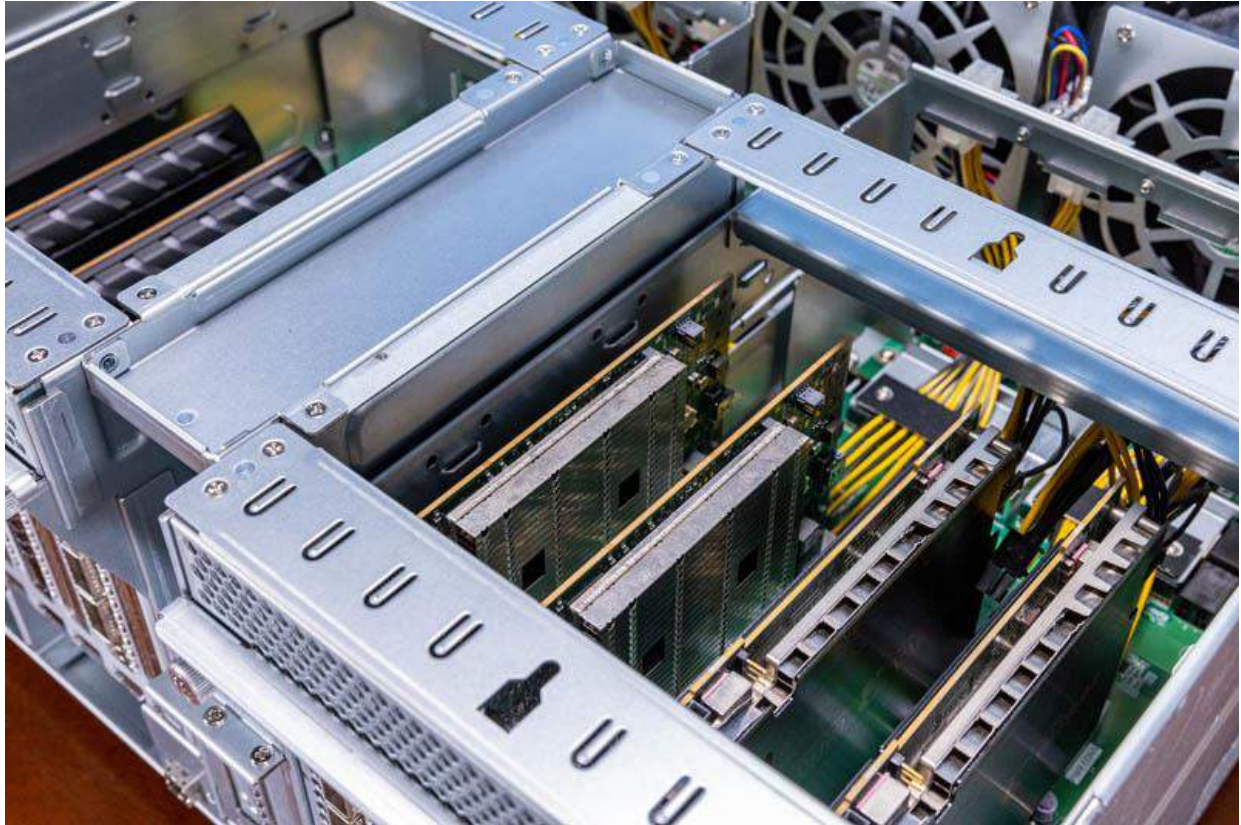


# AIC JBOX (J5010-02) Review Limitless Potential PCIe Gen4 Box



*AIC JBOX J5010 02 Many Different PCIe Cards Installed*

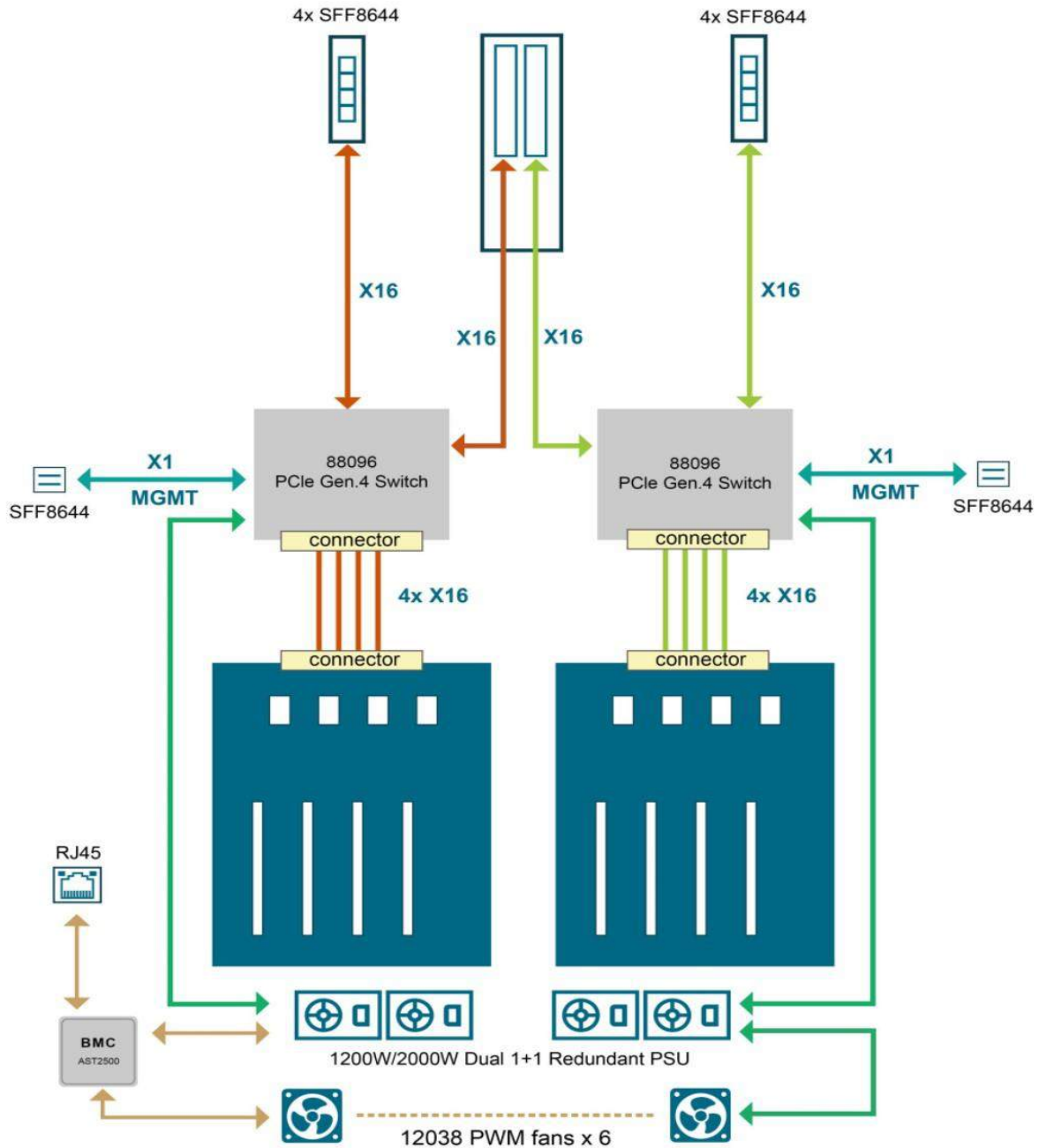
The title may be a bit reaching, but in our AIC JBOX review, we are going to look at a piece of hardware that is going to make STH'ers salivate with the possibilities. Indeed, after this formal review, we have a number of very cool projects that will be coming out over the next few weeks as we have been using this JBOX not just for this review, but also to showcase some really cool technology. The machine itself is in many ways very simple. There are no processors, nor built-in networking. Instead, the AIC JBOX is designed to service PCIe devices with PCIe Gen4 switches, power supplies, and cooling. That simplicity yields great flexibility. Let us get to it.

## AIC JBOX (J5010-02) Block Diagram

For this overview, we are going to do something very different than our standard review format. We are going to start with the block diagram for this one instead of

going through the hardware overview. Originally, this review had the opposite order, but this made it clearer when we get to look at the actual JBOX.

## J5010-02 System Block Diagram



AIC JBOX J5010 02 Block Diagram

In many systems we review, we have two CPUs, then connections to PCIe slots. This is different. There are two largely independent PCIe Gen4 switches. These are

Broadcom Atlas PEX88096 PCIe Gen4 switches. The last 96 means that there are 96 primary switch ports. A fun fact is that on these switches there are actually 98 PCIe lanes with two lanes used for management. They even have an Arm Cortex R4 CPU built-in, but that is more for managing the PCIe switch than it is something you would want to use as a server CPU.



*AIC JBOX J5010 02 Rear PCIe Sled Out And On Top*

