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# Compute and/or storage rack-wall


## Abstract

A rack-wall computing and/or data storage system includes computing and/or storage devices mounted in enclosures; the enclosures are also mounted in one or more device chassis that fit into one or more vertical slots of an open-faced mounting structure. The mounting structure is free of vertical or horizontal supports on a front side, which allows for a greater density of enclosures (and therefore computing or storage devices) to be mounted in a given volume of space, as compared to conventional racks that include vertical supports at repeating intervals (e.g., every 24 inches). Also, a given device chassis can be extracted from the mounting structure, via the open front face, using a rail system, wherein in the extracted position, the enclosures are accessible for servicing on at least two sides (e.g., front and back).



**Inventors:** **Rivnay; Roey (Sammamish, WA), Crain; Joel (Renton, WA), Megarity; William Mark (Renton, WA), Pizzino; Timothy Allan (Seattle, WA), Kelly; Noah Thomas (Cascade, CO), Crain; Andrew Charles (Everett, WA)**

**Applicant:** **Amazon Technologies, Inc.** (Seattle, WA)



**Family ID:** **1000007398083**

**Assignee:** **Amazon Technologies, Inc. (Seattle, WA)**

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*Primary Examiner:* Haughton; Anthony M

*Attorney, Agent or Firm:* Kowert, Hood, Munyon, Rankin & Goetzel, P.C.

## Background/Summary

BACKGROUND

(1) Computer systems typically include a number of components, including printed circuit boards, mass storage devices, power supplies, and processors. Some known computer systems are configured into rack-mountable components and are positioned within a rack system. Some known rack systems are configured to support **40** such rack-mounted components. Such rack systems typically include horizontal shelves supported by vertical posts, which are spaced at repeating intervals, such as every 24 inches. The rack-mountable computer systems fit within the horizontal shelves and are supported in the rack by the vertical posts included at the repeating intervals (e.g., every 24 inches). Moreover, typical data centers include a plurality of such rack systems.

(2) Some computer systems include a number of hard disk drives or other storage devices (for example, eight or more hard disk drives) to provide adequate data storage. Typically, the hard disk drives for servers are of a standard, off-the-shelf type. Standard, off-the-shelf hard disk drives are often a cost-effective solution for storage needs because such hard disk drives can be obtained at relatively low cost. Nonetheless, in server designs using such standard hard disk drives, the arrangement of the hard disk drives may leave a substantial amount of wasted space. This wasted space, especially when multiplied over many servers in a rack, and many racks in a data center, may result in inadequate computing or storage capacity.

## Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a perspective view illustrating a rack-wall computing and/or data storage system, wherein the rack-wall computing and/or data storage system comprises a top horizontal structural element, a bottom horizontal structural element, and a vertical structural element that form a mounting structure having an open front face, free of vertical supporting elements, which allows for a greater density of computing or storage devices than conventional rack systems having vertical posts at repeating intervals, according to some embodiments.

(2) FIG. **2** is a side view of a rack-wall computing and/or data storage system mounting structure, illustrating an interior space free of vertical supporting elements, according to some embodiments.

(3) FIG. **3** is a front view of a rack-wall computing and/or data storage system mounting structure, illustrating computing and/or storage device chassis installed in the mounting structure in vertical slots, according to some embodiments.

(4) FIG. **4** illustrates a top view and a front view of a data center comprising a set of rack-wall computing and/or data storage systems positioned on either side of a cold aisle, with hot aisles at the rears of the respective rack-wall computing and/or data storage systems, according to some embodiments.

(5) FIG. **5** illustrates a top view and a front view of a data center comprising a connected set of rack-wall computing and/or data storage systems positioned on either side of a cold aisle, with hot aisles at the rears of the respective rack-wall computing and/or data storage systems, wherein the rack-wall computing and/or data storage systems share a top vertical structural element that spans, overhead, across the cold aisle, according to some embodiments.

(6) FIG. **6** illustrates a side view of a rack-wall computing and/or data storage system that includes a power shelf and network devices mounted in a space beneath the interior of the computing and/or data storage system mounting structure, according to some embodiments.

