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Adaptable Power Cable Interface for Data Center Server Trays

ABSTRACT

In data center racks today, there is little space between a graphics processing unit (GPU) module and modules connected to it, such as power supply or input-output modules. This leads to the possibility of adverse thermal events and is also ergonomically undesirable. This disclosure describes techniques for auxiliary power connection to GPU trays. The described techniques provide increased operational space for operators. The described power cable interface can function as a power plane for distributing power in transverse directions. With appropriate voltage regulators, the power cable interface can function as a power supply for CPUs that lack floor space. Along with a substantial reduction in or elimination of safety and ergonomic risks, and reduced insertion force, the described power cable interface also has higher power-delivery capacity compared to existing techniques.

KEYWORDS

- Data center
- GPU tray
- Add-on GPU
- Auxiliary power delivery
- Printed circuit board assembly (PCBA)
- Power cable interface
- Peripheral component interconnect express (PCIe)
- Card electromechanical (CEM) specification

BACKGROUND

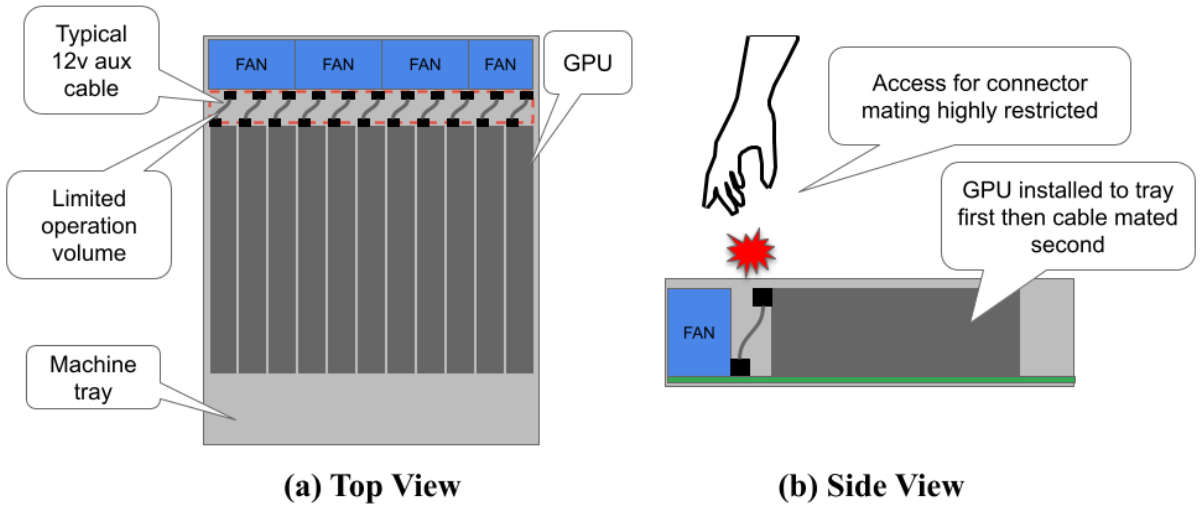

Fig. 1: GPU tray in a data center

Fig. 1 illustrates a schematic of a GPU installed in a tray of a data center rack. As illustrated, in data center racks today, there is little space or operating volume between a GPU module and modules that are connected to it, such as power supply or input-output modules. Aside from the lack of ergonomics, the present configuration has disadvantages such as:

- High-power GPU cables from some GPU vendors have been implicated in adverse thermal events [1].
- The power connection to the GPU using auxiliary (aux) cables is difficult during assembly (manufacture) as well as during maintenance in operation (e.g., within a data center). Repeated finger or hand motions to insert cables in constrained spaces can lead to musculoskeletal injuries and/or disorders for assembly line workers.
- GPU and accelerator trays are trending towards higher power densities. Some GPU cards can exceed current capabilities for existing cable designs given ergonomic serviceability constraints.

- In some contexts, the performance of the GPU can be impaired.