The key here is that instead of CPUs, the two PCIe Gen4 switches are the hearts of the JBOX. Also, one will notice that there are effectively two different sides, each with a Broadcom switch. One can, for example, plug this JBOX into a single server using the same CPU as the root. One can plug this JBOX into different CPUs to avoid socket-to-socket congestion. A third option is connecting one set of devices to a server, and one to another server. Perhaps the most unique, and one that we will show in a follow-up piece, is not connecting this JBOX to a traditional server. Many of our STH readers will see what we are doing in a few of the photos.

With that, let us get to the hardware to see how this block diagram is implemented.

## AIC JBOX (J5010-02) Hardware Overview



Originally this section was all just a large hardware overview, but it ended up with over two dozen photos, so we are splitting it into external and internal hardware overviews as we would do with our server reviews. Then, we are also going to show many different PCIe devices in the system.

## AIC JBOX (J5010-02) External Hardware Overview

First off, let us talk dimensions. The chassis is 5U, so it is certainly tall, but it is also relatively short in depth. The depth is 450mm or 17.7". We get many folks asking about short-depth servers and having add-in cards. This is a really interesting option.



*AIC JBOX J5010 02 Front*

The front of the unit has a giant inlet filled with fans, then ~2U of blanked-out spaces. On the bottom, we can see a service tag, along with a power button, serial, and a RJ45 port.



AIC JBOX J5010 02 Management Port And Service Tag

That RJ45 port uses MegaRAC SP-X management for sensor data. One can see things like fan speeds, power supply status, power consumption, and so forth. We are going to do a bigger piece on AIC management in the next few weeks when we look at our first AIC server, but many will be familiar with SP-X since it is an industry-standard solution.

