

INFORMATION STORAGE MEDIUM ON WHICH DRIVE DATA IS RECORDED

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Technical Field

The present invention relates to an information storage medium on which drive data is recorded, and a method of recording data on the information storage medium.

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Background Art

Recordable optical disks (e.g., 4.7GB DVD-RAM) are designed so that, after one disk is inserted into a drive, information is recorded about the drive used. For example, the information can be about the
15 manufacturer of the drive or the serial number of the drive. The recorded drive data is recorded in a disk identification zone, which is a recordable data zone in a lead-in area of the disk. Similarly, in recordable high definition digital versatile disks (HD-DVDs) having a recording capacity of 20GB or greater, the lead-in area needs to include
20 a drive zone having a plurality of physical clusters in order to record the drive data.

Accordingly, an optimal method of recording drive data on a new format of an information storage medium needs to be proposed.

25 Disclosure of the Invention

The present invention provides a method of adaptively recording drive data on an information storage medium with a new structure, and more particularly, an information storage medium in which drive-related data is recorded in a drive zone having a plurality of physical clusters or
30 ECC blocks, and new drive data is recorded in a physical cluster or ECC

block directly next to the recently-recorded physical cluster or ECC block, and a method of recording data in the information storage medium.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

According to an aspect of the present invention, an information storage medium includes a drive zone for recording disk drive data to be recorded in a plurality of physical clusters or ECC blocks, wherein newer drive data is recorded in a second physical cluster or ECC block adjacent a first physical cluster or ECC block containing a most recently recorded drive data recorded prior to the recording of the newer drive data.

According to an aspect of the invention, every time new drive data is to be recorded, previous drive data is also recorded in the second physical cluster or ECC block.

According to another aspect of the invention, identical drive data is recorded in a set of physical clusters or ECC blocks that are sequentially grouped in order of a layout of the physical clusters.

According to a further aspect of the invention, valid drive data and copy drive data are recorded in two sequential reliable, effective physical clusters or ECC blocks, respectively.

According to an additional aspect of the invention, the addresses of the physical clusters or ECC blocks are recorded in an area for recording information related to defect management, in an area for recording recording-related information, or in an area for recording disk-related information.

According to another aspect of the present invention, a method of recording drive data on an information storage medium includes recording first drive data in one of a plurality of physical clusters or ECC blocks which comprise a drive zone, and next recording new drive data in another physical cluster or ECC block directly adjacent to the one

physical cluster or ECC block containing the most recently recorded drive data.

Brief Description of the Drawings

5 FIG. 1 shows the data structure of a lead-in area or a lead-out area of a disk related to the present invention;

 FIG. 2A shows an information storage medium according to an embodiment of the present invention;

 FIG. 2B is a table showing a method of recording the address of a
10 drive zone on the information storage medium of FIG. 2A;

 FIG. 3A shows an information storage medium according to another embodiment of the present invention and a method of recording data on the information storage medium;

 FIG. 3B is a table showing a method of recording the address of a
15 drive zone on the information storage medium of FIG. 3A;

 FIG. 4 shows a defective drive zone in the information storage medium of FIG. 3A; and

 FIG. 5 is a block diagram of a recording apparatus according to an embodiment of the present invention.

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Best mode for carrying out the Invention

 Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like
25 elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

 FIG. 1 shows an example of the physical structure of a lead-in area which covers an area within a predetermined radius from the central hole of a disk 1000. The lead-in area includes a reproduction-only zone
30 100, in which data is pre-recorded, and a recordable zone 110. The reproduction-only zone 100 stores control data associated with the disk

1000. The recordable zone 110 includes a defect management area (DMA) 1 for processing and managing defects generated in a disk, a control data zone 2, an optimum power control (OPC) test zone 3, and a buffer zone 5.

5 The recordable zone 110 further includes a drive zone 10 in which drive data is recorded according to an aspect of the invention. The drive zone 10 includes a plurality of physical clusters or ECC blocks 10-0 through 10-n shown in FIG. 2A. Each of the physical clusters or ECC blocks 10-0 through 10-n includes a plurality of sectors or data frames.
10 The drive zone 10 having this structure stores drive data, such as information about the manufacturer of a used drive, the serial number of the drive, and the like.

