The steps of method 300 may, at certain times, be ongoing and/or may repeat.

[0033] Method 300 may start at step 302 and continue to step 304, where the method may include determining an electrical stress on a computer component at an operating frequency. The electrical stress may correspond to at least one of a current setting or a voltage setting. The electrical stress may be measured from an on-die sensor, an off-die sensor and/or one additional sensors. At step 306 the method may include predicting a life cycle of the computer component based on the electrical stress. At step 308, the method may include determining a thermal stress on the computer component at the operating frequency. The thermal stress may correspond to a temperature setting. The thermal stress may be measured from an on-die sensors, an off-die sensors and/or additional sensors. At step 310, the method may include predicting a life cycle of the computer component based on the thermal stress.

[0034] At step 312, the method may include determining an effect of operating under a predicted operating environment on a computer component. At step 314, the method may include predicting the life cycle of the computer component based on the effect of operating under the predicted operating environment. At step 316, the method may include determining a silicon durability of a computer component. The silicon durability may be determined based on data received from a stress probe on the computer component, such as an on-die sensor. At step 318, the method may include predicting the life cycle of the computer component based on the silicon durability. Method 300 may eventually continue to step 320, where method 300 may stop.

[0035] FIG. 4 is a block diagram of an example operating frequency determination system 400. System 400 may be similar to system 110 of FIG. 1A, for example. In the example shown in FIG. 4, system 400 includes requirements receiver 402, operating frequency determiner 404, life cycle predictor 406 and warranty determiner 408. The components of system 400 may be part of a firmware of a baseboard management controller, such as the baseboard management controller 152 described above in reference to FIG. 1B.

[0036] Requirements receiver 402 may receive a warranty period and a performance level for a computer component. The warranty period may define a desired period that a performance of the computer component will be guaranteed. The warranty period may be received from a customer planning to purchase the computer component. The performance level may define a desired level of performance of the computer component. Performance levels may correspond to any computer component and may be represented as numbers, descriptions, etc. For example, the performance level may represent a desired clock speed of a CPU. As another example, the performance level may be a category such as "high performance," "medium performance," etc.

[0037] Requirements receiver 402 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of system 400 and executed by at least one processor of system 400. Alternatively or in addition, requirements receiver 402 may be implemented in the form of a hardware device including electronic circuitry or in a firmware executed by a processor for implementing the functionality of requirements receiver 402.

[0038] Operating frequency determiner 404 may determine an operating frequency for the computer component that will cause the computer component to meet the performance level during the warranty period. The operating frequency may maximize the performance of the processor and may be the highest frequency under which the processor can operate reliably. The operating frequency may overclock the computer component higher than a manufacturer default frequency. The operating frequency may underclock the computer component lower than a manufacturer default frequency. As discussed above, computer components are typically designed to work under certain default or stock settings. Overclocking is a process where a computer component is set to operate at an operating frequency higher than the stock setting.

Underclocking is a process where a computer component is set to operate at an operating frequency lower than the stock setting.

[0039] Operating frequency determiner 404 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of system 400 and executed by at least one processor of system 400. Alternatively or in addition, operating frequency determiner 404 may be implemented in the form of a hardware device including electronic circuitry or in firmware executed by a processor for implementing the functionality of operating frequency determiner 404.

[0040] Operating frequency setter 406 may set the computer component to operate at the operating frequency. The life cycle of the computer component may be based on a determined silicon durability of the computer component. Life cycle predictor 406 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of system 400 and executed by at least one processor of system 400. Alternatively or in addition, life cycle predictor 406 may be implemented in the form of a hardware device including electronic circuitry for implementing the functionality of life cycle predictor 406.

[0041] FIG. 5 is a block diagram of an example system 500 for operating frequency determination. In the example shown in FIG. 5, system 500 includes a processor 502 and a machine-readable storage medium 504. Although the following descriptions refer to a single processor and a single machine-readable storage medium, the descriptions may also apply to a system with multiple processors and multiple machine-readable storage mediums. In such examples, the instructions may be distributed (e.g., stored) across multiple machine-readable storage mediums and the instructions may be distributed (e.g., executed by) across multiple processors. For example, the instructions of system 500 may be part of a firmware of a baseboard management controller, such as the baseboard management controller 152 described above in reference to FIG. 1B.

