United States Patent Application Publication	20250261326
Kind Code	A1
Publication Date	August 14, 2025
Inventor(s)	SCHUBERT; Alexis Grace et al.

TRAY WITH MOVEABLE CONNECTOR FOR CHASSIS SIDE PLANE ENGAGEMENT

Abstract

A tray is adapted for insertion within a tray slot formed in a chassis. The tray includes a lever and a moveable connector that protrudes from and engages with a side plane of the chassis in response to rotation of the lever.

Inventors: **SCHUBERT; Alexis Grace (Seattle, WA), PETERSON; Martha G. (Woodinville, WA), JUAREZ CAMPOS; Jorge Luis (Bothell, WA), MOHAGHEGH; Daniel Afsheen (Seattle, WA), DOLL; Wade (Enumclaw, WA)**

Applicant: **Microsoft Technology Licensing, LLC** (Redmond, WA)

Family ID: **1000007775766**

Appl. No.: **18/621945**

Filed: **March 29, 2024**

Related U.S. Application Data

us-provisional-application US 63552892 20240213

Publication Classification

Int. Cl.: **H05K7/14** (20060101)

U.S. Cl.:

CPC **H05K7/1489** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims benefit of priority to U.S. provisional patent application with Ser. No. 63,552,892 entitled “Chassis Side Plane Connection Design” which was filed on Feb. 13, 2024, which is hereby incorporated by reference for all that it discloses or teaches.

BACKGROUND

[0002] Within a data center, it is common to house servers in trays that slide in and out of corresponding slots (e.g., similar to drawers) in a rack or within a chassis that sits within the rack. In a common design, different servers are stored within different trays of a chassis. This chassis configuration advantageously allows each server to be serviced independently as a field-replaceable-unit (FRU). In a typical configuration, each tray in a chassis includes front-side ports that attach to many different cables coupled to external resources. In some configurations, it is also desirable to support data connectivity between trays. These configurations create challenges in space management, particularly in high density storage applications.

SUMMARY

[0003] According to one implementation, a system disclosed herein includes a tray adapted for insertion into a tray slot in a front side of a chassis. The tray includes a lever and a moveable connector that protrudes from a sidewall of the tray and that engages with a side plane of the chassis in response to rotation of the lever.

[0004] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

[0005] Other implementations are also described and recited herein.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1**A illustrates an example chassis with multiple trays interconnected via a cabled side plane.

[0007] FIG. **1**B illustrates an example tray with moveable tray-side connectors that are designed to mate with corresponding connectors of a side plane of the chassis shown in FIG. **1**A.

[0008] FIG. **2** illustrates a front side of an example chassis implementing a side plane connection design that provides electrical connectivity between different trays.

[0009] FIG. **3** illustrates a perspective view of an example chassis implementing the disclosed technology.

[0010] FIG. **4** illustrates further aspects of an example chassis implementing a side plane connection design with moveable tray-side connectors within each of multiple trays of the chassis.

[0011] FIG. **5**A illustrates a top-down view of a prototype mechanism for a tray with one moveable tray-side connector adapted for selective mating and unmating with corresponding connectors in a side plane of a chassis.

[0012] FIG. **5**B illustrates a side-on view of the mechanism of FIG. **5**A.

[0013] FIG. **6** illustrates a top-down cross-sectional view of an example chassis illustrating a mated connection formed between a tray and a chassis side plane.

[0014] FIG. **7** illustrates example operation for engaging a compute resource tray with a chassis side plane according to an aspect of the herein disclosed technology.

DETAILED DESCRIPTION

[0015] Common techniques for forging tray-to-tray electrical connections within a chassis include the use of cables on either the front side or back side of the chassis as well as dedicated backplanes, each of which presents its own unique challenges. The formation of tray-to-tray interconnects on the front side of the chassis can impede serviceability since trays are removed and re-inserted into slots on the front side of the chassis. While the back side of the chassis can be accessed without impeding serviceability, chassis cooling systems typically pull cool air from front to back and expel hot air on the chassis back-side, which can create unsafe human temperature conditions near chassis cooling system exhaust ports. Consequently, chassis designs that require operator access to the chassis back side (e.g., to connect tray-to-tray cables) present operator safety concerns.

[0016] In contrast to the above, a backplane advantageously eliminates external cables and instead includes a back-side PCB within the rack with dedicated electrical connectors that mate with corresponding connectors on server trays. However, backplanes impede airflow and therefore strain chassis cooling systems. In addition, since it is common for servers to be positioned near the front of their respective trays, long data channels may be needed to connect a server (near the front of the tray) with a backplane. These long data channels can impede signal quality.

[0017] The herein disclosed technology includes a chassis side plane connection design that facilitates tray-to-tray electrical connectivity while avoiding the aforementioned disadvantages of existing tray-to-tray connectivity solutions. The disclosed side plane design is, in one implementation, implemented in a chassis with left and right side planes that enable connections to the left and right sides of trays housed within the chassis. The herein-described side planes connections can support various types of connections including connections that enable disaggregation of resources, sharing of resources, provisioning of power, and/or provisioning of liquid cooling. In one implementation, the herein disclosed side plane design provides high-density interconnects, such as those utilized by AI applications when connecting GPUs to high-speed switches to form a high-count GPU PODS (Point of Delivery). A chassis implementing the disclosed side plane design can be designed to fit within a standard 19- or 23-inch rack, or can be deployed outside of a rack.