PSU Power Supply Units

Slot 1	Slot 2	Slot 3	Slot 4
Power Supply Status: PS OK	Power Supply Status: PS Off	Power Supply Status: PS Off	Power Supply Status: PS OK
AC Input Voltage: 228 V	AC Input Voltage: 0 V	AC Input Voltage: 0 V	AC Input Voltage: 227 V
AC Input Current: 0.513 A	AC Input Current: 0.000 A	AC Input Current: 0.000 A	AC Input Current: 0.453 A
DC 12V Output Voltage: 12.0 V	DC 12V Output Voltage: 0.0 V	DC 12V Output Voltage: 0.0 V	DC 12V Output Voltage: 12.0 V
DC 12V Output Current: 4.600 A	DC 12V Output Current: 0.000 A	DC 12V Output Current: 0.000 A	DC 12V Output Current: 4.375 A
Temperature 1: 30.0 C/86.0 F	Temperature 1: 31.0 C/87.0 F	Temperature 1: 31.0 C/87.0 F	Temperature 1: 29.0 C/84.0 F
Temperature 2: 46.0 C/114.0 F	Temperature 2: 31.0 C/87.0 F	Temperature 2: 30.0 C/86.0 F	Temperature 2: 46.0 C/114.0 F
Fan 1: 11008 RPM	Fan 1: 0 RPM	Fan 1: 0 RPM	Fan 1: 11008 RPM
DC 12V Output Power: 90 W	DC 12V Output Power: 0 W	DC 12V Output Power: 0 W	DC 12V Output Power: 53 W
AC Input Power: 107 W	AC Input Power: 0 W	AC Input Power: 0 W	AC Input Power: 91 W
Model: R1CA2200A	Model: R1CA2200A	Model: R1CA2200A	Model: R1CA2200A
Serial Number: F54001A0000AGB1 827000124	Serial Number: F54001A0000AGB2 821000075	Serial Number: F54001A0000AGB1 827000154	Serial Number: F54001A0000AGB2 821000056
FW Rev: 07 01 08 02	FW Rev: 00 00 08 02	FW Rev: 00 00 08 02	FW Rev: 06 01 08 02

AIC JBOX J5010 02 BMC MegaRAC SP X PSU Information



The fans have a covering, and getting into the two thumbscrews means we can pull off the fan cover. This appears to be a dust filter. Overall the chassis is very easy to service with thumb screws and the top is a simple push tab release. We will see more as we go through the review.



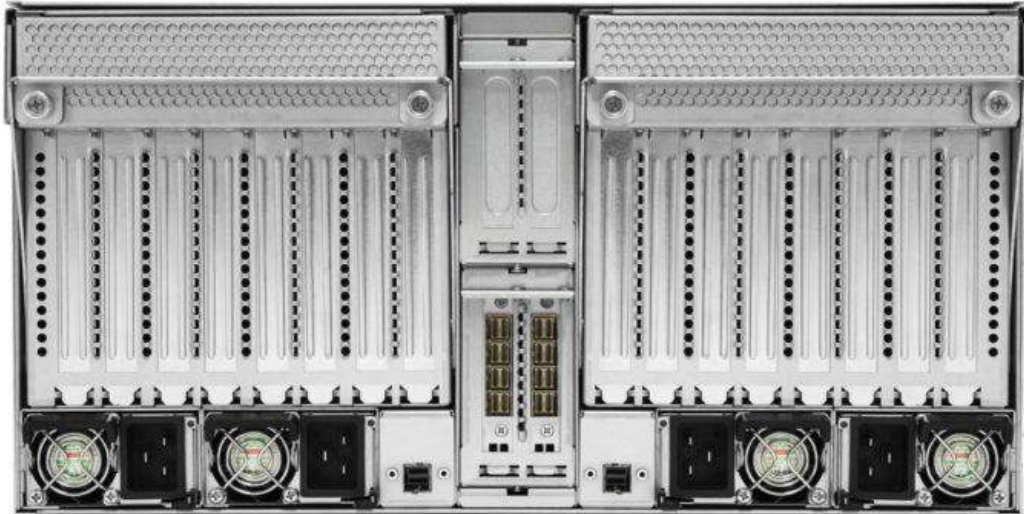
*AIC JBOX J5010 02 Front Air Filter*

The rear of our unit had a large hole. We are going to explain that in a moment. For now, we can see the big features. There are two sides of the chassis each with a low-profile expansion slot in the middle and two power supplies. Above them are eight full-height expansion slots. We will discuss those more in our internal hardware overview, but those are the big feature of this JBOX.



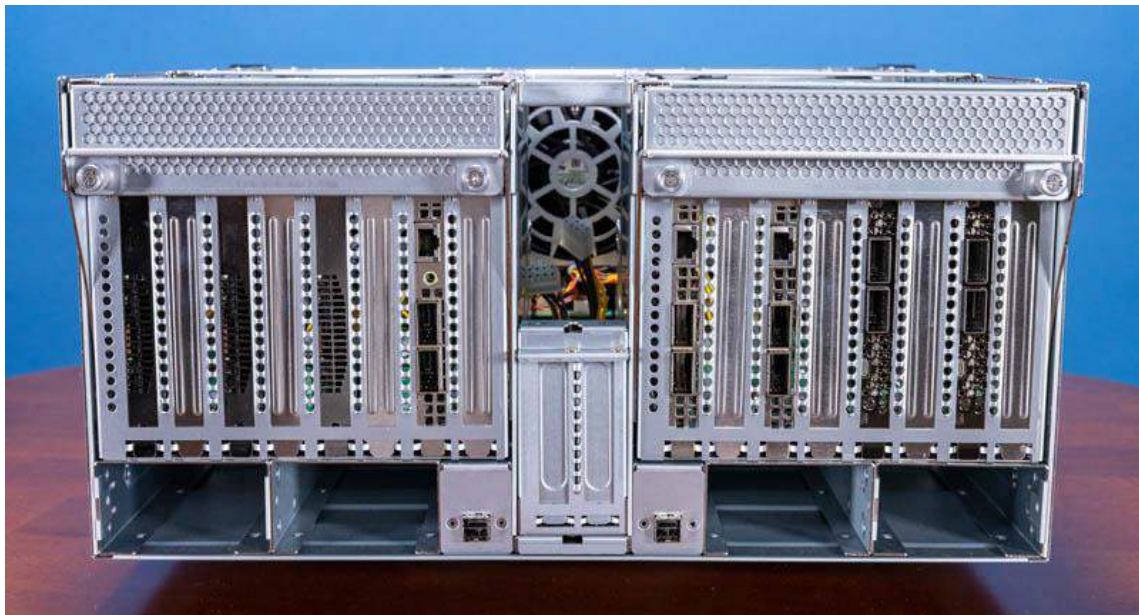
*AIC JBOX J5010 02 Rear*

The big hole in the middle is very interesting. In most configurations, there is a block with eight SFF-8644 connectors. Each connector has four PCIe lanes and that means there are sixteen total PCIe lanes that we can connect to a server. This allows one to do a direct PCIe connection to the external chassis from one, two, or potentially more servers.



