

SYSTEM AND METHOD FOR MAXIMUM COMMAND RESPONSE TIME OF A DISC DRIVE

Related Application

5 This application claims the benefit of U.S. Provisional Application Serial
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Field of the Invention

10 The present invention relates to the field of mass storage devices. More
particularly, this invention relates to a maximum response time in a disc drive.

Background of the Invention

 One key component of any computer system is a device to store data.
Computer systems have many different places where data can be stored. One
15 common place for storing massive amounts of data in a computer system is on a disc
drive. The most basic parts of a disc drive are a disc that is rotated, an actuator that
moves a transducer to various locations over the disc, and electrical circuitry that is
used to write and read data to and from the disc. The disc drive also includes
circuitry for encoding data so that it can be successfully retrieved and written to the
20 disc surface. A microprocessor controls most of the operations of the disc drive as
well as passing the data back to the requesting computer and taking data from a
requesting computer for storing to the disc.

 Information representative of data is stored on the surface of the storage disc.
Disc drive systems read and write information stored on tracks on storage discs.
25 Transducers, in the form of read/write heads attached to the sliders, located on both
sides of the storage disc, read and write information on the storage discs when the
transducers are accurately positioned over one of the designated tracks on the surface
of the storage disc. The transducer is also said to be moved to a target track. As the
storage disc spins and the read/write head is accurately positioned above a target
30 track, the read/write head can store data onto a track by writing information
representative of data onto the storage disc. Similarly, reading data on a storage disc

is accomplished by positioning the read/write head above a target track and reading the stored material on the storage disc. To write on or read from different tracks, the read/write head is moved radially across the tracks to a selected target track. The data is divided or grouped together on the tracks. In some disc drives, the tracks are a multiplicity of concentric circular tracks. In other disc drives, a continuous spiral is one track on one side of a disc drive.

Conventionally, disc drives store critical data where errors are not tolerable. However, the electronic and the mechanical components of the disc drive may introduce error in the data read back or written to the magnetic discs. Therefore whenever errors are detected in the data, the disc drive corrects errors on the fly or the firmware of the disc drive will attempt to correct these errors either by means of self-correcting error code correction (ECC) techniques or by reading/writing the data again. If the error persists, the disc drive will proceed with various data recovery procedures including retries. If the disc drive exhausts all of its retries, the error is reported to the host. The error correction will take a considerable amount of time, an amount of time that is often considered unacceptable to a user of the system because the time for error correction exceeds the expectations of the user.

Some data stored on disc has a degree of high importance or time-criticality, such as audio and video data, which often must be retrieved from the disc within a certain time period according to the expectation of a user. When the time-critical data is retrieved, the expectation of the user is not met when the data is not retrieved within a certain time period. In some instances, not retrieving all the data may not be noticed. However, if there is a pause of longer than a very short period of time in an audio or video stream while the disc drive is busy correcting some erroneous data, perceptible pause will occur in the transmission of data. This perceptible pause will be noticed immediately by the user. Conventional disc drive system, methods and protocols has not been able to adequately address the problem of perceptible pauses in the retrieval of data of time-criticality.

What is needed is a disc drive that eliminates perceptible pauses in time-critical application, such as audio and/or video streaming.

Summary of the Invention

In the present invention, time-critical data, such as audio/visual (AV) data, that is stored on a disc, is differentiated on the disc from non-time-critical data. In one aspect, the differentiation is implemented by partitioning. The time-critical data is differentiated from the non-time-critical data in order to enable methods of reading and writing the time-critical data in a manner that is responsive to the time-critical nature of the data.