[0018] According to one implementation, a chassis side plane is adapted for insertion into a vertically-oriented panel slot in a front side of the chassis. The chassis side plane extends parallel to the sides of multiple stacked trays and includes connector ports adapted to receive and mate with connectors that protrude from side planes of various stacked trays. In one implementation, select connector ports of the side plane at different heights (e.g., corresponding to different trays) are connected to one another via cables prior to insertion of the side plane into the chassis so as to provide desired tray-to-tray connections without a need for an operator to configure cable connections while standing in the proximity of the chassis at a data center.

[0019] According to another implementation, each tray within the chassis includes one or more moveable tray-side connectors adapted to transition between a protruded state and a retracted state in response to selective user rotation of a lever or other actuation mechanism. For example, an operator inserts a tray into a chassis while tray-side connectors in the tray are stowed in a retracted position. Once the tray is in place, the operator rotates a lever on the tray to cause the tray-side connectors to protrude outward from the side of the tray and mate with a corresponding connector of the side plane chassis. In one implementation, an interlock system prevents the operator from moving the handle until the tray and side plane are aligned properly. These and other configurations are contemplated in greater detail with respect to the following figures.

[0020] FIG. **1**A illustrates an example server chassis **100** with multiple trays (e.g., trays **102**, **104**, **112**), interconnected via a side plane connection design. The sever chassis **100** comprises an outer frame **114** that houses multiple trays. Each of the trays is oriented in a horizontal direction parallel to a base **108** of the chassis **100** and adapted to support various computer hardware such as processing components, memory, storage, and/or network components. In the illustrated implementations, some of the trays contain servers (e.g., a server tray **104**) and some of the trays contain hardware resources (e.g., network resource tray **102**, memory resources tray **112**, storage resources trays **113**) that are shared between multiple servers positioned within different respective trays of the chassis **100**.

[0021] Connections between different trays (e.g., server trays and the resource trays) are made via connections that occur on a side of the chassis. Specifically, sidewall **117** of the chassis **100** includes a side plane **106** that supports cable-based electrical connections between different trays. For instance, the resource trays **102**, **112**, and **113** are each shown to be connected to multiple different server trays via cable connection that extend between connection ports on the side plane **106**.

[0022] In the illustrated implementation, the side plane **106** is shown internal to the outer frame **114** with sidewall **117** transparent to illustrate aspects of the side plane **106**. The side plane **106** is oriented vertically within the chassis **100** (e.g., in a direction orthogonal to the chassis base **108**). In one implementation, the side plane **106** is removeable from the chassis **100** and the connections on the side plane **106** are pre-configured prior to insertion of the side plane **106**. Notably, the side plane **106** in other implementations of the disclosed technology may be non-removeable coupled to the chassis **100**.

[0023] Each of the trays **102**, **104**, **112**, **113** includes one or more moveable tray-side connectors (not visible in FIG. **1**A) and an actuation mechanism (e.g., a lever **121**) that can be selectably and bidirectionally engaged by a user to alter the position of moveable tray-side connectors between a retracted state and a protruded state. For example, rotating the lever **120** in a first direction causes the moveable tray-side connectors in the corresponding tray to retract inward toward (e.g., and at least partially within) a sidewall of the tray while rotating the lever **120** in a second opposite direction causes the moveable tray-side connectors in the corresponding tray to protrude outward from the side wall of the tray.

[0024] If the tray (e.g., the tray **102**) is properly positioned within a tray slot of the chassis **100**, transitioning the moveable try-side connectors from the retracted position to the protruded positions causes the moveable tray-side connectors to mate with corresponding connectors **124** of the side plane **106**. When, in contrast, the moveable tray-side connectors are transitioned back to the retracted state, the moveable tray-side connectors are decoupled from the side plane **106**, facilitating removal of the tray **102** from the chassis **100** through a corresponding tray slot in a front side **128** of the chassis.

[0025] FIG. **1**B illustrates an example tray **116** with moveable tray-side connectors **118** (shown in a retracted state) that are designed to mate with corresponding connectors of the side plane **106** of the chassis **100** shown in FIG. **1**A. The movable tray-side connectors **118** are adapted for bidirectional, single-axis movement along an axis substantially orthogonal to a sidewall **120** of the tray **116**.

[0026] In FIG. **1**B, the moveable tray-side connectors **118** are shown in a retracted state where the outward-most tip of each of the moveable tray-side connectors **118** is inward of the sidewall **120** of the tray **116**. A rotatable lever **121** protrudes through the front face of the tray **116** and is accessible on the front side of the chassis **100** (in FIG. **1**A) when the tray **116** is positioned within a corresponding horizontal slot (not shown) in the chassis **100**. As the rotatable lever **121** is rotated in a first direction, the movable tray-side connectors **118** gradually begin to protrude from corresponding slots in the sidewall **120** of the tray **116** to come into contact and mate with a corresponding connector on the side plane **106**.