*AIC JBOX J5010 02 Alternative Rear Configuration*

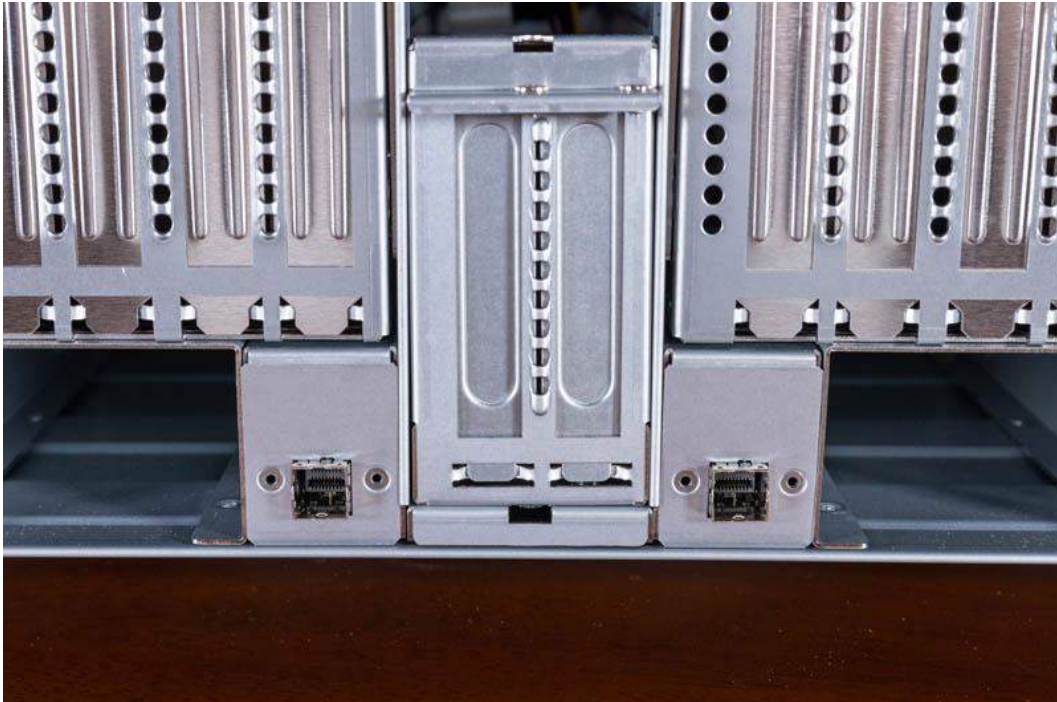
If you recall from the block diagram, each side of the chassis has four full-height double-width spaces, two x16 low profile slots, and then potentially the 4x4 lane external connections for a total of six PCIe Gen4 x16 blocks in the system (4x FH, 1x LP, 1x external.) Here is a view with single-width cards to just give you a sense of where the full-height PCIe slots are.



*AIC JBOX J5010 02 Rear With Different Types Of PCIe Cards*

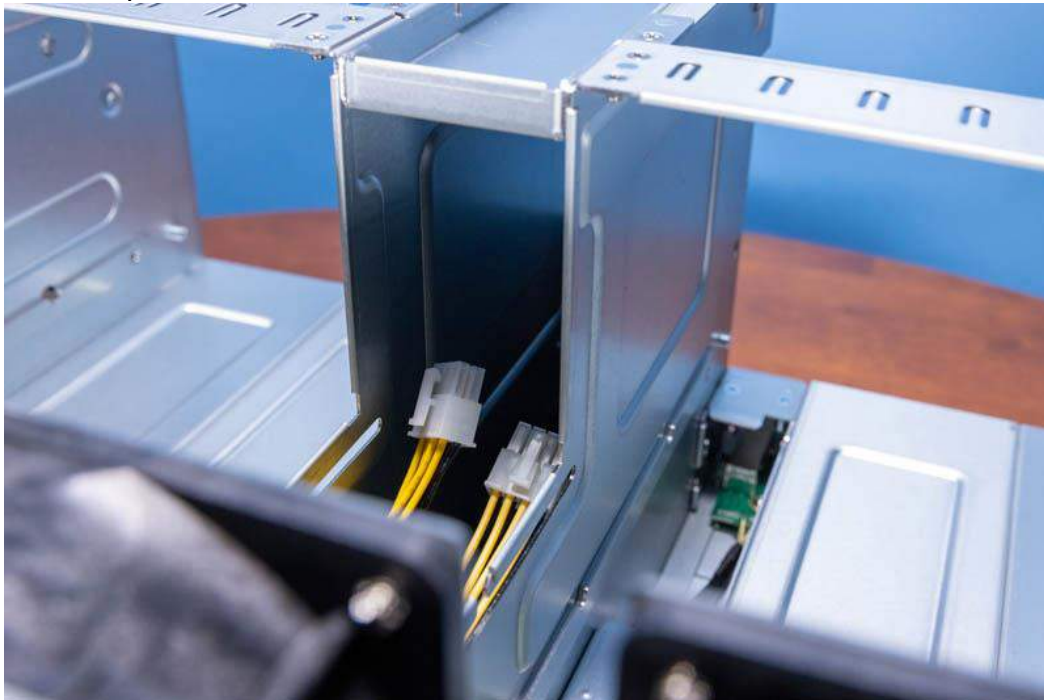


Flanking the two low-profile slots in our system are two SFF-8644 ports. These are x1 ports from the Broadcom PCIe switches meant for management. You would not use these for primary connectivity to servers just due to bandwidth constraints.