[0042] Processor 502 may be one or more central processing units (CPUs), microprocessors, and/or other hardware devices suitable for retrieval and execution of instructions stored in machine-readable storage medium 504. In the example shown in FIG. 5, processor 502 may fetch, decode, and execute instructions 506, 508, 510 and 512 to perform operating frequency determination. As an alternative or in addition to retrieving and executing instructions, processor 502 may include one or more electronic circuits comprising a number of electronic components for performing the functionality of

one or more of the instructions in machine-readable storage medium 504. With respect to the executable instruction representations (e.g., boxes) described and shown herein, it should be understood that part or all of the executable instructions and/or electronic circuits included within one box may be included in a different box shown in the figures or in a different box not shown.

[0043] Machine-readable storage medium 504 may be any electronic, magnetic, optical, or other physical storage device that stores executable instructions. Thus, machine-readable storage medium 504 may be, for example, Random Access Memory (RAM), an Electrically-Erasable Programmable Read-Only Memory (EEPROM), a storage drive, an optical disc, and the like. Machine-readable storage medium 504 may be disposed within system 500, as shown in FIG. 5. In this situation, the executable instructions may be “installed” on the system 500. Alternatively, machine-readable storage medium 504 may be a portable, external or remote storage medium, for example, that allows system 500 to download the instructions from the portable/external/remote storage medium. In this situation, the executable instructions may be part of an “installation package”. As described herein, machine-readable storage medium 504 may be encoded with executable instructions for a web technology responsive to mixtures of emotions.

[0044] Referring to FIG. 5, time period receive instructions 506, when executed by a processor (e.g., 502), may cause system 500 to receive a time period that a performance of a computer component is guaranteed. The time period may be received from a customer planning to purchase the computer component. Time period receive instructions 506 when executed by a processor (e.g., 502), may also cause system 500 to receive a performance level. The performance level may define a desired level of performance of the computer component. Performance levels may correspond to any computer component and may be represented as numbers, descriptions, etc. For example, the performance level may represent a desired clock speed of a CPU. As another example, the performance level may be a category such as “high performance,” “medium performance,” etc.

[0045] Operating frequency determine instructions 508, when executed by a processor (e.g., 502), may be the highest frequency that the processor can operate at and maintain a predicted life cycle that is within the warranty period. The operating frequency may maximize the performance of the processor. The operating frequency

may overclock the computer component higher than a manufacturer default frequency. The operating frequency may underclock the computer component lower than a manufacturer default frequency. As discussed above, computer components are typically designed to work under certain default or stock settings. Overclocking is a process where a computer component is set to operate at an operating frequency higher than the stock setting. Underclocking is a process where a computer component is set to operate at an operating frequency lower than the stock setting.

[0046] Operating frequency set instructions 510, when executed by a processor (e.g., 502), may cause system 500 to set the processor to operate at the highest frequency. Operating frequency set instructions 510 may cause a baseboard management controller to set the processor to operate at the highest frequency.

[0047] The foregoing disclosure describes a number of examples for operating frequency determination. The disclosed examples may include systems, devices, computer-readable storage media, and methods for operating frequency determination. For purposes of explanation, certain examples are described with reference to the components illustrated in FIGS. 1-5. The functionality of the illustrated components may overlap, however, and may be present in a fewer or greater number of elements and components. Further, all or part of the functionality of illustrated elements may co-exist or be distributed among several geographically dispersed locations. Further, the disclosed examples may be implemented in various environments and are not limited to the illustrated examples.

[0048] Further, the sequence of operations described in connection with FIGS. 1-5 are examples and are not intended to be limiting. Additional or fewer operations or combinations of operations may be used or may vary without departing from the scope of the disclosed examples. Furthermore, implementations consistent with the disclosed examples need not perform the sequence of operations in any particular order. Thus, the present disclosure merely sets forth possible examples of implementations, and many variations and modifications may be made to the described examples.