[0027] In one implementation, the rotatable lever **121** is coupled to a moving assembly that uses a pin and slot design to transition the moveable tray-side connectors **118** to the protruded state in response to lever movement in a first direction and to transition the moveable tray-side connectors **118** back to the retracted state in response to lever movement in a second opposite direction. In this manner, rotation of the rotatable lever **121** causes the moveable tray-side connectors **118** to mate with corresponding connectors of the side plane **106**, facilitating tray-to-tray electrical connections at locations that do not interfere with airflow near cooling system intake or exhaust (at the front and rear of the chassis **100**, respectively).

[0028] In an implementation where the side plane **106** (of FIG. **1**A) is configured with respective electrical connections (e.g., as shown) prior to insertion into the chassis **100**, the above-described tray-to-tray electrical connections can be achieved via the side plane **106** without operator access to the back side of the chassis **100** where cooling system exhaust runs dangerously hot. Moreover, the above-described tray-to-tray connections can also be achieved without operator access to the side of the chassis (e.g., in proximity of the side plane **106**), allowing for high-density distribution of racks within in a data center.

[0029] Further details of the illustrated side plane design are described in greater detail with respect to the following figures.

[0030] FIG. **2** illustrates a front side of an example chassis **200** implementing a side plane connection design that provides electrical connectivity between different trays (e.g., trays **206-226**). The chassis **200** includes two side planes **202** and **204** that include connectors designed to couple to corresponding connectors that protrude outwardly from chassis trays (e.g., the trays **206-228**. The trays are independently removable through the front side of the chassis **200** without severing connections formed on the side planes **202** and **204** and also without removing the side planes **202** and **204** from the chassis **200**. Other aspects of the chassis **200** not described with respect to FIG. **2** may be the same or similar to features of other chassis described herein.

[0031] FIG. **3** illustrates a perspective view of an example chassis **300** implementing the disclosed technology. The chassis **300** includes trays (e.g., trays **302**, **304**) adapted to slide in and out of respective horizontally-oriented tray slots in the chassis **300**. The chassis **300** further includes a side plane **306** adapted for insertion into a vertically-oriented panel slot **308** in the chassis **300**. The side plane **306** is removeable from the chassis **300** and supports a number of electrical connectors (e.g., ports) that each provides electrical connectivity (e.g., via a cable) to another corresponding electrical connector on the side plane **306** that is positioned to electrically couple with a different respective one of the trays within the chassis. Other aspects of the trays (e.g., trays **302**, **304**) and side plane **306** that are not described explicitly with respect to FIG. **3** are assumed the same or similar to other implementations described herein.

[0032] FIG. **4** illustrates further aspects of an example chassis **400** implementing a side plane connection design with moveable tray-side connectors within each of multiple trays (e.g., trays **402**, **404**) of the chassis **400**. The moveable tray-side connectors within each of the trays are adapted to mate with corresponding electrical ports (also referred to herein as “connectors”) on a side plane **406** of the chassis **400**. Cables are shown attached to pairs of the connectors on the side plane **406** at different heights, thereby providing electrical connectivity between various different trays in the chassis **400**.

[0033] Each of the trays **402**, **404** in the chassis **400** includes a rotatable lever (e.g., a lever **410** visible in expanded top-down views **408***a*, **408***b*, **408***c*) that can be selectably and bidirectionally engaged by a user to alter a position of moveable tray-side connectors within a corresponding tray of the chassis **400**. between a retracted state and a protruded state.

[0034] The expanded views **408***a*, **408***b*, and **408***c* illustrate different positions of moveable tray-side connectors **414** within the tray **402** corresponding to different positions of the lever **410**. The views **408***a*, **408***b*, and **408***c* correspond to a cross-section of a tray **402** in the chassis **400** when viewed from the top, with the illustrated cross-section corresponding to a slice along the x-y plane of the x-y-z coordinate system of the chassis **400** illustrated in FIG. **4**.

[0035] As shown in views **408***a*, **408***b*, **408***c*, the lever **410** is attached (e.g., either directly or indirectly, such as via one or more mechanical linkages not visible in FIG. **4**) to a slotted planar component **416**. As the lever **410** is rotated consecutively from the respective positions illustrated in each of views **408***a*, **408***b*, and **408***c*, the slot planar component slides in a first direction (e.g., to the left) along the x-axis, also referred to herein as a “side plane axis.” This directional movement of the slotted planar component **416** is illustrated by arrows A and B in views **408***b* and **408***c*, respectively.

[0036] Each of the moveable tray-side connectors **414** (visible in views **408***b*, **408***c*) is rigidly coupled to a connector pin (e.g., a connector pin **420**) that protrudes through a corresponding slot (e.g., a slot **418**) in the slotted planar component **416**. The moveable tray-side connectors **414** are constrained from moving along the side plane axis (the x-axis) but adapted to move bidirectionally in a direction orthogonal to the side plane axis (e.g., in the y-axis direction per the axis labeling scheme of FIG. **4**). Due to the fixed connection between the connector pin **420** and its corresponding moveable tray-side connector, sliding movement of the slot **418** relative to the connector pin **420** forces unified movement of the connector pin **420** and its corresponding moveable tray-side connector in the y-axis direction.