More specifically, one of the methods includes receiving a disc command associated with time-critical data and setting a maximum command response time (MCRT). In one example, the MCRT specifies the maximum amount of time that the disc will read or write data, regardless of the success of the command. Thereafter, the disc command is executed and during the execution of the command, the elapsed time of the execution of the disc command is monitored. When or if the elapsed time exceeds the MCRT, execution of the command is halted. In another embodiment, the command will be halted when or if the elapsed time exceeds the MCRT and if errors occur in the execution of the command. In the situation where the command is a read command and the time-critical data is AV data and errors occur in the execution, the read command will be stopped. In yet another embodiment, when errors are detected in data read from a disc, the firmware of the disc drive will attempt to correct these errors either by means of self-correcting error code correction techniques or by reading/writing the data again. If the error persists, the disc drive will proceed to retry the sectors until it succeeds or until it has exhausted all its retries and then report the error to the host.

In another aspect of the present invention, an information handling system, such as a disc drive, includes a base, a disc stack rotatably attached to the base, and means for controlling an output of the disc in reference to a maximum command response time.

In yet another aspect of the invention, a guaranteed command response time is used to determine when the MCRT is erroneously less than the guaranteed command response time and report an error accordingly.

5 In still another aspect of the invention, a mass storage device, such as a disc drive includes a base, a disc rotatably attached to the base, and a controller operably coupled to the disc for managing time-critical differentiated data on the disc. In one aspect of the controller, the controller includes a receiver of a MCRT, a receiver of a disc command of time-critical data, and a comparator of the MCRT to the elapsed time of the execution of the command. When the comparator indicates that the
10 elapsed time of the execution of the command exceeds the MCRT, the comparator will stop execution of the command.

Advantageously, the method described eliminates perceptible pauses in time-critical applications, such as audio and/or video streaming.

15 Brief Description of the Drawings

FIG. 1 is an exploded view of a disc drive.

FIG. 2 is a block diagram of a method for reducing pauses in input/output of a disc drive, according to an embodiment of the present invention.

20 FIG. 3 is a block diagram of a method of additional actions in reducing pauses in input/output of a disc drive in FIG. 2.

FIG. 4 is a block diagram of a method for reducing pauses in input/output of a disc drive of the present invention, according to an embodiment of the present invention.

25 FIG. 5 is a block diagram of a method for reducing pauses in input/output of a disc drive of the present invention, according to an embodiment of the present invention.

FIG. 6 is a block diagram of an apparatus for reducing pauses in input/output of a mass storage device, according to an embodiment of the present invention.

FIG. 7 is a block diagram of the controller in FIG. 6 for reducing pauses in input/output of a mass storage device, according to an embodiment of the present invention.

FIG. 8 is a schematic view of a computer system.

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Description of the Preferred Embodiment

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings, which form a part hereof, and in which are shown by way of illustration specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

The invention described in this application is useful for all types of disc drives, including hard-disc drives, ZIP drives, floppy-disc drives, and any other type of drives, systems of drives (such as a Aredundant array of inexpensive/independent disc drives, or RAID, configuration) or other devices, where an MR or GMR transducer head is used.

The invention described in this application is useful with many electrical and mechanical configurations of disc drives having either rotary or linear actuation. In addition, the invention is also useful in all types of disc drives including hard disc drives, zip drives, floppy disc drives and any other type of drives where providing a low-noise current source for the transducer may be desirable. Figure 1 is an exploded view of one embodiment of the present invention, this embodiment showing one type of a disc drive 100 having a rotary actuator. The disc drive 100 includes a housing or base 112, and a cover 114. The base 112 and cover 114 form a disc enclosure. Rotatably attached to the base 112 on an actuator shaft 118 is an actuator assembly 120. The actuator assembly 120 includes a comb-like structure 122 having a plurality of arms 123. Attached to the separate arms 123 on the comb 122, are load beams or load springs 124. Load beams or load springs are also referred to as suspensions. Attached at the end of each load spring 124 is a slider 126 which carries a magnetic

transducer 150. In some embodiments, transducer 150 includes a electromagnetic coil write head 97 and a magneto-resistive read head 98. The slider 126 with the transducer 150 form what is many times called the head. It should be noted that many sliders have one transducer 150 and that is what is shown in the figures. It should also
5 be noted that this invention is equally applicable to sliders having more than one transducer, such as what is referred to as an MR or magneto resistive head in which one transducer 150 is generally used for reading and another is generally used for writing. On the end of the actuator assembly 120 opposite the load springs 124 and the sliders 126 is a voice coil 128.