 In an information storage medium 1000 according to the present invention, new drive data is recorded in a physical cluster or ECC block
15 directly next to a physical cluster or ECC block in which previous data has been recorded. The drive zone 10 can also be located in an area other than a user data area of the disc 1000. For example, the drive zone 10 can be provided in a lead-in area or a lead-out area of the disc 1000.

20 As shown in FIG. 1, the lead-in area (or lead-out area) of the information storage medium 1000 includes the reproduction-only zone 100 and the recordable zone 110. The reproduction-only zone 100 stores basic information about a disk in the form of pits or a high frequency groove wobble. The reproduction-only zone 100 stores the
25 size, version number, and recording conditions of the disk. The recordable zone 110 includes the DMA 1, the control data zone 2, the OPC test zone 3, a drive zone, and the buffer zone 5. The drive zone 10 stores drive-related information in the recordable zone 110.

 Referring to FIG. 2A, a drive zone 10 in an information storage
30 medium 1000 according to an embodiment of the present invention includes (n+1) physical clusters or ECC blocks comprising a zero-th

physical cluster or ECC block 10-0 through an n-th physical cluster or ECC block 10-n. Each physical cluster or each ECC block 10-0 through 10-n includes a plurality of sectors or frames according to aspects of the invention. For convenience, reference will be made only to physical
5 clusters.

Zero-th drive data 15-0, which is first used, is recorded in the zero-th physical cluster 10-0. After the recording of the zero-th drive data, any remaining unrecorded area is filled with dummy data. Next, if data is recorded or reproduced by a new drive (i.e., a first drive), first
10 drive data 15-1 about the new drive is recorded in a first physical cluster 10-1 following the zero-th physical cluster 10-0. The first drive data 15-1 is recorded in the first physical cluster 10-1. The zero-th drive data 15-0 which is recorded in the zero-th physical cluster 10-0 is copied and is also recorded in the first physical cluster 10-1.

15 Similarly, if another new drive, which is a second drive, is used to execute recording, second drive data 15-2, which is data about the second drive, is recorded in a second physical cluster 10-2 following the first physical cluster 10-1 where the last data 15-1 has been recorded. The most recently recorded drive data, the second drive data 15-2, is
20 recorded at the head of the second physical cluster 10-2. The first and zeroth drive data 15-1 and 15-0, which have already been recorded, are copied and sequentially recorded next to the second drive data 15-2.

As described above, every time new drive data is recorded, previously-recorded drive data is recorded again so that the history of the
25 previous drive data is known. Recent drive data is recorded at the head of a physical cluster, and the previously-recorded drive data is copied and recorded next to the recent drive data. Accordingly, reproduction of all physical clusters containing previously-recorded drive data is not required since all of the drive data can be recognized by reproducing
30 only the physical cluster containing the most recent recorded drive data. Thus, the drives used can be efficiently managed. However, it is

understood that other arrangements of drive data can be made in order to manage the drives without departing from the spirit of the invention.

According to an aspect of the invention, an address of a physical cluster 10-0 through 10-n, which contains the most recently recorded drive data, is recorded in an area separate from the drive zone 10. As shown in FIG. 2B, the address of a physical cluster or ECC block 10-0 through 10-n, which contains the most recently recorded drive data, can be recorded in a predetermined area of the disc 1000. More specifically, the address of an area containing the most recently recorded drive data can be recorded in the DMA 1, which includes data about defect management, in an area containing recording-related data (e.g., a recording speed, a recording pulse, recording power, etc.), or in an area containing disk-related data (e.g., the type, version number, size, and number of layers of a disk). The area containing recording-related data or disk-related data may be the control data zone 2 of FIG. 1.

As shown in FIG. 2B, the address of a physical cluster or ECC block 10-0 through 10-n, which contains the most recently recorded drive data is recorded at a predetermined byte of a data frame included in the area containing recording-related data or disk-related data. Every time new drive data is recorded in a predetermined area, the physical address of the area containing the new drive data may be recorded at a byte different from the byte where the physical address of the area containing the previous drive data has been recorded, or may be overwritten at the byte where the physical address of the area containing the previous drive data has been recorded.

