CLAIMS

1. An active storage unit comprising:

a plurality of storage devices; and

an active control board comprising a processor, at least one internal memory module communicatively coupled to the processor, a memory controller, a non-volatile memory (NVM) module communicatively coupled to the processor, and a reconfigurable logic circuit communicatively coupled to the processor and the memory controller for providing on-field and on-time programmable offloading and supporting customized usage for programming the active storage unit on-the-fly,

wherein the plurality of storage devices are communicatively coupled to the active control board via the more than two interfaces, and wherein the active control board further comprises a media controller communicatively coupled to the processor and the plurality of storage devices for enabling the processor to control access to the plurality of storage devices, and wherein functions and features of the active storage unit can be changed on-the-fly.

2. The active storage unit as claimed in claim 1, wherein the non-volatile memory module of the active control board is a block-based NVM module and is configured to provide a cache for the block-based data stored in the plurality of storage devices.

3. The active storage unit as claimed in claim 2, wherein the plurality of storage devices comprise block-based storage media.

4. The active storage unit as claimed in claim 2, wherein the reconfigurable logic circuit is programmed via connection fabric by software running on processor cores and is programmable on-the-fly for changing the functions and features of the active storage unit.

5. The active storage unit as claimed in claim 2, wherein the processor is configured to write volatile data in the at least one internal memory module to the non-volatile memory module in an event of a power disruption.

6. The active storage unit as claimed in claim 5, further comprising a back-up power supply configured to provide emergency power for enough time to the active storage unit for the processor to write the volatile data in the at least one internal memory module to the non-volatile memory module in the event of a power disruption.

7. The active storage unit as claimed in claim 2, wherein the block-based non-volatile memory module comprises a solid state drive for storing block-based data.

8. The active storage unit as claimed in claim 1, wherein the active control board is configured to interpret object and file transfer protocols into actual data transfer to or from the plurality of storage devices.

9. The active storage unit as claimed in claim 1, wherein the active control board comprises an operating system (OS) configured to run distributed file system (DFS) software that collectively manages the plurality of storage devices.

10. The active storage unit as claimed in claim 1, wherein the active control board is configured to execute software programs which control the various hardware devices on the active control board to achieve one or more functions selected from the group comprising (a) perform commands, status and data exchanges with other active control boards accessible through internal and external network switches using distributed file system and other system and application software to self-form and maintain a distributed storage cluster and (b) maintain information on the active control board's participation in storage resources of the active storage unit for reinstatement of the storage resources after a power failure.

11. The active storage unit as claimed in claim 1, wherein the plurality of storage devices comprise at least one of a group consisting of hard disk drives (HDDs), hybrid HDDs, solid state drives (SSDs) and hybrid SSDs for storing block-based data.

12. The active storage unit as claimed in claim 1, wherein the active control board further comprises a non-volatile random access memory (NVRAM) controller configured to control at least one NVRAM module coupled thereto, the processor using the NVRAM controller to write cache data into the at least one NVRAM module in an event of a power disruption and, after power resumption, reloading cache data from the NVRAM module to resume processing.

13. The active storage unit as claimed in claim 1, wherein the active control board further comprises an inter-integrated circuit (I^2C) communicatively coupled to the processor, an I^2C bus communicatively coupled to the I^2C from a back plane board.

14. An active storage array comprising:

a backplane board;

one or more active storage units, each active storage unit comprising:

an active control board comprising a processor, at least one internal memory module communicatively coupled to the processor, a microprocessor communicatively coupled to the processor, and a bus communicatively coupled to the microprocessor from the backplane board; and

a plurality of storage devices communicatively coupled to the active control board; and

one or more switch control boards interfacing between the one or more active storage units and external devices, thereby allowing data operations directly between the external devices and the one or more active storage units without a need for storage servers since the active control board processes and interprets object and file transfer protocols into actual data transfer to and from the plurality of storage devices.

15. The active storage array as claimed in claim 14, further comprising an Ethernet connection, wherein the back plane board is further configured to receive the one or more active storage units and the one or more switch control boards, wherein the one or more active storage units and the one or more switch control boards are hot-pluggable to the back plane board, and wherein the microprocessor on each active control board is coupled to the Ethernet connection.

16. The active storage array as claimed in claim 14, wherein data redundancy is achieved by replicating data across all active control boards within a storage volume.

17. An active storage array comprising:

one or more active storage units, each active storage unit comprising:

an active control board comprising a processor, at least one internal memory module communicatively coupled to the processor, and a reconfigurable logic circuit communicatively coupled to the processor for programming the active storage unit; and a plurality of storage devices communicatively coupled to the active control board;

one or more switch control boards interfacing between the one or more active storage units and external devices, thereby allowing data operations directly between the external devices and the one or more active storage units; and

a plurality of switch control boards each interfacing between respective one or more active storage units and the external devices and each comprising a network switch communicatively coupled to a switch controller module.

18. The active storage array as claimed in claim 17, wherein the plurality of switch control boards are configured to cooperate with each other, via the network switch, to form a distributed active storage array.

19. An active storage array comprising:

one or more active storage units, each active storage unit comprising:

an active control board comprising a processor, at least one internal memory module communicatively coupled to the processor, and a reconfigurable logic circuit communicatively coupled to the processor for programming the active storage unit; and

a plurality of storage devices communicatively coupled to the active control board; and

one or more switch control boards interfacing between the one or more active storage units and external devices, thereby allowing data operations directly between the external devices and the one or more active storage units, wherein the one or more switch control boards each comprises a chassis management processor communicatively coupled to the network switch and configured to power on active control boards of the one or more active storage units in phases via a power switch disposed in each of the active control boards.