CLAIMS

1. A method for determining operating frequencies, the method comprising:
receiving a warranty period for a computer component;
determining an operating frequency that will cause a predicted life cycle of the computer component operating at the operating frequency to fall within the warranty period; and
setting the computer component to operate at the operating frequency.
2. The method of claim 1 wherein setting the computer component to operate at the operating frequency is performed by a baseboard management controller.
3. The method of claim 1 further comprising:
determining an electrical stress on the computer component at the operating frequency, wherein the electrical stress corresponds to at least one of a current setting or a voltage setting; and
predicting the life cycle of the computer component based on the electrical stress.
4. The method of claim 1 further comprising:
determining a thermal stress on the computer component at the operating frequency, wherein the thermal stress corresponds to a temperature setting; and
predicting the life cycle of the computer component based on the thermal stress.
5. The method of claim 1 further comprising:
determining an effect of operating under a predicted operating environment on the computer component; and
predicting the life cycle of the computer component based on the effect of operating under the predicted operating environment.
6. The method of claim 1 further comprising:

receiving data from a stress probe on the computer component;
determining a silicon durability of the computer component based on the received data; and
predicting the life cycle of the computer component based on the silicon durability.

7. A system for determining operating frequencies comprising:
a requirements receiver to receive a warranty period and a performance level for a computer component;
an operating frequency determiner to determine an operating frequency for the computer component that will cause the computer component to meet the performance level during the warranty period;
an operating frequency setter to set the computer component to operate at the operating frequency.
8. The system of claim 7, further comprising a baseboard management controller to set the computer component to operate at the operating frequency.
9. The system of claim 7, wherein the operating frequency is the highest frequency under which the processor can operate reliably.
10. The system of claim 7, further comprising:
a life cycle predictor to predict that a life cycle of the computer component operating at the operating frequency is within the warranty period.
11. The system of claim 7, further comprising:
an electrical stress determiner to receive electrical stress data from an electrical probe of the computer component and determine an electrical stress on the computer component at the operating frequency, wherein the electrical stress corresponds to at least one of a current setting or a voltage setting; and
the warranty determiner further to predict the life cycle of the computer component based on the electrical stress.

12. A non-transitory machine-readable storage medium encoded with instructions for determining operating frequencies, the instructions executable by a processor of a system to cause the system to:

- receive a time period that a performance of a computer component is guaranteed;

- determine a highest frequency that the computer component can operate at and maintain a predicted life cycle that is within the warranty period; and

- set the computer component to operate at the highest frequency.

13. The non-transitory machine-readable storage medium of claim 12, wherein the instructions executable by the processor of the system further cause the system to:

- receive data from a stress probe on the computer component;

- determine a silicon durability of the computer component based on the received

data; and

- predict the life cycle of the computer component based on the silicon durability.

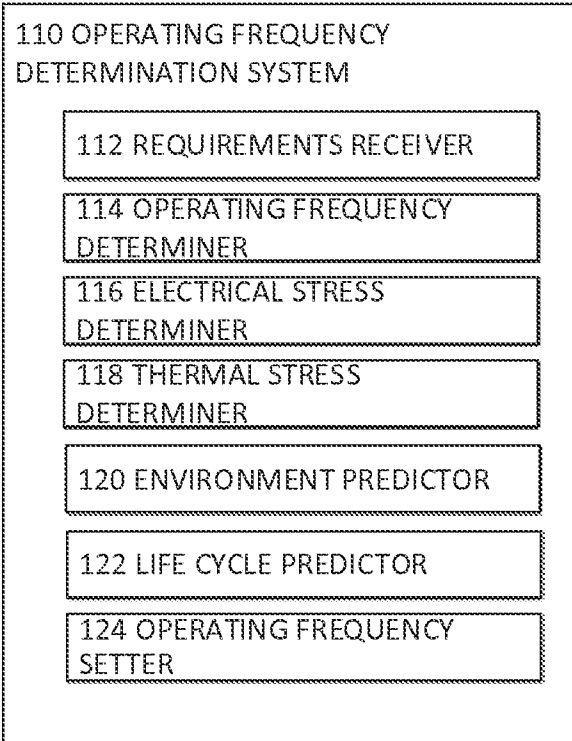
14. The non-transitory machine-readable storage medium of claim 12, wherein the instructions executable by the processor of the system further cause the system to:

- instructions to determine an effect of operating under a predicted operating environment on the computer component; and

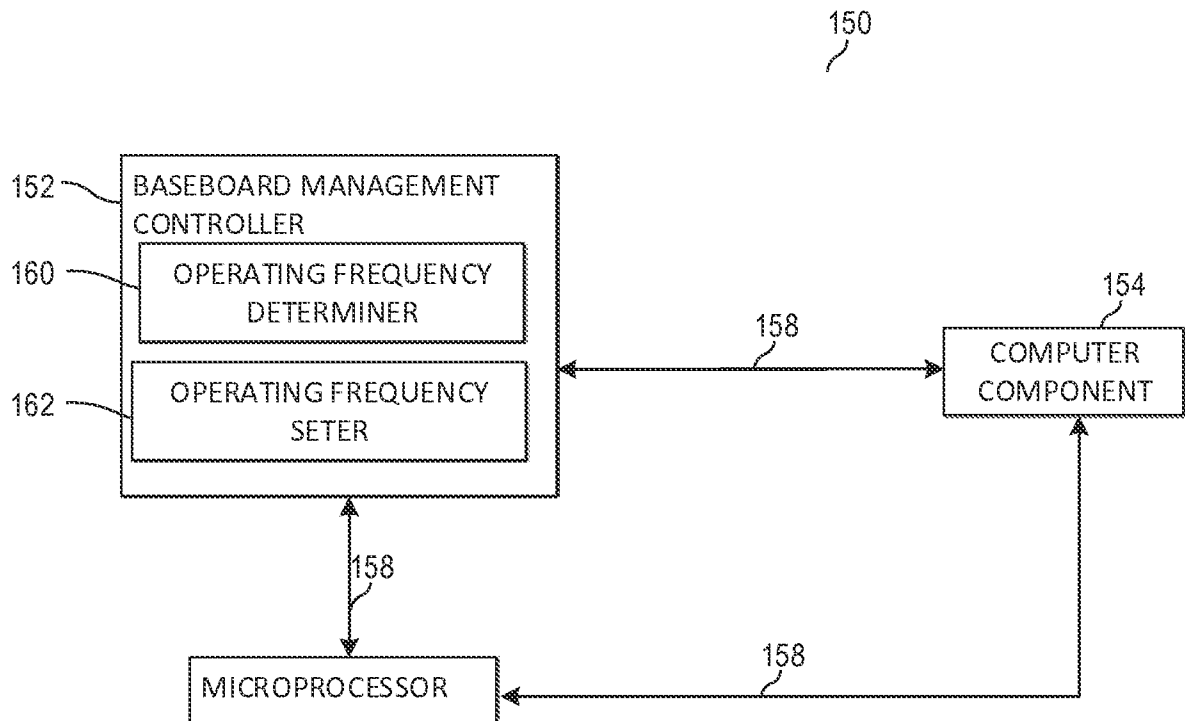
- instructions to predict the life cycle of the computer component based on the effect of operating under the predicted operating environment.