An information storage medium according to another embodiment of the present invention and a method of recording data thereon will now be described with reference to FIGS. 3A and 3B. In the data recording method, if a drive zone 10, where drive data is recorded, has unreliable physical clusters 10-0 through 10-n due to continuous or discontinuous generation of defects in the physical clusters or ECC blocks 10-0 through

10-n, the drive data is recorded in only the reliable, effective ones of the physical clusters 10-0 through 10-n in order of the layout of physical clusters 10-0 through 10-n. The drive data can be recorded in such a way that one drive datum is recorded on one physical cluster or ECC
5 block in sequence 10-0 through 10-n. Alternatively, to increase reliability, the same drive data can be recorded in a set of consecutive physical clusters or ECC blocks 10-0 through 10-n.

In case the drive data is damaged and cannot be used, identical data is recorded in at least two physical clusters or ECC blocks 10-0
10 through 10-n. Referring to FIG. 3A, for example, two physical clusters or ECC blocks 10-0 through 10-n are used to record the same drive data. Hereinafter, for the sake of simplicity, reference will be made only to physical clusters.

For example, zeroth valid drive data 20-0 is recorded in the zeroth
15 physical cluster 10-0 of an area for recording drive data. A zeroth copy drive data 21-0, which is a copy of the zeroth valid drive data 21-0, is recorded in the first physical cluster 10-1. If new first valid drive data 20-1 is recorded, the new first valid drive data 20-1 is recorded in the second physical cluster 10-2 following the first physical cluster 10-1,
20 which contains the most recently recorded copy drive data 21-0 (i.e., the zeroth copy drive data 21-0). The previously-recorded drive data (i.e., the zeroth valid drive data 20-0) is then recorded in the second physical cluster 10-2. First copy drive data 21-1, which is a copy of the first valid drive data 20-1, is recorded in the third physical cluster 10-3. As
25 described above, every time drive data is updated, valid drive data and copy drive data can be recorded in the aforementioned way.

The addresses of physical clusters, where valid drive data and copy drive data are recorded using a drive data recording method according to an embodiment of the present invention, are recorded and
30 managed in a predetermined area separate from the drive zone 10. For example, the address of the area containing the last valid drive data and

the address of the area containing the last copy drive data can be recorded at a predetermined byte in a data frame of the DMA 1, in a data frame of the area containing recording-related data, or in a data frame of the area containing disk-related data. Each of the areas containing recording-related data and disk-related data may be the control data zone 2 of FIG. 1.

The above description sets forth a case where all of the physical clusters or ECC blocks 10-0 through 10-n of a drive zone 10 are effective. However, a case may exist where ones of the physical clusters or ECC blocks 10-0 through 10-n are consecutively or discontinuously damaged or have defects. Accordingly, drive data recorded therein is not reliable. In this case, the drive data needs to be recorded in only reliable, effective ones of the physical clusters or ECC blocks 10-0 through 10-n.

FIG. 4 schematically shows a drive zone comprised of $n+1$ physical clusters, in which some damaged unreliable physical clusters 10-0, 10-1, 10-3, 10-5, 10-6, and 10-($n-1$) are indicated using hashing. Referring to FIG. 4, the zeroth and first physical clusters 10-0 and 10-1 are damaged, the second physical cluster 10-2 is effective, the third physical cluster 10-3 is damaged, and the fourth physical cluster 10-4 is effective. In this case, valid drive data and corresponding copy drive data are recorded in the second and fourth reliable, effective physical clusters 10-2 and 10-4, respectively. Also, copy drive data and valid drive data are recorded in effective seventh and eighth physical clusters 10-7 and 10-8, respectively. It is understood that the above method is useable if no copy drive data is used, such as in the embodiment set forth above with reference to FIG. 2A.

As described above, drive data is recorded in only reliable physical clusters, which are not damaged, in order of the physical cluster layout of a drive zone 10. Preferably, the same drive data is recorded in two sequential, reliable physical clusters. As shown in FIG. 4, if the zeroth and first physical clusters 10-0 and 10-1 are damaged and

unusable, the second physical cluster 10-2 is reliable, and the third physical cluster 10-3 is also unusable, drive data is recorded in reliable physical clusters in order of the layout of the physical clusters. Here, the drive data corresponds to a pair of valid drive data and copy drive data.