DESCRIPTION

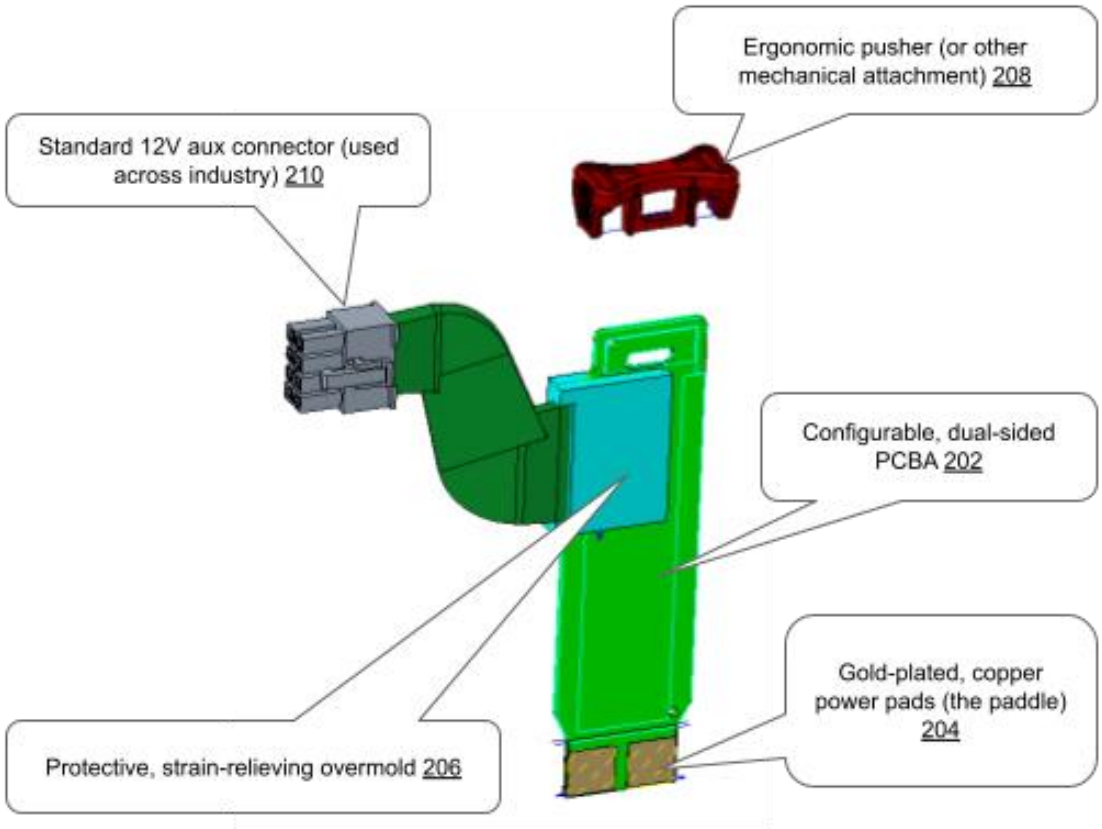

Fig. 2: Ergonomic power cable interface

This disclosure describes auxiliary power connection techniques to GPU trays that provide increased operational space for the operator, e.g., maintenance or assembly line workers. As illustrated in Fig. 2, the ergonomic power cable interface includes:

- a configurable, dual-sided, modular printed circuit board (202) with a high-weight copper core capable of handling high wattages, e.g., 600 Watts or more at 54 Volts or more;
- gold-plated, copper power pads (204, also known as paddle contacts) for high-power applications;
- a configurable, dual-sided solder pad array of flexible overmolded wires (206);

- an integrated pusher or grip feature to facilitate plugging and unplugging (208);
- a standard 12 Volt aux connector (210); etc.

The wire-soldered down-pads (206) to the printed circuit board assembly (PCBA) are reinforced with an overmolded polycarbonate/acrylonitrile butadiene styrene (PCABS) or other flame-retardant plastic. The solder interface connection acts as strain relief and thermal protection. It also provides a measure of heat dissipation. As explained below, the cable assembly can be attached to a GPU before inserting the GPU into a computer or system. The ergonomic pusher interface enables the operator to easily plug the PCBA into a mating connector on a motherboard.

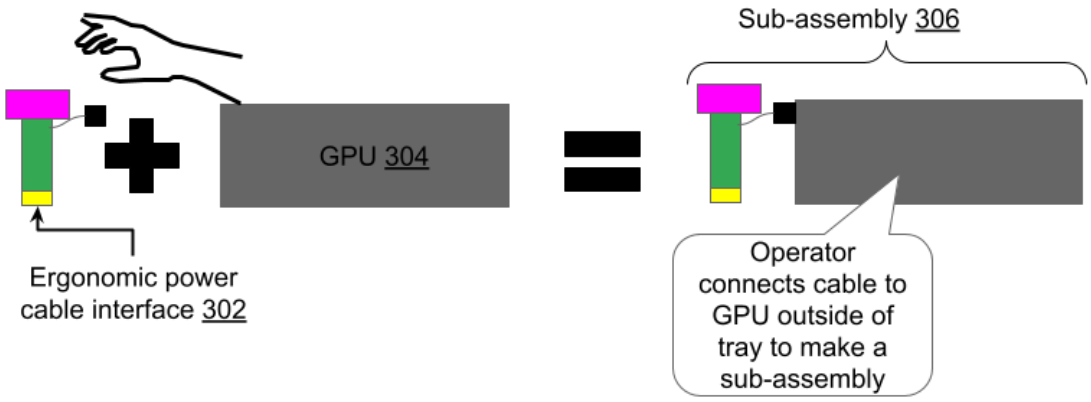

Fig. 3: An operator connects the power cable to the GPU outside the tray

Fig. 3 illustrates that the operator connects the power cable interface (302, represented schematically by a T-shaped figure with purple pusher, green cable assembly, and yellow paddle) to the GPU (304, gray rectangle) to form a sub-assembly (306) outside the tray. Since the sub-assembly is formed outside the tray, ergonomic difficulties with connecting a power cable to a tray-hosted GPU are resolved.