[0037] As the slotted planar component **416** moves consecutively between the positions illustrated in views **408***a*, **408***b*, and **408***c*, respectively (e.g. leftward movement), the movement of the slots (e.g., the slot **418**) relative to the connector pins (e.g., the connector pin **420**), pushes each pin along the length of its corresponding slot from the top of the slot (as shown in the view **408***a*) to the bottom of the slot (as shown in the view **408***c*). This movement of the connector pins within each of the slots in the slotted planar component **416** translates to corresponding y-direction movement of the moveable tray-side connectors **414**.

[0038] In the view **408***a*, the lever **410** is in a first position and the moveable tray-side connectors **414** of the tray **402** are not visible because they are in a most-retracted position and thus tucked below the slotted planar component **416**. In one implementation, an interlock (not shown) prevents the handle from moving from this position until the tray is fully seated within the outer chassis.

[0039] When the lever **410** is rotated from the position shown in the view **408***a* to the position shown in the view **408***b*, the slotted planar component **416** moves in the direction of arrow "A" by a first amount, causing the pins to shift in position within their corresponding slots (e.g., the pin **420** shifts within the slot **418**) toward the sidewall of the tray **402**. This shift in position of the pins within each slot causes a corresponding positional shift of the moveable tray-side connectors **414** such that the connectors now protrude slightly from the sidewall of the tray **402** and partially engage with corresponding side plane connectors **422** of the side plane **406**. In one implementation, the position of the lever **410** in view **408***b* corresponds to a point in time in which guide pins (not shown) of the moveable tray-side connectors **414** first begin to couple with guide pin receptacles of the corresponding side plane connectors **422**.

[0040] When the lever **410** is rotated from the position shown in the view **408***b* to the position shown in the view **408***c*, the slotted planar component **416** shifts further in the direction of arrow "B," causing the pins (e.g., the pin **420**) to further shift in position within their corresponding slots, thereby further exposing the moveable tray-side connectors **414** on the exterior of the tray **402** such that the moveable tray-side connectors **414** have now fully engaged with the corresponding side plane connectors **422** of the side plane **406**.

[0041] In the implementation of FIG. **4**, the slots (e.g., slot **418**) of the slotted planar component **416** are diagonal and substantially linear in shape such that an axis through the length of the slot forms a non-orthogonal angle with the side plane axis (e.g., parallel to the x-direction). In other implementations, such as those shown in FIG. **5-6**, the slots are non-linear and of variable slope tailored to provide specific mechanical advantage to the moveable tray-side connectors **414** at select ranges of their extension.

[0042] FIG. **5**A illustrates a top-down view of a tray **500** containing a side plane engagement mechanism **510** with a moveable tray-side connector **502** adapted for selective mating and unmating with corresponding connectors in a side plane of a chassis (not shown), such as the chassis shown in FIG. **1**A, FIG. **2**, or FIG. **3**. In FIG. **5**A, various components of the side plane engagement mechanism **510** are shown transparent in order to better illustrate aspects of the moveable tray-side connector **502** and its respective functionality. The moveable tray-side connector **502** is, in the illustrated image, shown in a most-retracted positioned and underlying other components of the side plane engagement mechanism **510** including a slotted planar component **516**. In this implementation the slotted planar component **516** is shown formed from sheet metal, with bent edges for added strength.

[0043] Guide pins **512** of the moveable tray-side connector **502** are just barely visible on an exterior side **506** of the tray **500**. Although not shown, hardware resources of the tray **500** are positioned on a tray interior **508**, and the tray **500** slides in and out of a corresponding tray slot in a chassis. When the tray **500** is inserted within the corresponding tray slot of the chassis, the exterior side **506** of the side plane engagement mechanism **510** faces a side plane (not shown) of the chassis with characteristics the same or similar to side plane **306** of FIG. **3**.

[0044] The side plane engagement mechanism **510** of the tray **500** includes a slotted planar component **516** that is adapted to move along an axis **520** parallel to the exterior side **506** of the tray **500** in response to a rotational force applied to a lever **514**, rotating about an axis through pivot point **519**. This movement of the slotted planar component **516** is relative to underlying planar component **528** and the tray **500**, each of which remains fixed in position as the lever **514** is rotated. A low-friction layer or coating **537** may be present beneath the slotted planar component **516**.

[0045] The lever **514** is attached to a linkage **524**, and the linkage **524** is to fixedly (e.g., non-slidably) attached the slotted planar component **516** by one or more fixed pins **526** that extend from the linkage **524** and through the slotted planar component **516**. Rotational movement of the lever **514** moves the linkage **524** along the side plane axis **520** and thereby forcibly slides the slotted planar component **516** in the same direction by a corresponding amount.

[0046] The slotted planar component **516** includes an angled slot **530** that is slidably coupled to a connector pin **536** that protrudes from and is fixedly attached to the moveable tray-side connector **502**. The angled slot **530** and connector pin **536** are collectively referred to herein as a “bar and slot assembly.” A bushing or low friction surface between the pin **536** and slot **530** may reduce friction between the pin and slot.