15. The non-transitory machine-readable storage medium of claim 12, further comprising:

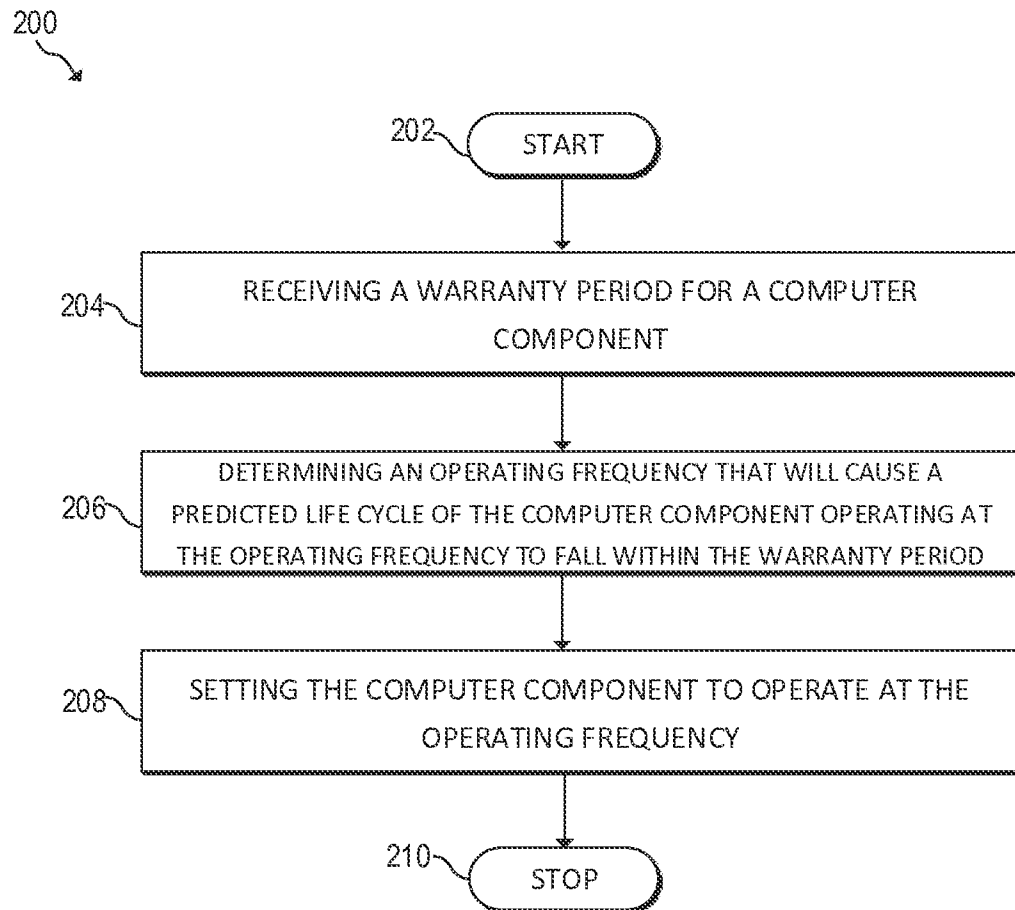
- instructions to cause a baseboard management controller to set the computer component to operate at the highest frequency.