10 Attached within the base 112 is a first magnet 130 and a second magnet 131. As shown in Figure 1, the second magnet 131 is associated with the cover 114. The first and second magnets 130, 131, and the voice coil 128 are the key components of a voice coil motor which applies a force to the actuator assembly 120 to rotate it about the actuator shaft 118. Also mounted to the base 112 is a spindle motor. The spindle
15 motor includes a rotating portion called spindle hub 133. In this particular disc drive, the spindle motor is within hub 133. In Figure 1, a number of discs 134 (one or more; four are shown) are attached to the spindle hub 133 to form disc assembly 132. In other disc drives, a single disc or a different number of discs may be attached to the hub. The invention described herein is equally applicable to disc drives which have a
20 plurality of discs as well as disc drives that have a single disc. The invention described herein is also equally applicable to disc drives with spindle motors which are within the hub 133 or under the hub.

Referring next to FIG. 2, a block diagram of a method 200 for reducing pauses in input/output of a disc drive, according to an embodiment of the present invention,
25 is shown. The method includes receiving from a host, a disc read command associated with time-critical data 210. The command includes a maximum command response time (MCRT). The time critical data may be any type of data. In one embodiment, the time-critical data is audio/visual data. Thereafter, method 200 includes executing the disc read command, yielding read data 220. Subsequently, the
30 method include comparing the elapsed time of the execution of the disc read

command 230 while the executing the disc command 220 is performed. The comparison 230 enables the execution of the command to be stopped 240 when the elapsed time exceeds the MCRT, thus ensuring that if the read command executes longer than the expectation of the user, such as when the time of the execution may
5 cause a perceptible pause to a human user, that the execution will be stopped, thus eliminating a perceptible pause. Where the elapsed time of the execution of the command has not exceeded the MCRT, a determination of whether or not the command has completed 250 is performed. If the command is not completed, then the method continues by performing the comparison of the elapsed time to the MCRT
10 230. However, if the command has completed, then the successfully read data is transmitted to the host 260. In one embodiment, after the execution has been stopped 240, data that precedes stopped command is smoothed between data that succeeds the stopped command. Suitable smoothing routines include three-point and five-point moving averages, polynomial functions, spline functions, etc.

15 Referring next to FIG. 3, a block diagram of a method 300 of additional actions in reducing pauses in input/output (I/O) of a disc drive 200, is shown. In one embodiment, the method 300 further includes calculating a MCRT in accordance with minimizing the size of a buffer associated with the read data in the host 310.
20 Calculating the MCRT so that the buffer size is minimized is advantageous where a small buffer is desirable, such as where the buffer size is limited as a result of prohibitive storage prices or physical size limitations in mobile devices. In another embodiment, the method 300 also includes calculating the MCRT in accordance with minimizing the number of retries 320 of the executing step 200 of FIG. 200.
25 Minimizing the number of retries is advantageous in applications where sensitivity to time-criticality of data operations is heightened, such as in AV application. In yet another embodiment of method 400, the method includes calculating a MCRT in accordance with minimizing a chance of error 330 in the executing step 200 of FIG. 200. Minimizing the chance of error is advantageous in applications where fault-

tolerance is low. Steps 310, 320 and/or 330 are performed before the receiving step 210 in FIG. 2.

In yet another embodiment, method 300 includes calculating the size of a buffer associated with the read data in the receiving device 340.

5 Referring next to FIG. 4, a block diagram of a method 400 for reducing pauses in input/output of a disc drive of the present invention, according to an embodiment of the present invention, is shown.