[0047] When the slotted planar component **516** slides along the side plane axis **520** relative to the underlying planar component **528**, the connector pin **536** does not move relative to the side plane axis **520**. However, the connector pin **536** and moveable connector **502** are free to move along a connector movement axis **532** orthogonal to the side plane axis **520**. Consequently, the sliding movement of the angled slot **530** relative to the connector pin **536** imparts movement on the connector pin **536** in direction of the connector movement axis **532**.

[0048] In the implementation shown, rightward movement of the slotted planar component **516** forces the connector pin **536** and the movable tray-side connector **502** in unison outward toward the chassis sidewall (toward the top of FIG. 5A) along the movement axis **532** until the connector pin **536** reaches the opposite end of the slot proximal to the exterior side **506** of the side plane engagement mechanism **510**. From this position, leftward movement of the slotted planar component **516** forces the connector pin **536** and the movable tray-side connector **502** in unison inward toward the tray interior **508** until the original (illustrated) position is reached.

[0049] In the implementation of FIG. 5A-5B, the angled slot **530** is oriented in a generally diagonal direction relative to the side plane axis **520**. The angled slot **530** also has a variable slope that is specifically tailored to alter mechanical advantage of the bar in slot assembly at specific locations of connector pin **536** within the angled slot **530** in response to a constant human-applied force acting on the lever **514**.

[0050] It is widely understood that the force required to mate electrical connectors increases while the connectors are mating (e.g., with force increasing as the surface area of contact increases between the connectors. For electrical connectors, this increased force is due to friction between and motion of the electrical contacts in the mating connectors. In a typical scenario, two electrical connectors are initially brought together to a point where guide pins engage to provide a coarse alignment between the electrical connectors. Systems typically allow for float, or motion between the two connectors, to account for any offsets or misalignment between the connectors. After this point of initial contact between the guide pins and corresponding receptacles, more force may be required to align the connectors. To continue the mating, the user has to overcome the force needed to mate the two connectors. The maximum force required to complete the mating is known as the "peak mating force." The peak mating force of needed to mate a single pair of connectors increases as a multiple of the number of electrical contacts being simultaneously connected. A single pair of electrical contacts may require less than one pound of force. This side plane mechanism may be used for high-speed electrical connectors, electrical power connectors, or liquid line connections.

[0051] In FIG. **5**A, the use of the lever **514** as the force application mechanism provides some mechanical advantage that reduces the human-applied force needed to achieve a given quantity of force against the movement connector **502** along the movement axis **532**. At any given position of the connector pin **536** within the angled slot **530**, the slope of the angled slot **530** directly influences the magnitude of this mechanical advantage. The angled slot **530** is therefore deliberately tailored in shape to ensure that a greater mechanical advantage is provided when the mating between the moveable connector **502** and side plane connector (not shown) is nearly complete—e.g., during a final fraction (e.g., last 25% or so) of the range of the connector's range of motion. In the illustrated implementation, the slope of the angled slot **530** relative to the side plane axis **520** is greater in a first region proximal to the tray interior **508** than in a second region distal from the tray interior **508** (e.g., that is comparatively closer to the exterior side **506** of the tray **500**).

[0052] In application, the slope of the angled slot **530** is greatest as the connector first begins to transition from the fully retracted position (as illustrated) to a protruded position. Once the moveable connector **502** is more than halfway through this range of motion, the slope of the angled slot **530** decreases, which translates to an increased mechanical advantage—meaning, the same magnitude of user-applied force translates to an increased outward force on the moveable connector **502**.

[0053] The above-described variable slope design for the angled slot **530** ensure that the moveable connector **502** can be mated with a side plane connector (not shown) with a lesser human-applied force (e.g., to the lever **514**) as compared to the human-applied force that is needed slot in designs with a linear slot, as shown in FIG. **3**. This increased mechanical advantage may be particularly useful in designs that incorporate many bar-in-slot assemblies in a single tray to move many moveable connectors in unison in response to movement on the lever.

[0054] FIG. **5**B illustrates a side-on view **501** of the side plane engagement mechanism **510** of the tray **500** of FIG. **5**A as viewed from the interior of the tray **500** (e.g., from the center of the tray **500** looking out at the side plane engagement mechanism **510**). The side-on view **501** better illustrates linkages between the lever **514**, linkage **524**, and fixed pin **526** that fixedly couples the linkage **524** to the slotted planar component **516**. Due to this fixed coupling, rotational movement of the lever **514** shifts the linkage along the side plane axis **520** and shifts the slotted planar component **516** by a corresponding amount relative to the underlying planar component(s) **528**, which remains fixed. While the slotted planar component **516** is moved along the x direction, the moveable connector **502** and fixed pin **526** move in unison in the y-direction (e.g., into and out of the page in FIG. **5**B) due to relative movement of the fixed pin **526** and the angled slot (not shown in FIG. **5**B) in the slotted planar component **516**.

[0055] In the side view of FIG. **5**B, the slotted planar component **516** is mirrored by an additional moving component **517** on the underside of the side plane engagement mechanism **510**. The additional moving planar component **517** is similar or identical in shape to the slotted planar component **516** and moves in unison with the slotted planar component **516**. The view of FIG. **5**B additionally shows an additional underlying planar component(s) **529** that mirror the structure and function of the underlaying planar component(s) **528**. The underlying planar components **528**, **529** remain fixed in position while the slotted planar component **516** and the additional moving planar component **517** move in unison while separated from one another by structural components **538**.