100 **FIG. 1A**

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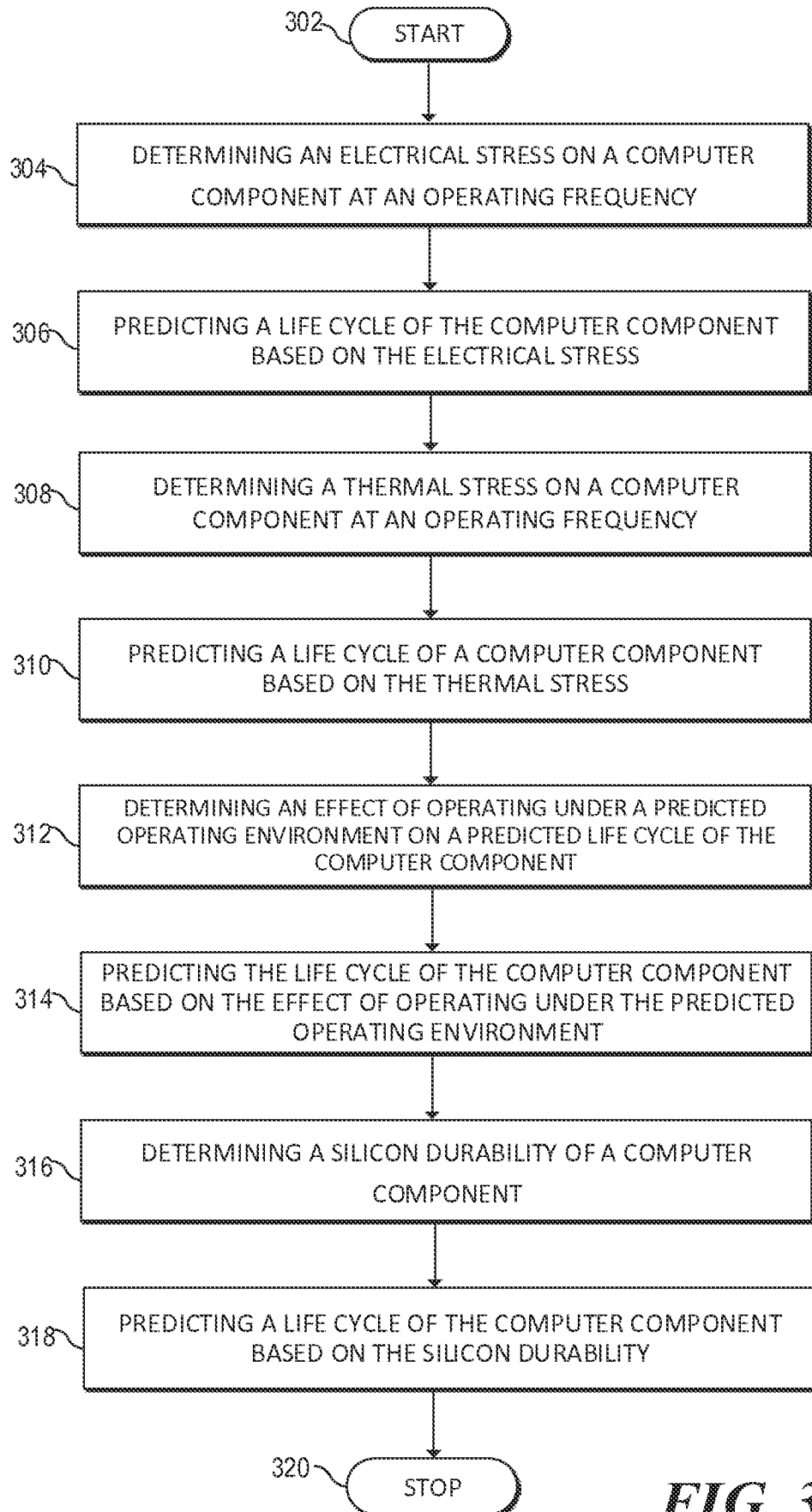
**FIG. 1B**

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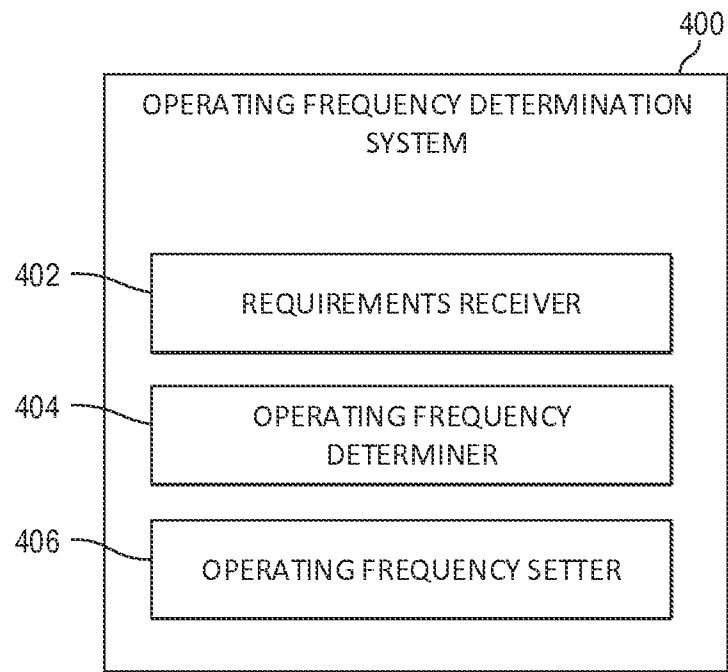
**FIG. 2**