Method 400 includes setting a MCRT 410. The MCRT defines the maximum amount of time that the disc will be allowed to perform a read or a write operation. In one embodiment, the MCRT is associated with, or designated for, read operations. In 10 another embodiment, the MCRT is associated with, or designated for, write operations. In yet another embodiment, the MCRT is associated with, or designated for, read and write operations. In still another embodiment, the MCRT is associated with, or designated for, all disc operations.

15 Method 400 also includes receiving a disc command associated with time-critical data 420. In one embodiment, the command is a read operation. In another embodiment, the command is a write operation. In yet another embodiment, the time-critical data is audio/visual data. In still another embodiment, the command is received from a host, as shown below in FIG. 4.

20 In varying embodiments, setting a MCRT 410 is performed before, during, and/or after receiving a disc command 420. In the embodiment where setting a MCRT 410 is performed after receiving a disc command 420, the MCRT is included in a portion of the disc command, such as in an operand or parameter of the disc command.

25 Thereafter, method 400 includes executing the disc command 430 that was received in step 420. In one embodiment of step 430, the disc command is executed by a disc. In another embodiment of method 400, the method also includes receiving an indication of an error of the executing, such as an indication of the number of retries in unsuccessful execution.

While the command is executed in step 430, the method 400 includes monitoring the elapsed time of the executing of the disc command 440. The elapsed time is monitored and the elapsed time is compared with the MCRT. Subsequently, method 400 includes stopping execution of the disc command when the elapsed time
5 is equal to and/or exceeds the maximum command response time 450. In one embodiment where the MCRT is greater than, and/or is longer than, the elapsed time associated with the execution, there is no indication of an error of the executing step 430. In another embodiment, there is an indication of an error in the execution 430.

In the embodiment of method 400, where the disc command is a read disc
10 command, in a further embodiment, the executing step 430 includes executing the read disc command, which yields read data, and thereafter, the method includes transmitting the read data to a receiving device. In one embodiment, the receiving device is the host. In another embodiment, the setting step 410 further includes calculating a MCRT in order to and/or in accordance with optimizing the size of a
15 buffer associated with the read data in the receiving device. In varying embodiments, calculating the MCRT is performed by the receiving device, such as host, or by the controller. In still another embodiment, the setting step 410 further includes calculating a MCRT in order to and/or in accordance with minimizing the size of a buffer associated with the read data in the receiving device. In still another
20 embodiment, the setting step 410 further includes calculating a MCRT, in order to and/or in accordance with minimizing a chance of error in the executing step 430. In the embodiment of method 400, where the disc command is a read disc command, in yet another embodiment, method 400 includes calculating the size of a buffer associated with the read data in the receiving device. In varying embodiments,
25 calculating the size of the buffer is performed by the receiving device, such as host, or by the controller. In still yet another embodiment, the setting step 410 includes calculating a MCRT, in order to and/or in accordance with, minimizing the number of retries of the executing step 430 in the receiving device.

In one embodiment of method 400, method 400 also includes setting a
30 guaranteed command response time (GCRT). In another embodiment of method 400,

the method also includes receiving the guaranteed command response time. In another embodiment of method 400, the method also includes determining that the GCRT is greater than the maximum command response time sending an indication of an erroneous guaranteed command response time.

5 Referring next to FIG. 5, a block diagram of a method 500 for reducing pauses in input/output of a disc drive of the present invention, according to an embodiment of the present invention, is shown.

The method includes detecting errors 510 in read or written data of a mass storage device. In one embodiment, the mass storage device is a disc drive.

10 Thereafter, the firmware of the mass storage device will attempt to correct these errors either by means of self-correcting error code correction techniques 520 and/or by reading/writing the data again 530. If the error persists 540, the mass storage device will proceed to retry the sectors 550 until the mass storage device succeeds in reading/writing, or until it has exhausted a MCRT 560 and then report the error to the
15 host 570.

Referring next to FIG. 6, a block diagram of an apparatus 600 for reducing pauses in input/output of a mass storage device, according to an embodiment of the present invention, is shown. In one embodiment, the apparatus 600 is a mass storage drive. In another embodiment, the mass storage drive is a disc drive.