*AIC JBOX J5010 02 Management And Center X16 LP*

We are only going to cover the two x16 low profile slots here, but we did want to note there are power connectors in this section as well.



*AIC JBOX J5010 02 Power Connectors For Center PCIe X16 LP*



In terms of power supplies, there are four 2kW 80Plus Platinum power supplies. One small item we would have liked to have seen is PSUs that could operate on 110/120V with output restrictions. This configuration is more for GPUs, and that is why we see the larger power supplies and the lack of lower voltage for edge racks in North America. If one really wanted to deploy these on 110/120V power, this is a fairly common form factor so it is likely AIC could arrange different PSUs for a good size order, but we were not able to confirm that.



*AIC JBOX J5010 02 2kW PSU 80Plus Platinum*

Still, the exciting part is inside the chassis. With that, let us get to our internal hardware overview.

## AIC JBOX (J5010-02) Internal Hardware Overview

Inside the system, we are going to start with the front, and specifically those fans that we saw in our external overview.



*AIC JBOX J5010 02 Front Air Filter*

While it may look like there are three fans from the front view, there are actually six large fans in the system.



*AIC JBOX J5010 02 Fans In Angle*

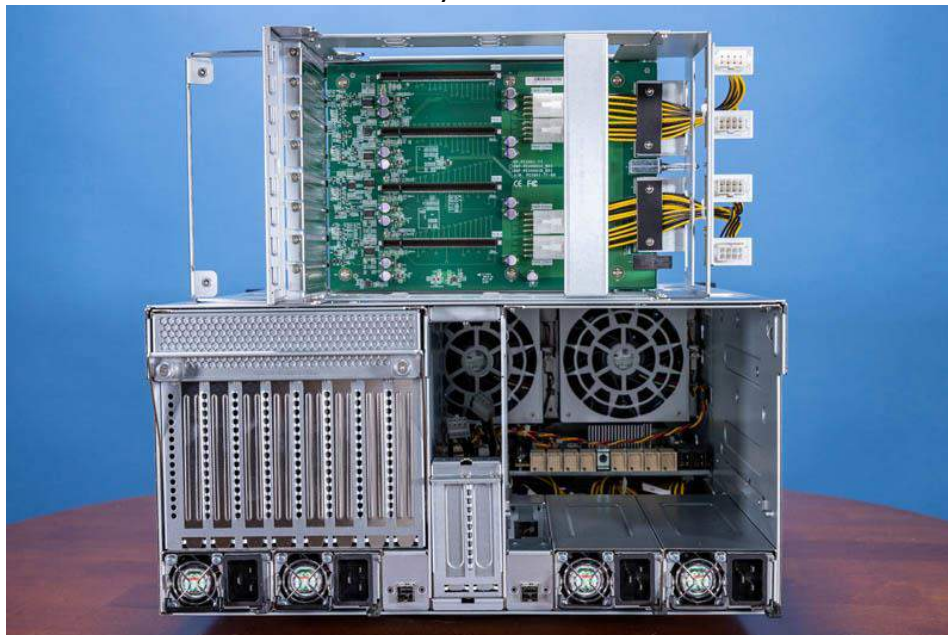


These fans are actually tool-less and hot-swappable and that was something we were frankly surprised to see. This is not the fanciest design, but it has one awesome aspect and that is rubber grommets around the fan screws. With this rubber mounting, vibration is dampened. While this may look like solely a data center box, it is small features like these that will help this go into data closets as well.