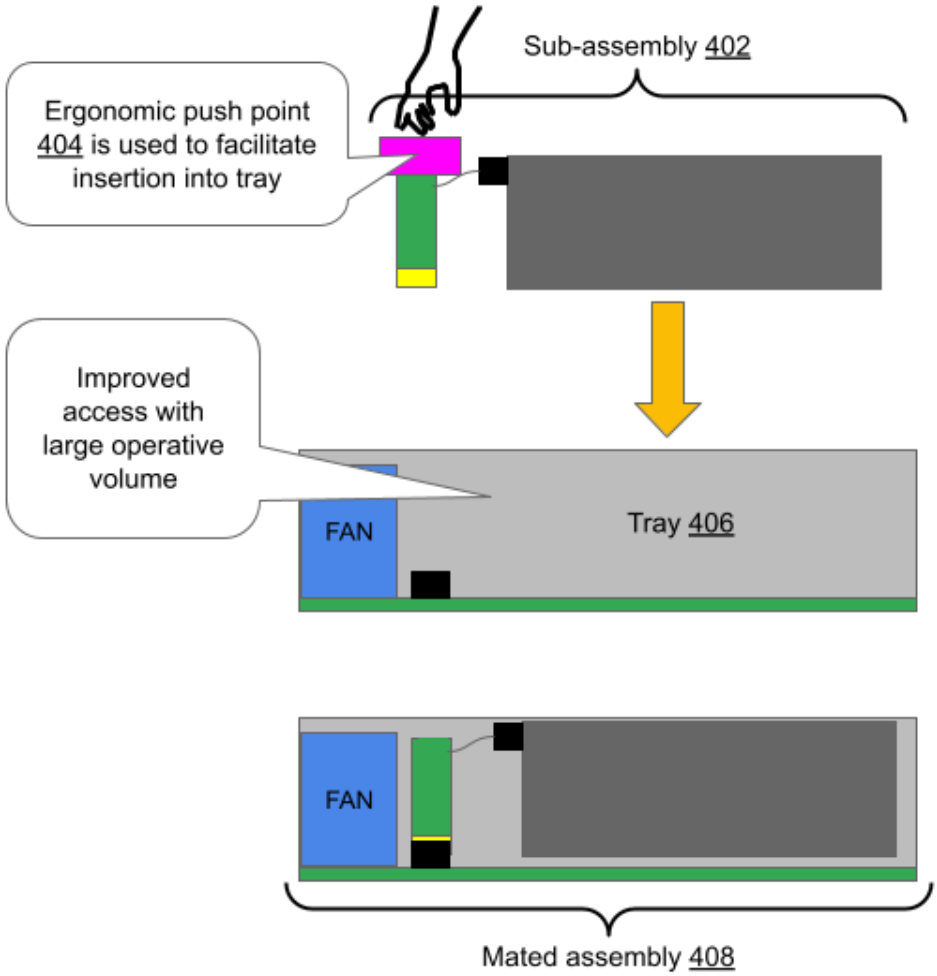

Fig. 4: Inserting the sub-assembly to create a mated assembly

Fig. 4 illustrates inserting the sub-assembly (402) into a tray (406) to create a mated assembly (408). The ergonomic pusher (404) on the power cable interface (which is now a part of the sub-assembly) is used to facilitate easy insertion of the subassembly into the tray. In this manner, the described power cable interface provides operators improved access to the tray with a larger operative volume.