(7) FIG. **7** illustrates a side view of a rack-wall computing and/or data storage system that includes a power shelf and network devices mounted in a space above the interior of the computing and/or data storage system mounting structure, according to some embodiments.

(8) FIG. **8** is a perspective view of a computing and/or storage device chassis that mounts in an interior of a mounting structure of a rack-wall computing and/or data storage system, according to some embodiments.

(9) FIG. **9** is a perspective view of an enclosure that mounts (with other enclosures) in a computing and/or storage device chassis, wherein the enclosure comprises multiple mass storage devices and controllers, according to some embodiments.

(10) FIGS. **10**A and **10**B are perspective views illustrating a first side and a second side of the computing and/or storage device chassis that has been loaded with a plurality of enclosures, according to some embodiments.

(11) FIG. **11** is a cut-away view illustrating components of an enclosure mounted in a computing and/or storage device chassis, according to some embodiments.

(12) FIG. **12** is a schematic diagram illustrating gap spacing between mass storage devices in an enclosure and also illustrating air flow through the gaps, according to some embodiments.

(13) FIG. **13** is a perspective view illustrating a set of adjacently mounted computing and/or storage device chassis, according to some embodiments.

(14) FIG. **14** is a perspective view providing a more detailed representation of an example rack-wall computing and/or data storage system, according to some embodiments.

(15) FIG. **15** is a perspective view providing a more detailed representation of an example set of rack-wall computing and/or data storage systems, according to some embodiments.

(16) FIG. **16** is a perspective view providing a more detailed representation of another example

rack-wall computing and/or data storage system, according to some embodiments.

(17) While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims. The headings used herein are for organizational purposes only and are not meant to be used to limit the scope of the description or the claims. As used throughout this application, the word “may” is used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Similarly, the words “include,” “including,” and “includes” mean including, but not limited to.

DETAILED DESCRIPTION OF EMBODIMENTS

(18) Various embodiments of rack-wall computing and/or data storage systems and methods for performing computing operations and data storage operations using rack-wall computing and/or data storage systems, are disclosed. According to some embodiments, a rack-wall computing and/or data storage system includes an open-faced mounting structure free of vertical supports on a front side. Also, computing and/or data storage device chassis are mounted in the open-faced mounting structure, vertically, in respective slots of the open-faced mounting structure. Each chassis includes a plurality of enclosures, wherein the contents of a given enclosure form a respective storage server or a respective computing server. For example, an enclosure may include a set of mass storage devices and respective controller cards that form a storage server; or memory devices and processors that form a respective computing server. In some embodiments, a computing server may include various types of specialized (or general purpose) processors, such as various types of accelerators (graphics processing units (GPUs), artificial intelligence (AI) processors, networking accelerators, etc.). The open-faced mounting structure includes top and bottom horizontally-oriented supporting elements with rails mounted to the supporting elements, wherein the rails are configured to engage with rail carriages of the computing and/or storage device chassis (within which the sets of enclosures are mounted). The open-faced mounting structure further includes a vertically-oriented supporting element at the rear of the mounting structure which supports the weight of the top horizontally-oriented supporting element and further provides rigidity for the overall mounting structure and the computing and/or storage device chassis, when mounted in the mounting structure. In some embodiments, the top horizontally-oriented structural element is coupled to the vertically-oriented supporting element in a cantilevered arrangement, or may be supported by extending, overhead over a cold aisle, to a corresponding mounting structure of an adjacent rack-wall computing and/or data storage system.