20 The apparatus 600 includes a mass storage medium 610 for recording data. Time-critical data stored 630 on the medium 610 is differentiated, segregated and/or identified from data stored on the disc that is not time-critical. In one embodiment, time-critical data is AV data. The purpose of storing time-critical data 630 differently than the non-time-critical data is to enable the data of different time-criticality to be
25 treated differently, according to the expectations of a host device/receiving device 640. In one embodiment, the differentiation, segregation and/or identification of the time-critical data from non-time critical data is implemented through partitioning.

The mass storage medium 610 is operably coupled to a controller 620 for managing time-critical differentiated data 630 on the medium 620. The controller
30 620 in the apparatus 600 receives a command 650 from the host/receiving device 640.

In one embodiment where the command 650 is a write command, the time-critical data 630 is also received from the host/receiving device 640 by the controller 620 in the apparatus 600. In another embodiment, the apparatus 600 receives a MCRT (not shown) at the controller 620 and the controller will stop execution of the command 5 650 if the execution indicates errors and the time that the execution has transpired exceeds the time boundaries indicated by the MCRT. In yet another embodiment, the MCRT is received from the host/receiving device 640.

Referring next to FIG. 7, a block diagram of the controller 700 in apparatus 600 for reducing pauses in input/output of a mass storage device, according to an 10 embodiment of the present invention, is shown.

The controller includes a receiver of a MCRT 710. In one embodiment, the MCRT is contained in the command 650 in FIG. 6. Controller 700 also includes a receiver of the mass storage command 720. The receiver of the mass storage command 720 is associated with the time-critical data 630 in FIG. 6. Controller 700 15 also includes an executor 730 of the mass storage command. The executor 730 is operably coupled to the receiver of the disc command 720. The controller 700 also includes a comparator 740 of the maximum command response time to an elapsed time of the execution of the mass storage command, 650 in Fig. 6.

The system 700 components can be embodied as computer hardware circuitry 20 or as a computer-readable program, or a combination of both.

More specifically, in the computer-readable program embodiment, the programs can be structured in an object-orientation using an object-oriented language such as Java, Smalltalk or C++, and/or the programs can be structured in a procedural-orientation using a procedural language such as COBOL or C. The 25 software components communicate in any of a number of means that are well-known to those skilled in the art, such as application program interfaces (A.P.I.) or interprocess communication techniques such as remote procedure call (R.P.C.), common object request broker architecture (CORBA), Component Object Model (COM), Distributed Component Object Model (DCOM), Distributed System Object 30 Model (DSOM) and Remote Method Invocation (RMI). The components execute on

as few as one computer as in computer 2000 in FIG. 8 below, or on at least as many computers as there are components.

FIG. 8 is a schematic view of a computer system. Advantageously, the invention is well-suited for use in a computer system 2000. The computer system 2000 may also be called an electronic system or an information handling system and includes a central processing unit, a memory and a system bus. The information handling system includes a central processing unit 2004, a random access memory 2032, and a system bus 2030 for communicatively coupling the central processing unit 2004 and the random access memory 2032. The information handling system 2002 includes a disc drive. The disc drive includes means for controlling the disc in reference to a MCRT. The MCRT is received either from the central processing unit 2004 through the bus 2030, or the MCRT is generated by the disc. The information handling system 2002 may also include an input/output bus 2010 and several devices peripheral devices, such as 2012, 2014, 2016, 2018, 2020, and 2022 may be attached to the input output bus 2010. Peripheral devices may include hard disc drives, magneto optical drives, floppy disc drives, monitors, keyboards and other such peripherals. Any type of disc drive may use the methods for reducing pauses in input/output of a disc drive as described above.

