CLAIMS

1. A data storage system comprising:

at least one storage drive;

a determination circuit configured to, based on an attribute of first data, determine whether to write first data to (i) a first portion of the at least one storage drive, or (ii) a second portion of the at least one storage drive, wherein the first portion comprises a plurality of magnetic recording zones, wherein the plurality of magnetic recording zones comprise (i) a first zone, and (ii) a second zone that overlaps the first zone, wherein the second portion comprises a plurality of non-overlapping storage zones or solid-state memory, and wherein the second portion does not include overlapping magnetic recording zones; and

a control circuit configured to, based on the determination, either write (i) the first data to the first portion in a first log structured manner, or (ii) write the first data to the second portion in a random access manner or a second log structured manner.

2. The data storage system according to claim 1, wherein the control circuit is configured to write the first data to the second portion in the random access manner.

3. The data storage system according to claim 1, wherein the control circuit is configured to write the first data to the first portion in the first log structured manner, which comprises:

writing the first data in a form of a circular log in the first portion, wherein the circular log includes a header and an end defining the first data written to the first portion; and

appending new data to the header of the circular log, wherein the appending of the new data moves the header toward the end of the circular log.

4. The data storage system according to claim 3, further comprising: a marking circuit configured to mark unwanted old data stored in the first portion.

5. The data storage system according to claim 4, wherein the control circuit in writing the first data to the first portion in the first log structured manner controls the writing of the new data over some of the old data by (i) appending unmarked portions of the old data to the header, and (ii) removing marked portions of the old data.

6. The data storage system according to claim 1, wherein attribute is a type of the first data, a size of the first data, or an access frequency of the first data.

7. The data storage system according to claim 1, wherein the determination circuit is configured to determine whether to write the first data to the first portion or the second portion based on whether old data relevant to the first data is located in the first portion or the second portion.

8. The data storage system according to claim 1, further comprising: an access monitor circuit configured to monitor an access pattern of the first data to and from the first portion and the second portion.

9. The data storage system according to claim 8, further comprising: a file migration circuit configured to move the first data between the first portion and the second portion based on the access pattern.

10. The data storage system according to claim 1, wherein the determination circuit is configured to determine whether the first data is file data or file system metadata.

11. The data storage system according to claim 10, wherein the control circuit is configured to (i) write the first data to the first portion if the determination circuit determines the first data is file data, and (ii) write the first data to the second portion if the determination circuit determines the first data is file system metadata.

12. The data storage system according to claim 1, wherein:

the second portion comprises the solid-state memory;

the first data is file system metadata; and

the solid-state memory is configured to store the file system metadata.

13. The data storage system according to claim 12, wherein:

the control circuit is configured to store the file system metadata in the solid-state memory in a form of a tree structure;

the tree structure comprises a plurality of nodes; and

each of the plurality of nodes comprises metadata information of a program file or a directory.

14. The data storage system according to claim 12, wherein the control circuit is configured to write the file system metadata in the second portion at periodic intervals.

15. The data storage system according to claim 1, wherein the second portion comprises the plurality of non-overlapping storage zones.

16. The data storage system according to claim 15, wherein a first zone of the plurality of non-overlapping storage zones is separated from a second zone of the plurality of non-overlapping storage zones by an inter-zone gap.

17. A storage array comprising:

the data storage system of claim 1; and

an array circuit comprising the at least one storage drive, wherein the at least one storage drive comprises a first storage drive and a second storage drive, wherein the first portion comprises the first storage drive, and wherein the second portion comprises the second storage drive.

18. A method of writing first data to at least one storage drive in a data storage system, wherein the at least one storage drive comprises a first portion and a second portion, wherein the first portion comprises a plurality of magnetic recording zones, wherein the plurality of magnetic recording zones comprise (i) a first zone, and (ii) a second zone that overlaps the first zone, wherein the second portion comprises a plurality of non-overlapping storage zones or solid-state memory, and wherein the second portion does not include overlapping magnetic recording zones, the method comprising:

based on an attribute of the first data, determining whether to write the first data to (i) the first portion of the at least one storage drive, or (ii) the second portion of the at least one storage drive; and

based on the determination, writing the first data to either (i) the first portion in a first log structured manner, or (ii) write the first data to the second portion in a random access manner or a second log structured manner.