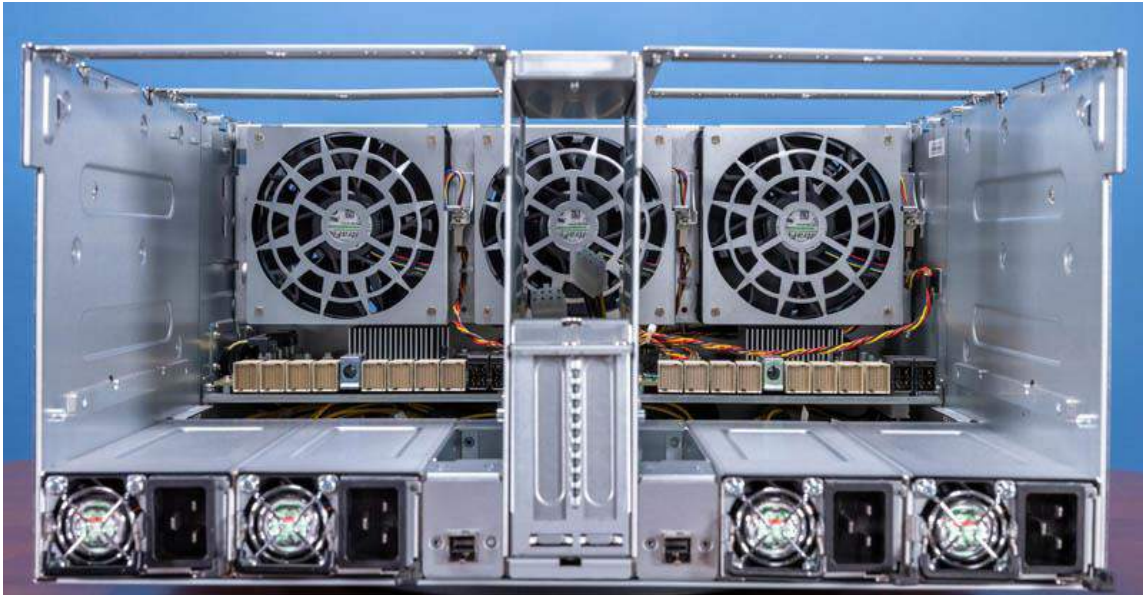
*AIC JBOX J5010 02 Fans Out*

We are going to get to the PCIe sleds in a bit, but on that service note, the sleds have two thumbscrews and levers to easily remove them. This is an important concept as we start to look inside the system.



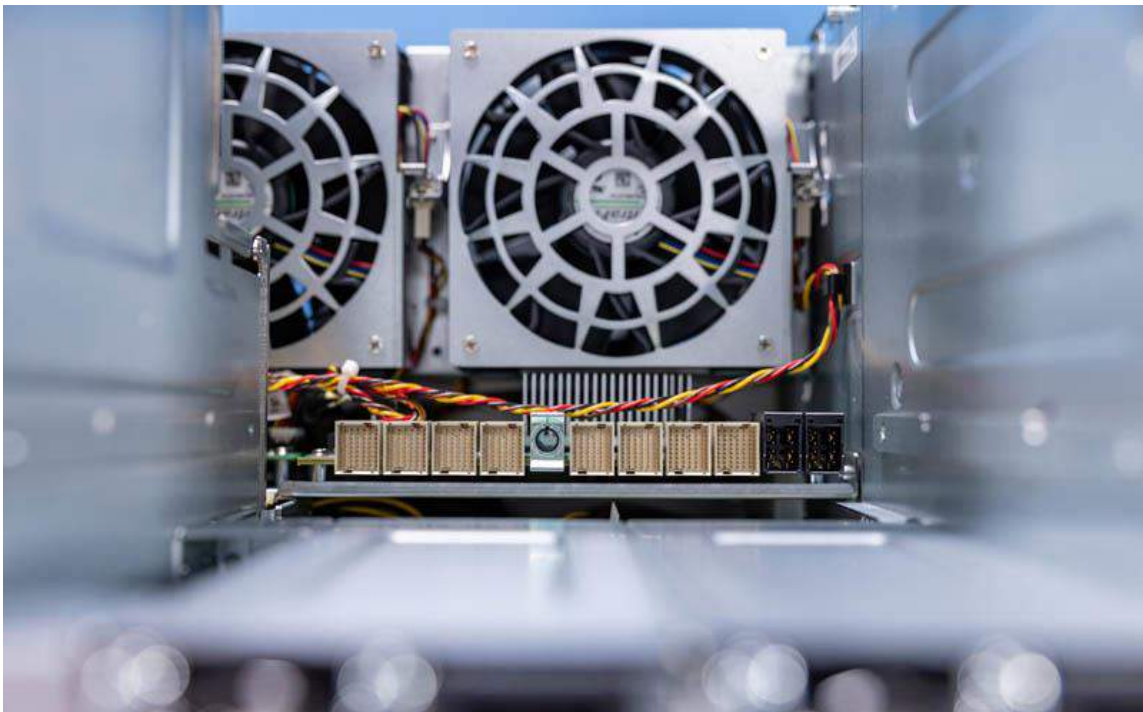
*AIC JBOX J5010 02 Rear PCIe Sled Out And On Top*

Removing both full-height 4x PCIe Gen4 x16 sleds, and the lids, we can see inside the system and just how much area is covered by those fans.



*AIC JBOX J5010 02 Rear With PCIe Sleds Removed*

The other interesting point is that AIC is using higher-density connectors for data (white) and power (black.) You can also see the guide pin hole in the middle of the white connectors. Something that may not be obvious from online pictures is that this JBOX is designed to easily service GPUs, FPGAs, NICs, SSDs, or other accelerators.