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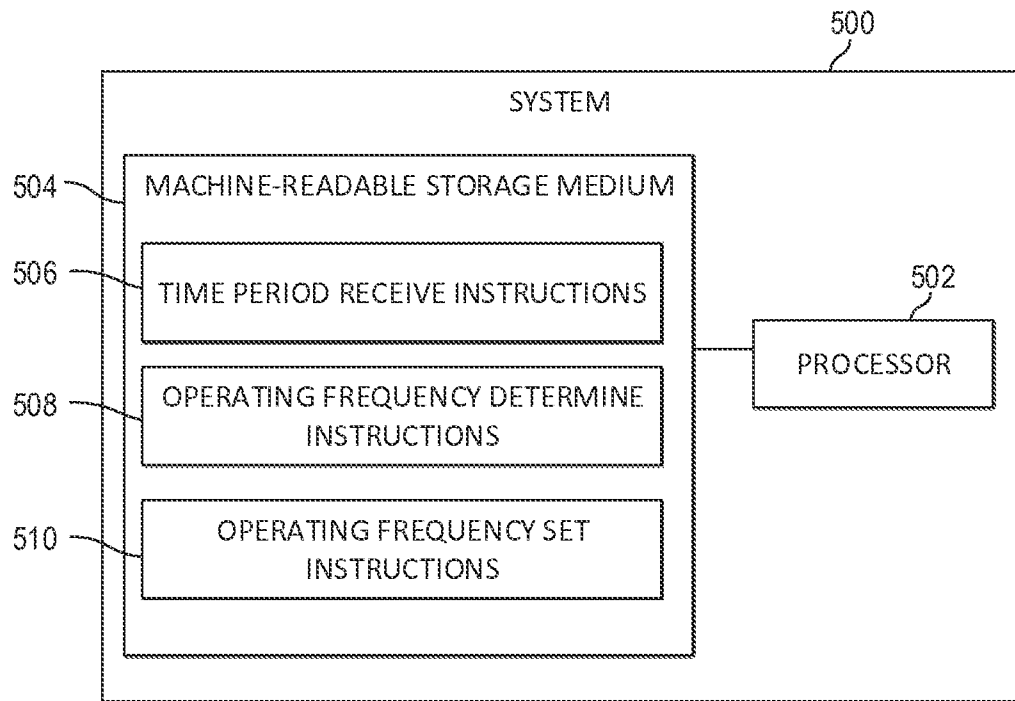
300

**FIG. 3**

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**FIG. 4**

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**FIG. 5**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/040986**A. CLASSIFICATION OF SUBJECT MATTER****G01R 31/00(2006.01)i, G01R 23/00(2006.01)i**

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)

G01R 31/00; G06F 3/06; G06F 19/00; G06F 1/04; G06F 9/44; G05B 15/02; G06F 1/32; F28F 27/00; G01R 23/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: warranty, set, operating, frequency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2008-0263383 A1 (KNEBEL et al.) 23 October 2008 See abstract, paragraph [0035], claim 1 and figures 1A-2.	1-6, 12-15
A		7-11
Y	US 2014-0343748 A1 (FUJITSU LIMITED) 20 November 2014 See paragraphs [0043]-[0045], claims 1, 10 and figures 4-5.	1-6, 12-15
A	US 2014-0380076 A1 (WEISSMANN et al.) 25 December 2014 See abstract, claim 1 and figures 1-8.	1-15
A	US 2015-0039806 A1 (HGST NETHERLANDS B.V.) 05 February 2015 See figures 1-6.	1-15
A	US 2009-0276178 A1 (GOODNOW et al.) 05 November 2009 See figures 1-4.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search

18 April 2016 (18.04.2016)

Date of mailing of the international search report

18 April 2016 (18.04.2016)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/040986

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US 2015-0039806 A1	05/02/2015	None	
US 2009-0276178 A1	05/11/2009	US 8452566 B2	28/05/2013