(19) The above approach allows for the relaxation of enclosure volume boundaries imposed by using standard racks, such as EIA **24**″ racks (e.g., an Electrical Industries Alliance standard rack). Also, by eliminating vertical support structures from the front side of the rack-wall mounting structure, a greater density of devices, such as mass storage devices, can be included in the mounting structure as compared to conventional racks, such as EIA racks, as an example. Note that a typical rack includes front facing and rear facing vertical support elements that occupy ˜ 3 inches of the front and rear face of the rack. However, the disclosed rack-wall mounting structure eliminates such front facing support elements, which frees up additional space (e.g., 3″ per conventional rack width) to be used to house computing and/or storage devices. For example, a typical rack row in a data center includes approximately 30-40 racks. By using a rack-wall mounting structure, as disclosed herein, instead of conventional 24″ racks, approximately 7.5-10 feet of mounting structure length along the cold aisle is freed up to house additional computing and/or storage devices. Also, this arrangement allows for greater space to be provided between computing and/or storage devices, such as gaps between adjacent mass storage devices. This additional space reduces air flow restrictions and allows for fans used to cool the computing and/or

storage devices to operate at lower speeds. For example, a set of fans may be reduced from operating at 14,700 RPMs to lower than 10,000 RPMs (e.g., 7,250 RPMs) by increasing the gap between adjacent mass storage devices. This may be achieved in a same volume of space in a data center as previously occupied by a set of conventional racks. This may improve other operational aspects, such as reducing vibrations, such as RVI (rotational vibration interference). In some embodiments, the space savings by eliminating front facing vertical supports may be used solely to increase density or may be used to both increase density (to a slightly lesser degree) and also reduce air flow restrictions by increasing gaps spaces between components, such as mass storage devices.

(20) Also, in some embodiments, the computing and/or storage device chassis (hosting the respective enclosures) may be rail mounted and may be hot-serviceable on two sides. For example, a technician may be able to pull a given computing and/or storage device chassis out of the mounting structure (while still connected to power) and service individual enclosures from both sides. In some embodiments, enclosures may include controller cards on a first side and openings for accessing mass storage devices (such as hard disk drives HDDs or solid-state drives (SSDs)) on a second side. In this way, once extracted the controller cards may be serviced from one side while the mass storage devices may be serviced from the other side. Also, greater density is achieved as compared to other hot-serviceable designs by using rails and rail carriages to move a whole computing and/or storage chassis (as opposed to including rails on each individual enclosure).

(21) Additionally, in some embodiments, size and form factor flexibility may be extended by using more than one vertical slot to house a computing and/or storage device chassis. For example, in some embodiments, a given chassis may have a width greater than one vertical slot and may occupy two or more adjacent vertical slots. This may further allow for improved density by eliminating a volume/size constraint horizontally in addition to the vertical constraint flexibility already realized by removing supporting elements from the front face.

(22) As used herein, “backplane” means a plate or board to which other electronic components, such as interposer cards and mass storage devices, etc. can be mounted. In some embodiments, mass storage devices, which can include one or more hard disk drives, are plugged into a backplane in a generally perpendicular orientation relative to the face of the backplane. In some embodiments, a virtualization offloading card is plugged into a backplane. In some embodiments, a backplane includes one or more power buses that can transmit power to components on the backplane, and one or more data buses that can transmit data to and from components installed on the backplane. Also, in some embodiments a backplane may include an application specific integrated circuit (ASIC) configured to provide Ethernet switching for components mounted on the backplane.

(23) As used herein, a “cable” includes any cable, conduit, or line that carries one or more conductors and that is flexible over at least a portion of its length. A cable may include a connector portion, such as a plug, at one or more of its ends.

(24) As used herein, “circuit board” means any board or plate that has one or more electrical conductors transmitting power, data, or signals from components on or coupled to the circuit board to other components on the board or to external components. In certain embodiments, a circuit board is an epoxy glass board with one or more conductive layers therein. A circuit board may, however, be made of any suitable combination of materials.

(25) As used herein, “chassis” means a structure or element that supports another element or to which other elements can be mounted. A chassis may have any shape or construction, including a frame, a sheet, a plate, a box, a channel, or a combination thereof. In one embodiment, a chassis is made from one or more sheet metal parts. A chassis for a computer system may support circuit board assemblies, power supply units, data storage devices, fans, cables, and other components of the computer system.

(26) As used herein, “computing” includes any operations that can be performed by a computer, such as computation, data storage, data retrieval, or communications.