Conclusion

In conclusion, an information handling system, such as a disc drive 100, includes a base 112, a disc stack rotatably attached to the base 112, a controller 620 coupled to the disc drive 100, and an actuator assembly 120 movably attached to the base 112. The controller 620 contains computer-executable instructions in which a maximum command response time is received from a master or host 640 that defines the longest amount of time within which the disc drive 100 will attempt to perform input/output operations 650, such as a read instruction, for time-critical data 630, such as audio and/or video data stream. In the absence of performing input/output operation 650 within the maximum command response time, the controller 620 will abandon the operation 650. Abandoning the operation 650 prevents a discontinuity of

the data stream 630 that is deemed by a user to be undesirable. The maximum command response time can be set by the controller 620, or by the host 640 according to a variety of criteria, such as minimizing the size of the receiving buffer 310 for a read operation or minimizing a chance of error in execution 330 of the input/output operation. Lastly, a guaranteed command response time is used to determine when the maximum command response time is erroneously less than the guaranteed command response time and report an error accordingly.

Methods for reducing pauses in input/output of a disc drive 100 is disclosed. One method includes setting a MCRT 410, receiving 420 a disc command 650 associated with time-critical data 630. In one embodiment of the method, the time-critical data 630 is audio/visual data. The method also includes executing 430 the disc command 650 and monitoring, or comparing the MCRT to, the elapsed time of the executing of the disc command 440 while the disc is executing the command 650. Another embodiment of the method includes stopping execution of the disc command 650 when the elapsed time 740 exceeds the MCRT 450. One embodiment of receiving a disc 420 command 650 includes receiving a disc command 650 associated with time-critical data 630 from a host 640. In varying embodiments, receiving 420 the command 650 is performed before, during and/or after setting 410 the MCRT. Yet another embodiment of receiving 420 includes receiving a disc command 650 associated with time-critical data 630, the disc command 650 further includes the MCRT. In yet another embodiment of the method, the disc command 650 further comprises a read disc command, executing 430 includes executing the read disc command, yielding read data; and the method also includes transmitting the read data to a receiving device 640. One embodiment of transmitting includes transmitting the read data to a host.

One embodiment of setting 410 includes calculating a MCRT in accordance with optimization of a size of a buffer associated with the read data in the receiving device 310. Another embodiment of setting 410 includes calculating a MCRT in accordance with minimizing a number of retries of the execution 320. One embodiment of optimization 310 includes minimization. Yet another embodiment of

setting 410 includes setting a MCRT in accordance with minimizing a chance of error 330 in the execution 430.

Still another embodiment of the method includes calculating the size of a buffer associated with the read data in the receiving device 340.

5 In still yet another embodiment of the method, the executing 430 includes executing the disc command by a disc and the method further includes receiving an indication of an error of the executing 430. Furthermore, where the MCRT is greater than the elapsed time associated with execution of the disc command 650, no indication of an error of the execution exists.

10 A further embodiment of the method includes receiving an indication of an error of the execution. A still further embodiment of the method includes setting a guaranteed command response time (GCRT). An alternative embodiment of the method includes receiving the GCRT. In yet another alternative embodiment includes determining that the GCRT is greater than the MCRT and sending an
15 indication of an erroneous GCRT.

Another method for reducing pauses in data input and output of a disc drive 100 includes receiving 210 from a host 640, a disc read command 650 associated with audio/visual data 630 in which the command 650 includes a MCRT. The method also includes executing 220 the disc read command 650, yielding read data. The method
20 also includes comparing 230 the elapsed time of the execution of the disc read command 650 while the disc command 650 is executed, stopping execution 240 of the command 650 when the elapsed time exceeds the MCRT, and transmitting 260 successfully read data 630 to the host 640.

In one embodiment, the method includes calculating a MCRT in accordance
25 with minimizing 310 the size of a buffer size associated with the read data in the host 640. In another embodiment, the method includes calculating a MCRT in accordance with minimizing 320 the number of retries of the executing. In yet another embodiment, the method includes setting a MCRT in accordance with minimizing 330 a chance of error in the execution. In still another embodiment, the method
30 includes calculating the size of a buffer associated with the read data in the host 340.