*AIC JBOX J5010 02 PCIe Connector View From Chassis*

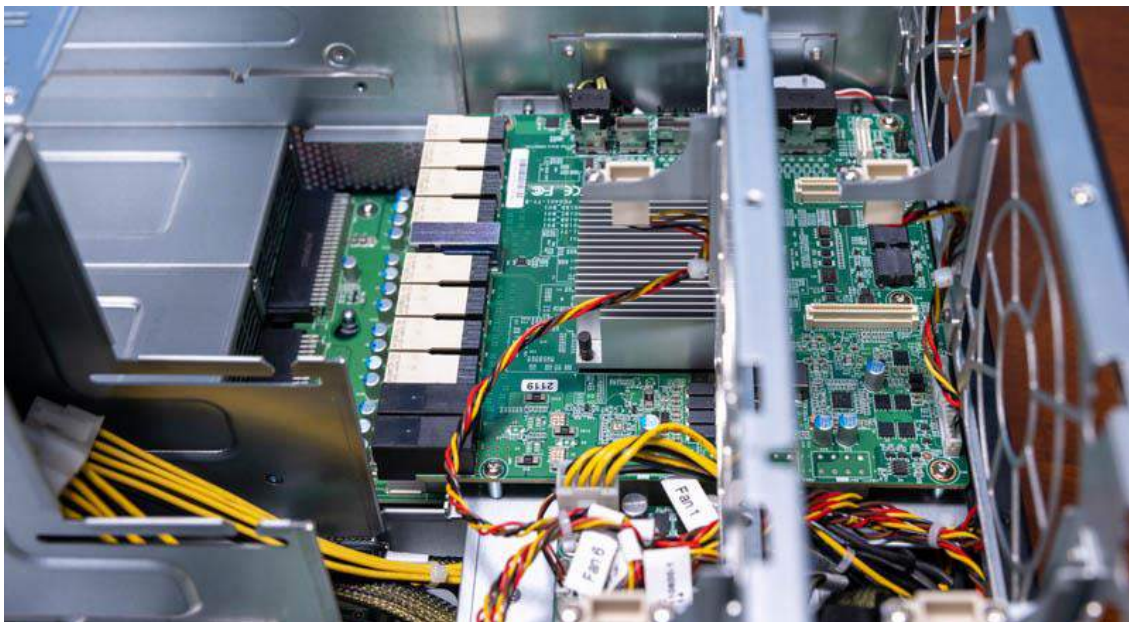


Here is a top view with the PCIe sleds and fans removed. There is a theme that we hope is coming through and that is simply that this system is set up as two different hemispheres sharing a chassis and fans.



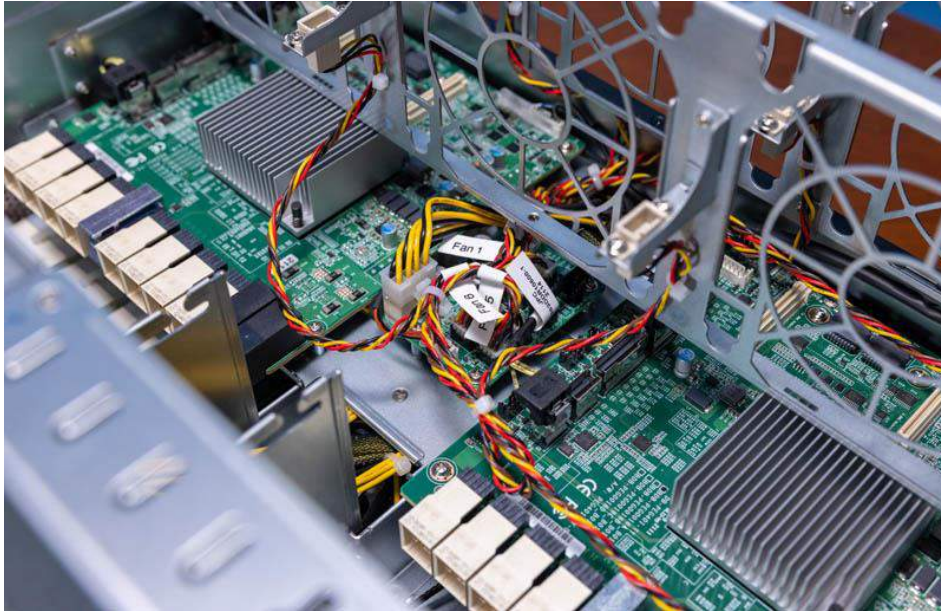
*AIC JBOX J5010 02 Internal Orientation*

Powering the JBOX are the two Broadcom Atlas PEX88096 PCIe Gen4 switches. Each sits on its own PCB. We can see the high-density white connectors on the left of the photo below. There are cabled connectors for other ports on the far edge as well.



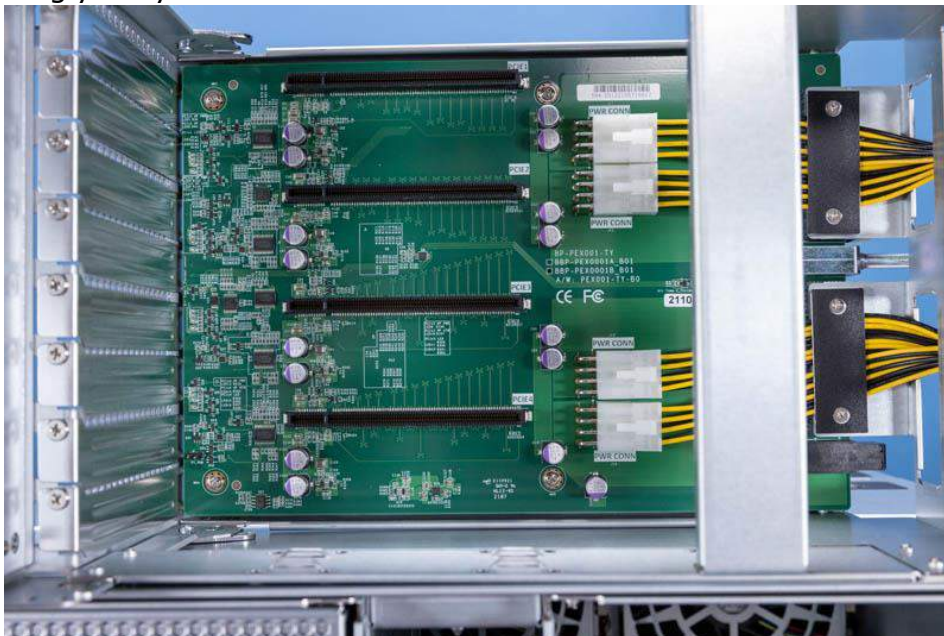
*AIC JBOX J5010 02 15*

In the center, we get power distribution for things like the fans. One nice touch is that these cables are labeled. If they were not, this would be very hard to service.