5 In FIG. 4, "0" denotes recording of drive data in two sequential reliable, effective physical clusters.

As also noted above, the recording method is equally applicable to a drive zone 10 which includes ECC blocks instead of physical clusters.

10 FIG. 5 is a block diagram of a recording apparatus according to an embodiment of the present invention. Referring to FIG. 5, the recording apparatus includes a recording/reading unit 1001, a controller 1002, and a memory 1003. The recording/reading unit 1001 records data on a disc 1000, which is an embodiment of an information storage medium 1000 of the present invention, and reads the data from the disc 1000.

15 The controller 1002 records and manages drive data according to the present invention as set forth above in relation to FIGs. 1 through 4.

While not required in all aspects, it is understood that the controller 1002 can be computer implementing the method using a computer program encoded on a computer readable medium. The computer can be implemented as a chip having firmware, or can be a general or special purpose computer programmable to perform the method.

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In addition, it is understood that, in order to achieve a recording capacity of several dozen gigabytes, the recording/reading unit 1001 could include a low wavelength, high numerical aperture type unit usable to record dozens of gigabytes of data on the disc 1000. Examples of such units include, but are not limited to, those units using light wavelengths of 405 nm and having numerical apertures of 0.85, those units compatible with Blu-ray discs, and/or those units compatible with

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Advanced Optical Discs (AOD). Examples of other write once discs include CD-R and DVD-R.

Industrial Applicability

5 The present invention provides a new drive data recording method which is applicable to a new format of an information storage medium. The new drive data recording method can be effectively applied not only to recordable information storage media, but also to write-once information storage media. In write-once information storage
10 media, each physical cluster or ECC block records data once. Accordingly, when new drive data is recorded in a write-once information storage medium, it cannot be recorded in a previously-recorded physical cluster or ECC block but only in a physical cluster or ECC block directly next to the physical cluster or ECC block where the last drive data has
15 been recorded. Therefore, the recording method according to the present invention is suitable for write once recording media. As such, the method could be applied to CD-R, DVD-R, and next generation high definition DVDs, such as Blu-ray discs and Advanced Optical Discs (AODs).

20 In recordable information storage media, new drive data is recorded in an area where the last drive data has been recorded. Hence, even if only the area containing the last drive data is reproduced, drive data can be effectively managed.

 Although a few embodiments of the present invention have been
25 shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. An information storage medium comprising a drive zone comprising physical clusters or error correction code (ECC) blocks for use by an apparatus for managing drive data related to a drive or drives
5 with which data have been recorded on the information storage medium, the physical clusters or ECC blocks comprising:
 - a first one of the physical clusters or ECC blocks in which is recorded first disk drive data related to a first drive which recorded and/or reproduced data with respect to the information storage medium, and
10 a second one of the physical clusters or ECC blocks in which is recorded new second drive data, the new second drive data being recorded in the second physical cluster or ECC block adjacent to the first physical cluster or ECC block which contains the first drive data,
wherein the first drive data is the drive data most recently
15 recorded as compared to the second drive data.
2. The information storage medium of claim 1, wherein the second physical cluster or ECC block further comprises the first drive data in addition to the second drive data.
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3. The information storage medium of claim 1 or 2, wherein the physical clusters or ECC blocks further comprise a first copy physical cluster or ECC block which sequentially follows the first physical cluster or ECC block in order of a layout of the physical clusters or ECC
25 blocks,
 - a copy of the first drive data is recorded in the first copy physical cluster or ECC block, and
the second physical cluster or ECC block is adjacent a set of physical clusters or ECC comprising the first physical cluster or ECC
30 block and the first copy physical cluster or ECC block.