(27) As used herein, “data center” includes any facility or portion of a facility in which computer operations are carried out. A data center may include servers dedicated to specific functions or serving multiple functions. Examples of computer operations include information processing, communications, testing, simulations, power distribution and control, and operational control.
(28) As used herein, “mounting” a particular element on another element refers to positioning the particular element to be in physical contact with the other element, such that the other element provides one or more of structural support, positioning, structural load transfer, stabilization, shock absorption, some combination thereof, or the like with regard to the particular element. The mounted particular element may be positioned to rest upon one or more upper surfaces of the other element, independent of coupling the elements via one or more coupling elements. In some embodiments, mounting the particular element to another element includes coupling the elements such that the other element provides one or more of structural support, positioning, structural load transfer, stabilization, shock absorption, some combination thereof, or the like with regard to the particular element.
(29) As used herein, a “rack” means a rack, container, frame, or other element or combination of elements that can contain or physically support one or more computer systems. In some embodiments a rack is a standard 19″ or 24″ rack that conforms to EIA standards.
(30) FIG. **1** is a perspective view illustrating a rack-wall computing and/or data storage system, the rack-wall computing and/or data storage system comprises a top horizontal structural element, a bottom horizontal structural element, and a vertical structural element that form a mounting structure having an open front face, free of vertical supporting elements, which allows for a greater density of computing or storage devices than conventional rack systems having vertical posts at repeating intervals, according to some embodiments.
(31) In some embodiments, a rack-wall computing and/or data storage system, such as rack-wall computing and/or data storage system **100**, includes a top horizontally-oriented supporting element **104**, a bottom horizontally-oriented supporting element **108**, and a vertically-oriented supporting element **106**. In some embodiments, the supporting elements **104**, **106**, and **108** may be made out of structural materials, such as steel, or other metals or polymers. In some embodiments, the structural elements **104**, **106**, and **108** may be solid (as shown in FIG. **1**) or may be formed from structural elements with spaces in between the structural elements such as beams, tubes, braces, etc. For example, FIGS. **14** and **15** illustrate more detailed example configurations. In some embodiments, top horizontally-oriented supporting element **104** may be supported by vertically-oriented supporting element **106** without the need for additional structural supports at the open front facing side **112** of the mounting structure **102**. Also, in some embodiments, top horizontally-oriented supporting element **104** may be supported, at least in part, by an adjacent mounting structure, such as is shown in FIGS. **5** and **15**. The mounting structure **102** may span a full length of an aisle in a data center. For example, instead of arranging 30-40 individual racks in a row in a data center on a given side of an aisle, which is a common practice, a single mounting structure **102** may span an equivalent length of the aisle but may avoid the need for vertical support elements being interspersed, at the front facing side **112**, along the length of the aisle.
(32) Additionally, the rack-wall computing and/or data storage system **100** includes computing and/or storage device chassis(s) **114** mounted in the mounting structure **102** via rails **110**. In some embodiments, rails **110** may be mounted to the top horizontally-oriented supporting element **104**, the bottom horizontally-oriented supporting element **108**, or both. In some embodiments, casters may be used, for example instead of having rails on both the top and bottom of computing and/or storage device chassis(s) **114**, casters may be used on the bottom, such as shown in FIG. **16**.
(33) Each of the computing and/or storage device chassis(s) **114** may include a set of enclosures, such as shown in FIG. **8**, wherein each of the enclosures includes mass storage devices and controllers (or other computing devices), such as shown in FIG. **9**.
(34) FIG. **2** is a side view of a rack-wall computing and/or data storage system mounting structure,