[0056] FIG. **6** illustrates a top-down cross-sectional view of an example chassis **600** illustrating a mated connection formed between a tray **605** and a chassis side plane **640**. Specifically, the mated

connection is formed between a moveable connector **602** in a side plane portion **610** of the tray **605** and a connector **603** mounted on the chassis side plane **640**.
[0057] Components of the side plane portion **610** of the tray function the same or similar to corresponding components described with respect to FIG. **5**A-**5**B. Specifically, the tray **605** includes a lever **614** attached to a slotted planar component **616** via one or more linkages (not shown) and fixed pin **626**. When a user applies a force to the lever **614**, the rotation of the lever **614** causes the slotted planar component **616** to slide along a side plane axis **620** relative to underlying planar component **628** and relative to the moveable connector **602**. The moveable connector **602** is fixedly attached to a connector pin **636** slidably coupled to a slot **630** in the slotted planar component **616**. As the slotted planar component **616** slides along the side plane axis **620**, the connector pin **636** and moveable connector **602** are pushed outward from the tray **605** toward the chassis exterior (e.g., in a direction orthogonal direction to the side plane axis **620**), until the connector pin **636** reaches the illustrated position.
[0058] Provided that both the tray **605** and the chassis side plane **640** are positioned within a chassis (e.g., as generally shown with respect to FIG. **1**A), the above-described rotation of the lever **614** causes the moveable connector **602** to mate with the connector **603** on the chassis side plane **640** as shown.
[0059] FIG. **7** illustrates example operation **700** for engaging a compute resource tray (e.g., a server tray or a tray storing resources utilize by a server) with a chassis side plane according to an aspect of the herein disclosed technology. A first lever rotation operation **702** rotates a lever on the tray in a first direction to cause a moveable connector on a sidewall of the tray to retract inward toward the tray and to an inward-most position. While the moveable connector remains stowed at the inward-most position, an insertion operation **704** inserts the tray into a tray slot on a front side of a chassis. When the tray is inserted within the tray slot, the lever remains accessible to a user positioned (e.g., standing) proximal to the front side of the chassis. While the tray remains inserted in the tray slot, a second lever rotation operation **706** rotates the lever in a second direction (e.g., opposite the first direction) to cause the moveable connector of the tray to begin moving outward away from the sidewall of the tray and into engagement with a side plane of the chassis. For example, the moveable connector moves into engagement with an electrical connector attached to a chassis side plane, and this establishes an electrical coupling between the moveable connector of the tray and the chassis side plane.
[0060] In some aspects, the techniques described herein relate to a system including: a tray adapted for insertion into a tray slot in a front side of a chassis, the tray including: a lever; and a moveable connector that protrudes from a sidewall of the tray and that engages with a side plane of the chassis in response to rotation of the lever.
[0061] In some aspects, the techniques described herein relate to a system, wherein: the lever is accessible on the front side of the chassis when the tray is positioned in the tray slot, and wherein: the moveable connector is adapted to: protrude outward from the sidewall of the tray in response to rotation of the lever in a first direction; and retract inward and at least partially into the sidewall in response to rotation of the lever in a second direction opposite the first direction.
[0062] In some aspects, the techniques described herein relate to a system, further including: a chassis side plane adapted for insertion into a panel slot that is within the chassis and substantially orthogonal to the tray slot, the chassis side plane including a connector port adapted to receive the moveable connector of the tray in response to rotation of the lever.
[0063] In some aspects, the techniques described herein relate to a system, wherein the chassis side plane extends parallel to the sidewall of the tray and to sidewalls of multiple other trays positioned within the chassis, and wherein the chassis side plane includes multiple other connector ports adapted to receive and mate with moveable connectors that protrude from multiple of other trays in the chassis to facilitate electrical connects between various ports in various trays.
[0064] In some aspects, the techniques described herein relate to a system, wherein the lever is

attached to a slotted planar component that includes a slot slidably coupled to a connector pin fixedly attached to the moveable connector, the slotted planar component being adapted to slide along a side plane axis parallel to a chassis side plane in response to rotational movement of the lever.

[0065] In some aspects, the techniques described herein relate to a system, wherein the slot forms a non-orthogonal angle with the side plane axis and movement of the slotted planar component along the side plane axis forces movement of the connector pin and the moveable connector in a direction orthogonal to the side plane axis.

[0066] In some aspects, the techniques described herein relate to a system, where the slot has variable slope designed to increase mechanical advantage acting on the moveable connector as the moveable connector is moved outward from the sidewall of the tray.

[0067] In some aspects, the techniques described herein relate to a system, wherein the slot has a slope defined relative to the side plane axis, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

[0068] In some aspects, the techniques described herein relate to a method including: rotating a lever on a tray in a first direction to cause a moveable connector on a sidewall of the tray to retract inward toward the tray and to an inward-most position; while the moveable connector is stowed at the inward-most position, insert the tray into a tray slot on a front side of a chassis with the lever remaining accessible from the front side of the chassis; while the tray remains inserted within the tray slot, rotation the lever in a second direction to cause the moveable connector of the tray to protrude outward from the sidewall of the tray and move into engagement with a chassis side plane.

