

SUMMARY

According to a first aspect, there is provided a server cooling system comprising an inside space defined by a floor, one or more lateral walls, and a roof; one or more openings defined in the roof or the one or more lateral walls; an enclosure installed within the inside space, the enclosure defining an interior space in fluid communication with upper regions of the inside space; one or more air-handling units operable to provide external air into the inside space; and a rack installed in the inside space and engaging the enclosure in a substantially sealed manner, one or more rack-mounted units installed in the rack such that respective front faces of the rack-mounted units interface with the inside space, and that respective back faces of the rack-mounted units interface with the interior space defined by the enclosure, and one or more cooling fans operable to draw air from the inside space through the front faces of the one or more rack-mounted units and expel heated air through the back faces of the one or more rack-mounted units to the interior space.

According to a second aspect, there is provided a server cooling system comprising an inside space defined by a floor, one or more lateral walls, and a ceiling; an attic space defined by the ceiling and a roof; one or more valved openings coupled to the roof or the one or more lateral walls; an enclosure installed within the inside space, the enclosure defining an interior space operably connected to the one or more valved openings and the attic space; one or more valved ceiling openings coupled to the ceiling operable to exchange air between the attic space and the inside space; one or more air-handling units operable to draw external air into the inside space; and a rack installed in the inside space and engaging the enclosure in a substantially sealed manner, one or more rack-mounted units installed in the rack such that respective front faces of the rack-mounted units interface with the inside space, and that respective back faces of the rack-mounted units interface with the interior space defined by the enclosure, and one or more cooling fans operable to draw air from the inside space through the front faces of the one or more rack-mounted units and expel heated air through the back faces of the one or more rack-mounted units to the interior space.

According to a third aspect, there is provided a server cooling system comprising an inside space defined by a floor, one or more lateral walls, and a ceiling; an attic space defined by the ceiling and a roof; one or more valved openings coupled to the roof or the one or more lateral walls; a cold row enclosure installed within the inside space, the enclosure defining an cold row interior space operably connected to the one or more valved openings; a hot row enclosure installed within the inside space, the enclosure defining an hot row interior space operably connected to the attic space; one or more valved ceiling openings coupled to the ceiling operable to exchange air between the attic space and the inside space; one or more air-handling units operable to draw external air into the inside space; and a rack installed in the inside space and engaging the cold row enclosure and the hot row enclosure in a substantially sealed manner, one or more rack-mounted units installed in the rack such that respective front faces of the rack-mounted units interface with the cold row interior space, and that respective back faces of the rack-mounted units interface with the hot row interior space, and one or more cooling fans operable to draw air from the cold row interior space through the front faces of the one or more rack-mounted units and expel heated air through the back faces of the one or more rack-mounted units to the hot row interior space.

According to a fourth aspect, there is provided a method, comprising substantially encapsulating an interior space having at least one lateral portion defined by a front face of at least one server rack, wherein the at least one server rack comprises one or more servers mounted therein, and wherein one or more valved openings are operably connected to a top side of the interior space; introducing a cooling air source from a back face of the at least one server rack wherein the one or more servers mounted in the server rack includes a cooling fan operable to draw cooled air from the cooling air source and expel heated air to the interior space to allow the heated air to rise to upper regions of the inside space; and expelling the heated air from the inside space.

Embodiments of The present invention provides systems and methods directed to an integrated, building-based air handling system for efficient cooling of data centers. In a particular embodiment, the present invention provides an enclosure comprising at least one server rack port configured to interface with one or more server racks. The server rack ports are configured to engage the server racks such that a back face of a rack-mounted unit installed in the server racks interface with the interior space defined by the enclosure. One or more fans draw cooling air from a front face of the rack-mounted unit and expel heated air to the interior space. In some embodiments, the server racks ports and the server racks are engaged in a substantially sealed manner to reduce air leakage into and out of the enclosure.

In other embodiments of the present invention, the systems and methods involve utilizing natural cool air to cool the servers. In one embodiment, valved openings on the lateral walls of a data center may be connected to a control system which is operable to open up the valved openings when the difference in temperature inside and outside the data center reaches certain threshold values. External cool air enters the data center through the valved openings. One or more fans draw the cool air from a front face of the rack-mounted unit and expel heated air through the back face of the rack-mounted unit to the interior space defined by the enclosure. The enclosure is operably connected to the valved openings on the roof of the data center and the heated air inside the enclosure is exhausted out of the data center through the valved openings. In some embodiments, one or more evaporative cooling units are used to cool external air coming from the valved openings on the lateral walls of the data center. In other embodiments, a ceiling may be used in a data center. The roof and the ceiling define an attic space. The enclosure is operably connected to the attic space. Heated air is expelled to the attic space and exhausted out of the data center through valved openings coupled to the roof.

In some embodiments, both a hot row enclosure and a cold row enclosure are used. Air cooled by one or more cooling units enters the cold row enclosure. One or more fans draw cold air from the cold row enclosure through the rack-mounted units to cool the servers and eject heated air to the hot row enclosure. In some embodiments, the cooling fans mounted internally within the rack-mounted units