illustrating an interior space free of vertical supporting elements, according to some embodiments.
(35) As can be seen in FIG. **2**, the interior space **208** is free of vertical (or horizontal supports) at the front of the mounting structure **102** and throughout the interior space of the mounting structure, other than the rear vertical support **106**. Also, the mounting structure **102** has an overall structure height **204** that includes outer frame height **206** and an additional amount of height added by the legs **202**. As can be seen, the mounting structure **102** is configured to mount on floor **210**, such as a floor of a data center hall of a data center. In some embodiments, the outer frame height and/or the overall structure height may exceed 5 feet or more. In some embodiments, the mounting structure **102** may be self-standing or may be anchored into floor **210** (not shown).
(36) FIG. **3** is a front view of a rack-wall computing and/or data storage system mounting structure, illustrating computing and/or storage device chassis installed in the mounting structure in vertical slots, according to some embodiments.
(37) As can be seen in FIG. **3**, the front **302** of the mounting structure **102** is open and free of supports, which allows for a greater density of computing and/or storage device chassis(s) **114** to be mounted in the mounting structure. For example, it is not necessary to leave space for vertical support beams, such as are included every 24″ when arranging conventional racks into a row.
(38) FIG. **4** illustrates a top view and a front view of a data center comprising a set of rack-wall computing and/or data storage systems positioned on either side of a cold aisle, with hot aisles at the rears of the respective rack-wall computing and/or data storage systems, according to some embodiments.
(39) In some embodiments, rack-wall mounting structures, such as shown in FIGS. **1-3** may be included in a data center, for example as an alternative to using rows of conventional racks. For example, FIG. **4** illustrates data center **402** that includes rack-wall mounting structures **102**A and **102**B on either side of cold aisle **404**. Also, hot aisles **406** and **408** abut the rear side of the rack-wall mounting structures **102**A and **102**B. For example, the fans of the enclosures included in the computing and/or storage device chassis **114** of the rack-wall mounting structures **102**A and **102**B may exhaust air into the hot aisles **406** and **408**. Also, these fans may cause cold air to be drawn into the enclosures via the front faces of the mounting structures **102**A and **102**B, which face cold aisle **404**.
(40) In some situations, in order to perform maintenance, individual ones of the computing and/or storage device chassis **114**A or **114**B may be partially extracted out of a respective one of the rack-wall mounting structures **102**A or **102**B, and positioned in a portion of cold aisle **404** to enable a technician to access the enclosures included in the computing and/or storage device chassis **114**. For example, FIGS. **10**A and **10**B illustrate a first and second side of a computing and/or storage device chassis **114** that are accessible when partially extracted into the cold aisle **404**.
(41) FIG. **5** illustrates a top view and a front view of a data center comprising a connected set of rack-wall computing and/or data storage systems positioned on either side of a cold aisle, with hot aisles at the rears of the respective rack-wall computing and/or data storage systems, wherein the rack-wall computing and/or data storage systems share a top vertical structural element that spans, overhead, across the cold aisle, according to some embodiments.
(42) The arrangement in FIG. **5** is similar to that of FIG. **4**, however in some embodiments, an overhead horizontally oriented top structural element **510** may span a width of cold aisle **504** and connect between the respective mounting structures **102**A and **102**B. In some embodiments, the top horizontally-oriented supporting element **104** of both mounting structures **102**A and **102**B may be a single shared supporting element that spans the cold aisle **504**. Alternatively, in some embodiments, respective ones of the top horizontally-oriented supporting elements **104** of respective mounting structures **102**A and **102**B may connect to each other, for example in an overhead location above cold aisle **504**.
(43) FIG. **6** illustrates a side view of a rack-wall computing and/or data storage system that includes a power shelf and network devices mounted in a space beneath the interior of the