[0069] In some aspects, the techniques described herein relate to a method, further including: rotating the lever on a tray back in the first direction to cause the moveable connector to retract inward toward the tray and to the inward-most position; and removing the tray from the chassis while the moveable connector is at the inward-most position.

[0070] In some aspects, the techniques described herein relate to a method, wherein the chassis side plane is substantially orthogonal to the tray slot and includes a connector port adapted to receive the moveable connector of the tray and to mate with the moveable connector when the moveable connector is at an outward-most position relative to the sidewall of the tray.

[0071] In some aspects, the techniques described herein relate to a method, wherein the chassis side plane extends parallel to the sidewall of the tray and to sidewalls of multiple other trays positioned within the chassis, and wherein the chassis side plane includes multiple other connector ports adapted to receive and mate with moveable connectors that protrude from multiple of other trays in the chassis to facilitate electrical connects between various ports in various trays.

[0072] In some aspects, the techniques described herein relate to a method, wherein the lever is attached to a slotted planar component that includes a slot slidably coupled to a connector pin fixedly attached to the moveable connector, the slotted planar component being adapted to slide along a side plane axis parallel to a chassis side plane in response to rotational movement of the lever.

[0073] In some aspects, the techniques described herein relate to a method, wherein the slot forms a non-orthogonal angle with the side plane axis and movement of the slotted planar component along the side plane axis forces movement of the connector pin and the moveable connector in a direction orthogonal to the side plane axis.

[0074] In some aspects, the techniques described herein relate to a method, wherein the slot has a slope defined relative to the side plane axis, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

[0075] In some aspects, the techniques described herein relate to a method, wherein the moveable connector and the connector pin are fixed in position along the side plane axis and adapted to move in a plane orthogonal to the side plane axis.

[0076] In some aspects, the techniques described herein relate to a system including: a chassis including a plurality of tray slots; a tray adapted for insertion within a tray slot of the plurality of tray slots, the tray including: a front wall that includes a lever accessible on a front side of the chassis when the tray is positioned in the tray slot; a sidewall substantially orthogonal to the front wall that rests internal to the chassis when the tray is positioned within the tray slot; and a moveable connector adapted to move in a direction orthogonal to the sidewall of the tray in response to rotation of the lever, the rotation of the lever driving a pin-in-slot assembly that forcibly slides a planar component with a slot relative to a connector pin positioned within the slot and attached to the moveable connector.

[0077] In some aspects, the techniques described herein relate to a system, wherein rotation of the lever in a first direction forcibly slides a slotted planar component in a first direction to drive the connector pin away outward away from an interior of the tray and wherein the rotation of the lever in a second opposite direction forcibly slides the slotted planar component in a second opposite direction to drive the connector pin to inward toward the interior of the tray.

[0078] In some aspects, the techniques described herein relate to a system, wherein the slot has a slope defined relative to a movement axis of the slotted planar component, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

[0079] In some aspects, the techniques described herein relate to a system, further including a chassis side plane adapted for insertion into a panel slot that is within the chassis and substantially orthogonal to the plurality of tray slots, the chassis side plane including a connector port adapted to receive the moveable connector of the tray in response to rotation of the lever.

[0080] Some implementations may comprise an article of manufacture. An article of manufacture may comprise a tangible storage medium (a memory device) to store logic. Examples of a storage medium may include one or more types of processor-readable storage media capable of storing electronic data, including volatile memory or non-volatile memory, removable or non-removable memory, erasable or non-erasable memory, writeable or re-writeable memory, and so forth. Examples of the logic may include various software elements, such as software components, programs, applications, computer programs, application programs, system programs, machine programs, operating system software, middleware, firmware, software modules, routines, subroutines, operation segments, methods, procedures, software interfaces, application program interfaces (API), instruction sets, computing code, computer code, code segments, computer code segments, words, values, symbols, or any combination thereof. In one implementation, for example, an article of manufacture may store executable computer program instructions that, when executed by a computer, cause the computer to perform methods and/or operations in accordance with the described implementations. The executable computer program instructions may include any suitable type of code, such as source code, compiled code, interpreted code, executable code, static code, dynamic code, and the like. The executable computer program instructions may be implemented according to a predefined computer language, manner, or syntax, for instructing a computer to perform a certain operation segment. The instructions may be implemented using any suitable high-level, low-level, object-oriented, visual, compiled and/or interpreted programming language.

[0081] The logical operations described herein are implemented as logical steps in one or more computer systems. The logical operations may be implemented (1) as a sequence of processor-implemented steps executing in one or more computer systems and (2) as interconnected machine or circuit modules within one or more computer systems. The implementation is a matter of choice, dependent on the performance requirements of the computer system being utilized. Accordingly, the logical operations making up the implementations described herein are referred to variously as operations, steps, objects, or modules. Furthermore, it should be understood that logical operations may be performed in any order, unless explicitly claimed otherwise or a specific order is inherently necessitated by the claim language. The above specification, examples, and data, together with the attached appendices, provide a complete description of the structure and use of exemplary implementations.

[0082] The above specification, examples, and data, together with the attached appendices, provide a complete description of the structure and use of example implementations.