4. The information storage medium of claim 3, wherein:
the first drive data is valid,
the first physical cluster or ECC block and the first copy physical
cluster or ECC block include, respectively, the first valid drive data and
5 the first copy drive data, and
the first physical cluster or ECC block and the first copy physical
cluster or ECC block are two sequential reliable, effective ones of the
physical clusters or ECC blocks.
- 10 5. The information storage medium of claim 1 or 2, further
comprising an address of the first or second physical cluster or ECC
block recorded in an area of the information storage medium other than
the drive zone.
- 15 6. The information storage medium of claim 5, wherein the
address of the first or second physical cluster or ECC block is recorded
in an area where information related to defect management is recorded.
- 20 7. The information storage medium of claim 5, wherein the
address of the first or second physical cluster or ECC block is recorded
in an area where recording-related information is recorded.
- 25 8. The information storage medium of claim 5, wherein the
address of the first or second physical cluster or ECC block is recorded
in an area where disk-related information is recorded.
- 30 9. The information storage medium of claim 1 or 2, further
comprising a user data area in which user data is to be recorded,
wherein the drive zone is included in an area other than the user data
area.

10. The information storage medium of claim 9, further comprising a lead-in area having a recordable area, wherein the drive zone is included in the recordable zone of the lead-in area.

5 11. The information storage medium of claim 1 or 2, wherein:
additional drive data identical to the first or second drive data is recorded in a set of physical clusters or ECC blocks which includes the corresponding one of the first and second physical clusters or ECC blocks, and

10 the set comprises sequentially grouped physical clusters or ECC blocks in order of a layout of the physical clusters or ECC blocks within the drive zone.

15 12. The information storage medium of claim 11, wherein:
the first or second drive data is valid,
the additional drive data is a copy of the valid first or second drive data,
the valid first or second drive data and copied additional drive data are recorded in two sequential reliable, effective physical clusters or ECC
20 blocks, respectively, and
the two sequential reliable, effective physical clusters or ECC blocks include the corresponding one of the first and second physical clusters or ECC blocks.

25 13. A recording and/or reproducing apparatus for use with a recording medium, comprising:
an optical pickup to record and/or reproduce data with respect to the recording medium; and

a controller to control the optical pickup to record and/or reproduce the data, and, where the data is to be recorded on the recording medium and a first physical cluster or error correction code (ECC) block in a drive zone of the recording medium indicates that
5 previously recorded data was recorded using a different apparatus, to record new drive data related to the apparatus in an adjacent second physical cluster or ECC block of the drive zone.

14. The apparatus of claim 13, wherein the first physical cluster
10 or ECC block further indicates that other previously recorded data was recorded using another different apparatus.

15. The apparatus of claim 14, wherein another physical cluster or ECC block adjacent the first physical cluster or ECC block indicates
15 that the other previously recorded data was recorded using the another different apparatus.

16. The apparatus of claim 13, wherein the controller further copies different drive data related to the different apparatus from the first
20 physical cluster or ECC block into the second physical cluster or ECC block such that the second physical cluster or ECC block includes the new drive data and the different drive data.

17. The apparatus of claim 13, wherein:
25 the drive zone comprises multiple physical clusters or ECC blocks including the first and second physical clusters or blocks, and
the controller, prior to recording the new drive data in the second physical cluster or ECC block and if one of the physical clusters or ECC blocks having a next sequential address to the first physical cluster or
30 ECC block is not writeable, further

detects a next most adjacent one of the physical clusters or ECC blocks which is writeable to be designated as the second physical cluster or ECC block, and

5 records the new drive data into the designated second physical cluster or ECC block such that no drive data is recorded in the one physical cluster or ECC block which is not writeable disposed between the first and second physical clusters or ECC blocks.

18. The apparatus of claim 13, wherein:

10 the drive zone comprises multiple physical clusters or ECC blocks including the first and second physical clusters, and

the controller further copies the new drive data into a third physical cluster or ECC block adjacent the second physical cluster or ECC block such that the second and third physical clusters or ECC blocks contain
15 identical information.

19. The apparatus of claim 18, wherein the controller, prior to recording the new drive data in the second and third physical clusters or ECC blocks and if one of the physical clusters or ECC blocks having a
20 next sequential address to the second physical cluster or ECC block is not writeable, further

detects a next most adjacent one of the physical clusters or ECC blocks which is writeable to be designated as the third physical cluster or ECC block, and

25 records the copied new drive data into the designated third physical cluster or ECC block such that no drive data is recorded in the one physical cluster or ECC block which is not writeable disposed between the second and third physical clusters or ECC blocks.