computing and/or data storage system mounting structure, according to some embodiments.
(44) In some embodiments, an additional power shelf and/or networking device container may be included in the rack-wall computing and/or data storage system **100**, wherein the power shelf and/or network device, such as **602**, mounts below the mounting structure **102**, or above the mounting structure. For example, FIG. **7** illustrates a side view of a rack-wall computing and/or data storage system that includes a power shelf and network devices mounted **702** in a space above the interior of the computing and/or data storage system mounting structure, according to some embodiments.
(45) FIG. **8** is a perspective view of a computing and/or storage device chassis that mounts in an interior of a mounting structure of a rack-wall computing and/or data storage system, according to some embodiments.
(46) In some embodiments, the computing and/or storage device chassis(s) **114**, as shown in FIGS. **1-7**, include frame **802** and rail carriages **804**, **806**, and **814** configured to slide on rails, such as rails **110**. Also, each computing and/or storage device chassis **114** includes multiple enclosures **808**, each including mass storage devices **812** and fans **810**.
(47) In some embodiments, spacing between the mass storage devices **812** may allow for lower speed fans to be used. For example, fans **810** may spin at 7,250 RPM (as opposed to 14,700 RPM fans used in configurations with less spacing between mass storage devices). Also, as shown in FIG. **10**B, each of the enclosures **808** may include one or more controller cards **1004**, for example for performing storage operations related to storing (or retrieving) data on the mass storage devices **812**.
(48) FIG. **9** is a perspective view of an enclosure that mounts (with other enclosures) in a computing and/or storage device chassis, wherein the enclosure comprises multiple mass storage devices and controllers, according to some embodiments.
(49) For example, enclosure **808** includes rows and columns of mass storage devices **812** arranged within a frame **902** of the enclosure **808**. Also, fans **810** are included at a rear of enclosure **808** that is proximate to a rear of the mounting structure **102**, when the enclosure **808** is mounted in a computing and/or storage device chassis **114** that is in turn mounted in mounting structure **102**.
(50) FIGS. **10**A and **10**B are perspective views illustrating a first side and a second side of the computing and/or storage device chassis that has been loaded with a plurality of enclosures, according to some embodiments.
(51) Also, as shown in FIGS. **10**A and **10**B, the computing and/or storage device chassis **114** may include a frame **808** comprising multiple frame elements, such as frame elements **1008** and **1010**. Also, as can be seen in FIG. **10**B, controller cards **1004** may be mounted on a second side of the enclosures **808**, wherein the chassis **114** includes space for cabling **1006** for connections to the controller cards **1004**.
(52) FIG. **11** is a cut-away view illustrating components of an enclosure mounted in a computing and/or storage device chassis, according to some embodiments.
(53) In some embodiments, computing and/or storage device chassis **114** and an enclosure **808** mounted in the computing and/or storage device chassis **114** may have a cross-section as shown in FIG. **11**. For example, mass storage devices **812** may plug into backplane **110**. Also, backplane **110** may be connected to controller card **1004** via interposer card **1104** and card edge connector **1102**. In some embodiments, the mass storage devices **812** may connect to backplane **110** via blind-mate connectors, such that individual ones of the mass storage devices **812** may be removed, or inserted, such as during hot servicing. Also, the controller card **1004** may be easily removable via card edge connector **1102** on a back side of the enclosure **808**. Networking connections to the controller card may pass through pass-thru for card connection **1108**. For example, networking cables may be routed in this space.
(54) FIG. **12** is a schematic diagram illustrating gap spacing between mass storage devices in an enclosure and also illustrating air flow through the gaps, according to some embodiments.

(55) In some embodiments, gaps may be provided between respective mass storage devices to allow for better air flow. For example, in FIG. **12**, gaps **1202** through **1214** are provided between mass storage devices **812**A through **812**N. These gaps may facilitate airflow **1216** such that fans **810**A and **810**B may operate at lower fan speeds, thus saving energy and reducing vibrations.
(56) FIG. **13** is a perspective view illustrating a set of adjacently mounted computing and/or storage device chassis, according to some embodiments.
(57) In some embodiments, the computing and/or storage device chassis may be densely arranged next to one another, such as shown for chassis rack arrangement **1302**. In some embodiments, any number of computing and/or storage device chassis **114** may be arranged next to each other in a rack-wall mounting structure **102**.
(58) FIG. **14** is a perspective view providing a more detailed representation of an example rack-wall computing and/or data storage system **1400** including a computing/device mounting structure **1402**, according to some embodiments.
(59) FIG. **15** is a perspective view providing a more detailed representation of an example set of rack-wall computing and/or data storage systems **1500** including a computing/device mounting structure **1502**, according to some embodiments.
(60) As can be seen in FIG. **15**, in some embodiments, an overhead top horizontally-oriented structural element **1504** may be shared and may span a width of a cold aisle **504**. Also, FIG. **15** illustrates example implementations of horizontally and vertically oriented supporting elements, such as vertically-oriented supporting element **1506** and bottom horizontally-oriented supporting elements **1508**A and **1508**B.
(61) In some embodiments, mass storage devices in a data storage system are standard, off-the-shelf hard disk drives. Examples of suitable hard disk drive form factors may include 3.5″, 5.25″, and 2.5″. In one embodiment, a standard 3.5″ hard disk drive is installed in a device slot of a plurality of device slots of an array along with other standard 3.5″ hard disk drives.
(62) FIG. **16** is a perspective view providing a more detailed representation of another example rack-wall computing and/or data storage system, according to some embodiments. For example, in some embodiments, a bottom horizontally-oriented structural element may be provided by a floor, such as floor **202**. In such embodiments castors **110** may support at least some of the weight of computing/device chassis **114** via the casters **110**. In some embodiments, computing device/mounting structure **1602** may have a width similar to a conventional rack, but may be completely free from vertically-oriented supporting elements on a front face of the structure **1602**.
(63) The various methods as illustrated in the figures and described herein represent example embodiments of methods. The order of method may be changed, and various elements may be added, reordered, combined, omitted, modified, etc.
(64) Although the embodiments above have been described in considerable detail, numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. It is intended that the following claims be interpreted to embrace all such variations and modifications.