CLAIMS

1. A data storage system comprising:

a determination circuit configured to determine whether to write first data to a first portion of a memory or to a second portion of the memory, wherein the first portion comprises shingled-magnetic recording zones, and wherein the second portion comprises non-shingled-magnetic recording zones; and

a control circuit configured to control the writing of the first data to the first portion in a log structured manner, wherein the control circuit is configured to control the writing of the first data such that the first data is stored in a form of a circular log, wherein the circular log has only one header and only one end, wherein the header defines the first data as written to the first portion, wherein the circular log comprises a plurality of ring-shaped bands of the memory, and wherein the control circuit is configured to, during the writing of the first data to the first portion, append the first data to the header and move the header relative to the end.

2. The data storage system according to claim 1, wherein the control circuit is configured to control the writing of the first data to the second portion in a random access manner.

3. The data storage system according to claim 1, further comprising a marking circuit configured to mark unwanted old data on the first portion,

wherein the control circuit is configured to, subsequent to marking the unwanted old data, (i) append the unmarked old data to the header, and (ii) write the first data over the marked unwanted old data.

4. The data storage system according to claim 1, wherein:

the determination circuit is configured to, based on attributes of the first data, determine whether to write the first data to the first portion or to the second portion; and

the attributes comprise a type of file, a file size, and a file popularity value.

5. The data storage system according to claim 1, wherein the determination circuit is configured to determine whether to write the first data to the first portion or to the second portion based on (i) whether old data is located in the first portion or the second portion, and (ii) whether the old data is to be overwritten by the first data.

6. The data storage system according to claim 1, further comprising:

an access monitor circuit configured to monitor an access pattern of the first data in the first portion and the second portion; and

a file migration circuit configured to move the first data between the first portion and the second portion based on the access pattern.

7. The data storage system according to claim 1, wherein:

the determination circuit is configured to determine whether the first data is metadata; and

control circuit is configured to write the first data to (i) the first portion if the determination circuit determines the first data is not metadata, and (ii) the second portion if the determination circuit determines the first data is metadata.

8. The data storage system according to claim 1, the control circuit is configured to store metadata in the second portion, wherein:

the metadata is stored in a form of a tree structure;

the tree structure comprises a plurality of nodes;

each of the plurality of nodes comprises metadata information of a program file or a directory; and

the control circuit is configured to write the metadata to the second portion at periodic intervals and when the metadata indicates a change in operations.

9. A data storage system comprising:

a first hard disk comprising

a first portion comprising a plurality of shingled magnetic recording zones, and

a second portion comprising a non-shingled magnetic recording zone;

a first management module configured to (i) control access to the plurality of shingled magnetic recording zones, and (ii) record first data in the plurality of shingled magnetic recording zones in a log structured manner, wherein the first data does not include metadata;

a second management module separate from the first management module and configured to (i) control access to the non-shingled magnetic recording zone, and (ii) record metadata in the non-shingled magnetic recording zone in a random access manner,

wherein

the metadata is stored in a form of a tree structure,

the tree structure comprises a plurality of nodes,

each of the plurality of nodes comprises metadata information of a program file or a directory, and

the second management module is configured to write the metadata to the second portion at periodic intervals and when the metadata indicates a change in operations.

10. The data storage system according to claim 9, wherein:

the plurality of shingled magnetic recording zones comprises a first shingled magnetic recording zone and a second shingled magnetic recording zone; and

the first shingled magnetic recording zone is separated from the second shingled magnetic recording zone by an inter-zone gap.

11. The data storage system according to claim 9, further comprising:

an array circuit; and

a plurality of hard disks controlled by the array circuit, wherein the plurality of hard disks comprise the first hard disk,

wherein the plurality of hard disks comprise

respective pluralities of shingled magnetic recording zones; and

respective non-shingled magnetic recording zones.

12. The data storage system of claim 9, further comprising a determination circuit configured to (i) determine whether to store second data in the first portion or the second portion, and (ii) based on the determination, provide the second data to one of the first management module or the second management module.

13. The data storage system of claim 12, wherein the determination circuit is configured to provide the second data to the first management module if no data stored on the hard disk is an old version of the second data.

14. A method of writing data to a memory in a data storage system, wherein the memory comprises a first portion and a second portion, wherein the first portion comprises shingled-magnetic recording zones, and wherein the second portion comprises non-shingled-magnetic recording zones, the method comprising:

determining whether to write data to the first portion or to the second portion; and

controlling the writing of the data to the first portion in a log structured manner such that the data is stored in a form of a circular log, wherein the circular log has only one header and only one end, wherein the header defines the data as written to the first portion, wherein the circular log comprises a plurality of ring-shaped bands of the memory, and wherein the writing of the data to the first portion includes appending the data to the header and moving the header relative to the end.