In another aspect of the invention, an information handling system 2000 includes a disc and a means for controlling the disc in reference to a MCRT.

5 In yet another aspect of the invention, an apparatus 600 includes a mass storage medium 610 and a controller 620 operably coupled to the mass storage medium 610 for managing time-critical differentiated data on the mass storage medium. The controller 620 includes a receiver of a MCRT 710, a receiver 720 of a mass storage command 650 associated with time-critical data 630, an executor 730 the mass storage command 650, operably coupled to the receiver 720 of the disc command, and a comparator of the MCRT to an elapsed time of the execution of the
10 mass storage command 720.

It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full
15 scope of equivalents to which such claims are entitled.



What is claimed is:

1. A method for reducing pauses in data input and output of a disc drive, the method comprising the steps of:

- 5 (a) setting a maximum command response time;
- (b) receiving a disc command associated with time-critical data;
- (c) executing the disc command; and
- (d) monitoring the elapsed time of the executing of the disc command while the step of (c) executing the disc command is performed.

10 2. The method of claim 1, wherein the time-critical data is audio/visual data.

3. The method of claim 1, wherein the method further comprises step:

- 15 (e) stopping execution of the disc command when the elapsed time exceeds the maximum command response time.

4. The method of claim 1, wherein the receiving step (b) further comprises:

- (b)(i) receiving a disc command associated with time-critical data from a host.

20 5. The method of claim 1, wherein the receiving step (b) is performed before the setting step (a).

6. The method of claim 5, wherein the receiving step (b) further comprises:

- 25 (b)(i) receiving a disc command associated with time-critical data, the disc command further comprises the maximum command response time.

7. The method of claim 1, wherein

the disc command further comprises a read disc command;

30 the executing step (c) comprises:



(c)(i) executing the read disc command, yielding read data; and
the method further comprises:

(f) transmitting the read data to a receiving device.

5 8. The method of claim 7, wherein the transmitting step (f) further comprises
(f)(i) transmitting the read data to a host.

9. The method of claim 7, wherein the setting step (a) further comprises:
(a)(i) calculating a maximum command response time in accordance with
10 optimization of a size of a buffer associated with the read data in the
receiving device.

10. The method of claim 7, wherein the setting step (a) further comprises:
(a)(i) calculating a maximum command response time in accordance with
15 minimizing a number of retries of the executing step (c).

11. The method of claim 7, wherein the method further comprises:
(g) calculating the size of a buffer associated with the read data in the
receiving device.

20 12. The method of claim 1, wherein:
the executing step (c) further comprises:

(c)(i) executing the disc command by a disc; and
the method further comprises:
25 (e) receiving an indication of an error of the executing step (c).

13. The method of claim 12, wherein the maximum command response time is
greater than the elapsed time associated with the step (c) executing the disc command,
and in which there is no indication of an error of the executing step (c).

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14. The method of claim 1, wherein the method further comprises:
(e) receiving an indication of an error of the executing step (c).
15. The method of claim 1, wherein the setting step (a) further comprises:
5 (a)(i) setting a maximum command response time in accordance with
minimizing a chance of error in the executing step (c).
16. The method of claim 1, wherein the method further comprises:
(e) setting a guaranteed command response time.
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17. The method of claim 16, wherein the method further comprises:
(f) determining that the guaranteed command response time is greater
than the maximum command response time; and
(g) sending an indication of an erroneous guaranteed command response
15 time.
18. An information handling system comprising:
a disc; and
means for controlling the disc in reference to a maximum command response
20 time.
19. A mass storage drive comprising:
a mass storage medium; and
a controller operably coupled to the mass storage medium for managing time-
25 critical differentiated data on the mass storage medium.
20. The mass storage drive of claim 19, wherein the controller further comprises:
a receiver of a maximum command response time;
a receiver of a mass storage command associated with time-critical data;



an executor of the mass storage command, operably coupled to the receiver of
the disc command; and
a comparator of the maximum command response time to an elapsed time of
the executing of the mass storage command.