## Claims

1. A data center, comprising: a plurality of rows of computing or storage devices, wherein the computing or storage devices of at least one of the rows are mounted in a mounting structure comprising: a top horizontally-oriented frame element; a bottom horizontally-oriented frame element; a vertical frame element coupled to the top horizontally-oriented frame element and the bottom horizontally-oriented frame element, wherein the vertical frame element is located at a rear portion of the mounting structure; and an open front side of the mounting structure that is free of vertically-oriented frame elements on a left side and a right side of the mounting structure, wherein the open front side of the mounting structure is configured to accept installation of the computing

or storage devices using one or more device chassis that engage with rails coupled to the top horizontally-oriented frame element or the bottom horizontally-oriented frame element.
2. The data center of claim 1, wherein the mounting structure further comprises: a plurality of vertically-oriented slots configured to accept the installation of a plurality of the one or more device chassis, wherein: an exterior vertical height of the mounting structure comprises a distance between a bottom portion of the bottom horizontally-oriented frame element and a top portion of the top horizontally-oriented frame element; and the vertically-oriented slots encompass a vertical interior height of the mounting structure extending from a top portion of the bottom horizontally-oriented frame element to a bottom portion of the top horizontally-oriented frame element.
3. The data center of claim 1, wherein the vertical frame element located in the rear portion of the mounting structure provides vertical structural support without vertical structural supports in a front or middle portion of the mounting structure.
4. The data center of claim 1, wherein the computing or storage devices of the at least one row mounted in the mounting structure extend along a cold aisle on a front side of the at least one row, and wherein a hot aisle extends along a back side of the at least one row.
5. The datacenter of claim 4, wherein at least two of the rows comprise respective instances of the mounting structure, wherein the mounting structures of the at least two rows are positioned on either side of the cold aisle, and wherein: the top horizontally-oriented frame elements of the respective mounting structures of the at least two rows extend, overhead, across the cold aisle; the respective mounting structures of the at least two rows each comprise an open front side facing the cold aisle; and the respective mounting structures of the at least two rows are configured to accept installation of the computing or storage devices via the respective open front sides facing the cold aisle.
6. A mounting structure, comprising: a top horizontally-oriented supporting element; a bottom horizontally-oriented supporting element; a vertical supporting element coupled to the top horizontally-oriented supporting element and the bottom horizontally-oriented supporting element, wherein the vertical supporting element is located at a rear portion of the mounting structure; and an open front side of the mounting structure that is free of vertically-oriented frame elements on a left side and a right side of the mounting structure, and that is configured to accept installation of computing or storage devices, wherein the computing or storage devices are installed in the mounting structure using one or more device chassis that engage with rails attached to the top horizontally-oriented supporting element or the bottom horizontally-oriented supporting element, wherein the vertical supporting element located in the rear portion of the mounting structure provides vertical structural support without vertical structural supports in a front portion of the mounting structure.
7. The mounting structure of claim 6, further comprising: a plurality of vertically-oriented slots, each configured to accept the installation of a device chassis.
8. The mounting structure of claim 6, wherein: the bottom horizontally-oriented supporting element is configured to mount on a floor of a facility in which the mounting structure is installed.
9. The mounting structure of claim 6, wherein: a vertical exterior height of the mounting structure comprises a distance between a bottom portion of the bottom horizontally-oriented supporting element and a top portion of the top horizontally-oriented supporting element; the vertically-oriented slots encompass a vertical interior height of the mounting structure extending from a top portion of the bottom horizontally-oriented supporting element to a bottom portion of the top horizontally-oriented supporting element; and the rails are mounted to the top horizontally-oriented supporting element and the bottom horizontally-oriented supporting element, wherein the device chassis engages with the top horizontally-oriented supporting element and the bottom horizontally-oriented supporting element via the rails.
10. The mounting structure of claim 6, wherein the open front side of the mounting structure is configured to accept the installation of the computing or storage devices along a length of the open