Claims

1. A system comprising: a tray adapted for insertion into a tray slot in a front side of a chassis, the tray including: a lever; and a moveable connector that protrudes from a sidewall of the tray and that engages with a side plane of the chassis in response to rotation of the lever.

2. The system of claim 1, wherein: the lever is accessible on the front side of the chassis when the tray is positioned in the tray slot, and wherein: the moveable connector is adapted to: protrude outward from the sidewall of the tray in response to rotation of the lever in a first direction; and retract inward and at least partially into the sidewall in response to rotation of the lever in a second direction opposite the first direction.

3. The system of claim 1, further comprising: a chassis side plane adapted for insertion into a panel slot that is within the chassis and substantially orthogonal to the tray slot, the chassis side plane including a connector port adapted to receive the moveable connector of the tray in response to rotation of the lever.

4. The system of claim 3, wherein the chassis side plane extends parallel to the sidewall of the tray and to sidewalls of multiple other trays positioned within the chassis, and wherein the chassis side plane includes multiple other connector ports adapted to receive and mate with moveable connectors that protrude from multiple of other trays in the chassis to facilitate electrical connects between various ports in various trays.

5. The system of claim 1, wherein the lever is attached to a slotted planar component that includes a slot slidably coupled to a connector pin fixedly attached to the moveable connector, the slotted planar component being adapted to slide along a side plane axis parallel to a chassis side plane in response to rotational movement of the lever.

6. The system of claim 5, wherein the slot forms a non-orthogonal angle with the side plane axis and movement of the slotted planar component along the side plane axis forces movement of the connector pin and the moveable connector in a direction orthogonal to the side plane axis.

7. The system of claim 5, where the slot has variable slope designed to increase mechanical advantage acting on the moveable connector as the moveable connector is moved outward from the sidewall of the tray.

8. The system of claim 7, wherein the slot has a slope defined relative to the side plane axis, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

9. A method comprising: rotating a lever on a tray in a first direction to cause a moveable connector on a sidewall of the tray to retract inward toward the tray and to an inward-most position; while the moveable connector is stowed at the inward-most position, insert the tray into a tray slot on a front side of a chassis with the lever remaining accessible from the front side of the chassis; while the tray remains inserted within the tray slot, rotation the lever in a second direction to cause the moveable connector of the tray to protrude outward from the sidewall of the tray and move into engagement with a chassis side plane.

10. The method of claim 9, further comprising: rotating the lever on a tray back in the first direction to cause the moveable connector to retract inward toward the tray and to the inward-most position; and removing the tray from the chassis while the moveable connector is at the inward-most position.

11. The method of claim 9, wherein the chassis side plane is substantially orthogonal to the tray slot and includes a connector port adapted to receive the moveable connector of the tray and to mate with the moveable connector when the moveable connector is at an outward-most position relative to the sidewall of the tray.

12. The method of claim 11, wherein the chassis side plane extends parallel to the sidewall of the tray and to sidewalls of multiple other trays positioned within the chassis, and wherein the chassis side plane includes multiple other connector ports adapted to receive and mate with moveable connectors that protrude from multiple of other trays in the chassis to facilitate electrical connects between various ports in various trays.

13. The method of claim 11, wherein the lever is attached to a slotted planar component that includes a slot slidably coupled to a connector pin fixedly attached to the moveable connector, the slotted planar component being adapted to slide along a side plane axis parallel to a chassis side plane in response to rotational movement of the lever.

14. The method of claim 13, wherein the slot forms a non-orthogonal angle with the side plane axis and movement of the slotted planar component along the side plane axis forces movement of the connector pin and the moveable connector in a direction orthogonal to the side plane axis.

15. The method of claim 13, wherein the slot has a slope defined relative to the side plane axis, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

16. The method of claim 13, wherein the moveable connector and the connector pin are fixed in position along the side plane axis and adapted to move in a plane orthogonal to the side plane axis.

17. A system comprising: a chassis including a plurality of tray slots; a tray adapted for insertion within a tray slot of the plurality of tray slots, the tray including: a front wall that includes a lever accessible on a front side of the chassis when the tray is positioned in the tray slot; a sidewall substantially orthogonal to the front wall that rests internal to the chassis when the tray is positioned within the tray slot; and a moveable connector adapted to move in a direction orthogonal to the sidewall of the tray in response to rotation of the lever, the rotation of the lever driving a pin-in-slot assembly that forcibly slides a planar component with a slot relative to a connector pin positioned within the slot and attached to the moveable connector.

18. The system of claim 17, wherein rotation of the lever in a first direction forcibly slides a slotted planar component in a first direction to drive the connector pin away outward away from an interior of the tray and wherein the rotation of the lever in a second opposite direction forcibly slides the slotted planar component in a second opposite direction to drive the connector pin to inward toward the interior of the tray.

19. The system of claim 17, wherein the slot has a slope defined relative to a movement axis of the slotted planar component, the slope being greater in a first region proximal to a tray interior than in a second region distal from the tray interior.

20. The system of claim 17, further comprising a chassis side plane adapted for insertion into a panel slot that is within the chassis and substantially orthogonal to the plurality of tray slots, the chassis side plane including a connector port adapted to receive the moveable connector of the tray in response to rotation of the lever.