20. The apparatus of claim 13, wherein the controller records an address of the first or second physical cluster or ECC block in an area of the recording medium other than the drive zone.

5 21. The apparatus of claim 20, wherein the area in which the address is recorded is an area in which information about defect management is recorded.

10 22. The apparatus of claim 20, wherein the area in which the address is recorded is an area in which recording-related information is recorded.

15 23. The apparatus of claim 20, wherein the area in which the address is recorded is an area in which recording medium-related information is recorded.

24. The apparatus of claim 13, wherein:
the recording medium further includes a lead-in area having a recordable zone, and
20 the drive zone is included in a recordable zone of the lead-in area.

25. A computer readable medium encoded with processing instructions for implementing a method of recording drive data on a recording medium performed by a computer of an apparatus, the method
25 comprising

 determining if a first physical cluster or error correction code (ECC) block in a drive zone of the recording medium indicates that previously recorded data was recorded on the recording medium using a different apparatus; and
30 recording new drive data related to the apparatus in an adjacent second physical cluster or ECC block of the drive zone.

26. The computer readable medium of claim 25, wherein the first physical cluster or ECC block further indicates that other previously recorded data was recorded using another different apparatus.

5 27. The computer readable medium of claim 26, wherein another physical cluster or ECC block adjacent the first physical cluster or ECC block indicates that the other previously recorded data was recorded using the another different apparatus.

10 28. The computer readable medium of claim 25, wherein the method further comprises copying different drive data related to the different apparatus from the first physical cluster or ECC block into the second physical cluster or ECC block such that the second physical cluster or ECC block includes the new drive data and the different drive
15 data.

 29. The computer readable medium of claim 25, wherein:
 the drive zone comprises multiple physical clusters or ECC blocks including the first and second physical clusters or blocks, and
20 the method further comprises, prior to recording the new drive data in the second physical cluster or ECC block and if one of the physical clusters or ECC blocks having a next sequential address to the first physical cluster or ECC block is not writeable,
 detecting a next most adjacent one of the physical clusters
25 or ECC blocks which is writeable to be designated as the second physical cluster or ECC block, and
 recording the new drive data into the designated second physical cluster or ECC block such that no drive data is recorded in the one physical cluster or ECC block which is not writeable disposed
30 between the first and second physical clusters or ECC blocks.

30. The computer readable medium of claim 29, wherein:
the drive zone comprises multiple physical clusters or ECC blocks including the first and second physical clusters, and
the method further comprises copying the new drive data into a
5 third physical cluster or ECC block adjacent the second physical cluster or ECC block such that the second and third physical clusters or ECC blocks contain identical information.

31. The computer readable medium of claim 30, wherein the
10 method further comprises, prior to recording the new drive data in the second and third physical clusters or ECC blocks and if one of the physical clusters or ECC blocks having a next sequential address to the second physical cluster or ECC block is not writeable,
detecting a next most adjacent one of the physical clusters or
15 ECC blocks which is writeable to be designated as the third physical cluster or ECC block, and
recording the copied new drive data into the designated third physical cluster or ECC block such that no drive data is recorded in the one physical cluster or ECC block which is not writeable disposed
20 between the second and third physical clusters or ECC blocks.

32. The computer readable medium of claim 25, wherein the method further comprises recording an address of the first or second physical cluster or ECC block in an area of the recording medium other
25 than the drive zone.

33. The computer readable medium of claim 32, wherein the area in which the addresses are recorded is an area in which information about defect management is recorded.

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34. The computer readable medium of claim 32, wherein the area in which the addresses are recorded is an area in which recording-related information is recorded.

5 35. The computer readable medium of claim 32, wherein the area in which the addresses are recorded is an area in which recording medium-related information is recorded.

10 36. The computer readable medium of claim 25, wherein:
the recording medium further includes a lead-in area having a recordable zone, and
the drive zone is included in a recordable zone of the lead-in area.