front side without supporting elements interspersed along the length of the open front side of the mounting structure.

11. A system, comprising: a plurality of computing or storage devices; a plurality of device chassis, wherein respective sets of the plurality of computing or storage devices are mounted in respective enclosures and wherein sets of the respective enclosure are mounted in respective ones of the device chassis; and a mounting structure for the plurality of device chassis, the mounting structure comprising: a top horizontally-oriented supporting element; a bottom horizontally-oriented supporting element; a vertical supporting element coupled to the top horizontally-oriented supporting element and the bottom horizontally-oriented supporting element, wherein the vertical supporting element is located at a rear portion of the mounting structure; and an open front side of the mounting structure that is free of vertically-oriented frame elements on a left side and a right side of the mounting structure, and that is configured to accept installation of the plurality of device chassis, wherein respective ones of the plurality of device chassis engage with the top horizontally-oriented supporting element or the bottom horizontally-oriented supporting element via rails mounted to the top horizontally-oriented supporting element or the bottom horizontally-oriented supporting element, wherein the vertical supporting element located in the rear portion of the mounting structure provides vertical structural support without vertical structural supports being included in a front portion of the mounting structure.

12. The system of claim 11, wherein the mounting structure further comprises: a plurality of vertically-oriented slots configured to accept the installation of the plurality of device chassis, wherein: a vertical exterior height of the mounting structure comprises a distance between a bottom portion of the bottom horizontally-oriented supporting element and a top portion of the top horizontally-oriented supporting element; and the vertically-oriented slots encompass a vertical interior height of the mounting structure extending from a top portion of the bottom horizontally-oriented supporting element to a bottom portion of the top horizontally-oriented supporting element.

13. The system of claim 11, wherein respective ones of the computing devices mounted in the respective ones of the enclosures form respective computing servers.

14. The system of claim 11, wherein respective ones of the storage devices mounted in the respective ones of the enclosures form respective storage servers.

15. The system of claim 11, further comprising respective sets of casters mounted on bottom sides of the respective ones of the plurality of device chassis, wherein the casters engage with the bottom horizontally-oriented supporting element to support the respective ones of the plurality of device chassis.

16. The system of claim 11, wherein the plurality of device chassis are configured for hot-serviceability from at least two sides of respective ones of the device chassis.

17. The system of claim 16, wherein mass storage devices mounted in respective sets of enclosures that are mounted in the respective ones of the device chassis are hot serviceable from a first side of the respective ones of the plurality of device chassis, and wherein controller cards, for the mass storage devices, mounted in the enclosures mounted in the device chassis are hot-serviceable from a second side of the respective ones of the plurality of device chassis.

18. The system of claim 11, further comprising: a power shelf mounted in a space: below a top side of the bottom horizontally-oriented supporting element; or above a bottom side of the top horizontally-oriented supporting element.

19. The system of claim 11, wherein the open front side has a height of 5 feet or more.

20. The system of claim 11, wherein the open front side of the mounting structure is configured to accept the installation of the device chassis along a length of the open front side without supporting elements interspersed along the length of the open front side of the mounting structure.