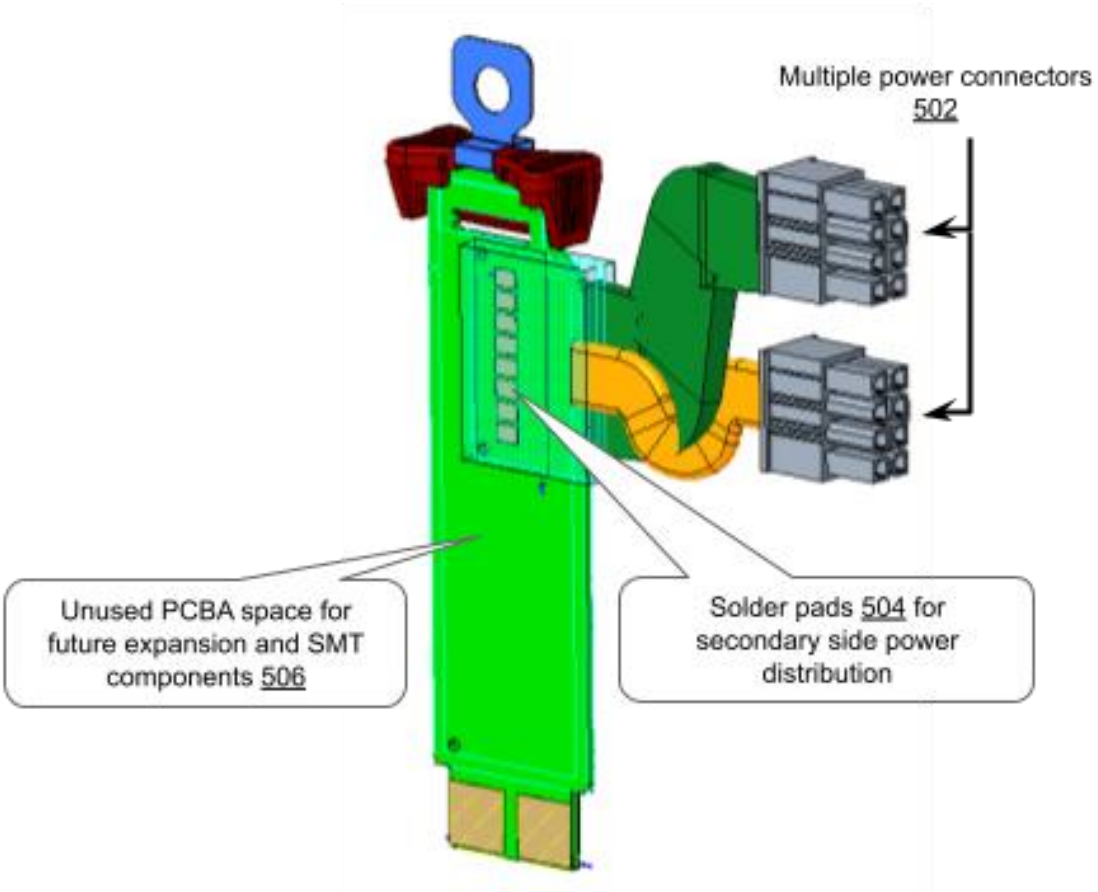

Fig. 5: Extensions to the power cable assembly

Fig. 5 describes a few extensions to the power cable assembly. As illustrated, the power cable interface can be fitted with multiple power connectors (502). The multiple power connectors can be facilitated by solder pads (504) for secondary side power distribution. Furthermore, unused PCBA space (506) can be used for surface-mount technology (SMT) components and for future expansions. Some examples of SMT components include application-specific integrated circuits (ASICs) for smart cables, onboard memory, embedded multimedia cards (EMMC), temperature and humidity sensors, mechanical hardware connections, etc. Mechanical hardware connections can function as mounts for thermal solutions, fans, cable managers, airflow redirection baffling, etc. The described power cable interface can function as a

power plane PCBA for distributing power in transverse directions. With appropriate voltage regulators, the power cable interface can function as a power supply for CPUs that lack floor space.

Alternatively, a similarly constructed power cable interface can have a different cable terminal side that utilizes connectors such as direct solder to PCBA (using through holes or SMT); pogo pins; radial plugs or sockets; coaxial cables (e.g., of a surface-mount assembly (SMA)); high-power USB; etc. The paddle card terminal of the power cable interface can be made a part of the GPU card, enabling directly plugging into a power source without the use of any cables. The described power cable interface can be used for any model of cable connector and for voltages other than 12 volts, such as 48 or 54 volts, for which a cable connector specification is present in PCIe CEM.

Some advantages of the described power cable interface include:

- Substantial reduction in or elimination of safety and ergonomic risks.
- Reduced insertion force required as compared to standard connectors.
- Substantially higher (e.g., double) power-delivery capacity compared to existing techniques. The higher power capacity results from branching to multiple connectors; the thicker wires translate to higher powers.
- Extendibility to multiple (dual, quadruple, etc.) cable harnesses per PCBA, based on the form factor of the PCBA.

CONCLUSION

This disclosure describes techniques for auxiliary power connection to GPU trays. The described techniques provide increased operational space for operators. The described power cable interface can function as a power plane for distributing power in transverse directions.

With appropriate voltage regulators, the power cable interface can function as a power supply for CPUs that lack floor space. Along with a substantial reduction in or elimination of safety and ergonomic risks, and reduced insertion force, the described power cable interface also has higher power-delivery capacity compared to existing techniques.