*AIC JBOX J5010 02 16*

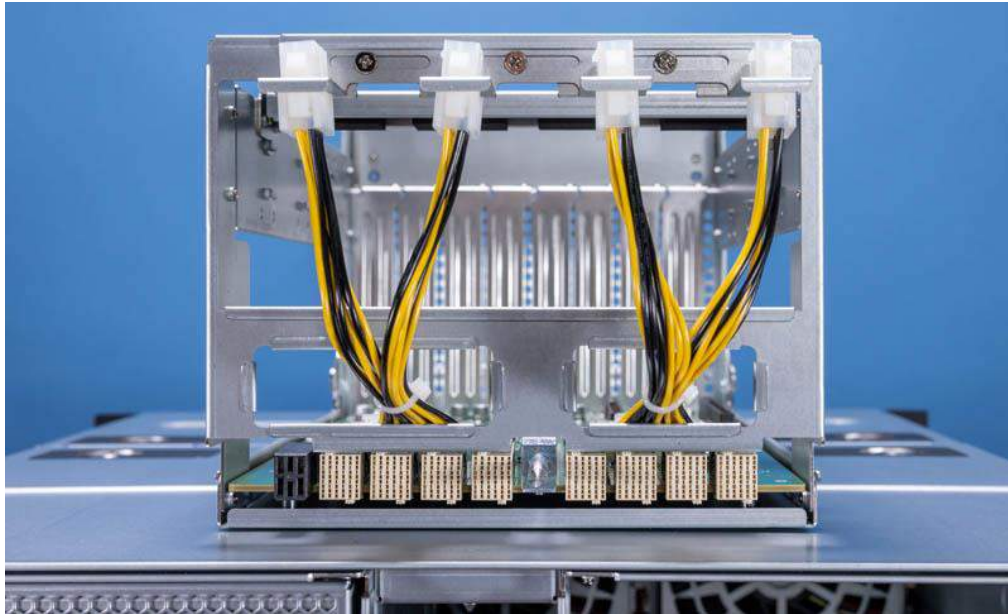
Let us now move to the PCIe sleds. Each sled has four PCIe Gen4 x16 slots. Helping to keep things serviceable, these are not locking slots, and that is great for this type of card. Each full-height x16 slot is double width. One will also notice the retention bar on the right above the power cables. That ensures large and heavy PCIe cards stay put. This bar uses four screws, two at each end, and was one of the two items in this chassis we wish was tool-less that is not. The other being that this system uses screws on the I/O brackets instead of a tool-less solution. Overall though, this was surprisingly easy to service.



*AIC JBOX J5010 02 PCIe Sled Top*

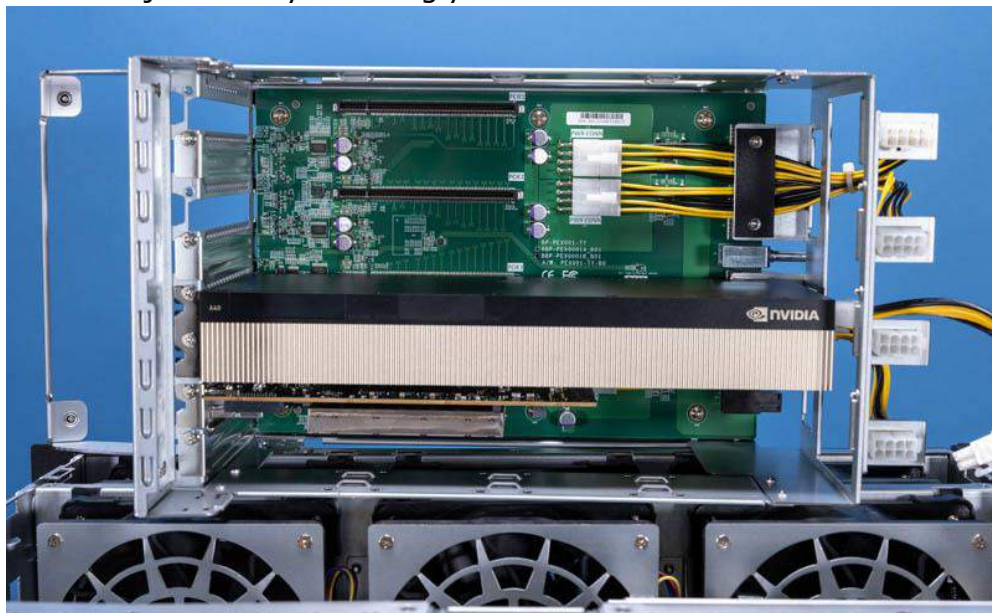


Here is the connector view of the PCIe sleds, and this shows an important concept. We have the eight data connectors and then the power connector that goes to the chassis. What AIC is doing here, and this is a great feature, is to push power to the PCIe sled, then use cabled connections to power each of the cards. This allows for the entire sled to be pulled out without having to worry about a cabled connection to the chassis. It also makes it easy to power various devices. This is a small detail, but in practice, this works surprisingly well.



*AIC JBOX J5010 02 PCIe Connector View From PCIe Sled*

Here is a PCIe sled with two different cards so you can see the basic formula. The empty slots are above. A single slot NVIDIA BlueField-2 DPU is on the bottom, so there is extra space below. In the middle, there is a NVIDIA A40 300W GPU. One can see how this GPU just barely fits snugly in the sled.



*AIC JBOX J5010 02 AIC JBOX J5010 02 NVIDIA BlueField 2 And A40 Installed 3*

Let us now show some interesting PCIe configurations from just a day of using the box.

## AIC JBOX (J5010-02) Some Fun PCIe Configurations

Continuing from the internal overview, here is the BlueField-2 DPU and the NVIDIA A40 GPU installed in the chassis. If you are thinking, that looks like a way to connect a GPU to a DPU through a PCIe switch, you would be correct.



*AIC JBOX J5010 02 NVIDIA BlueField 2 And A40 Installed 2*

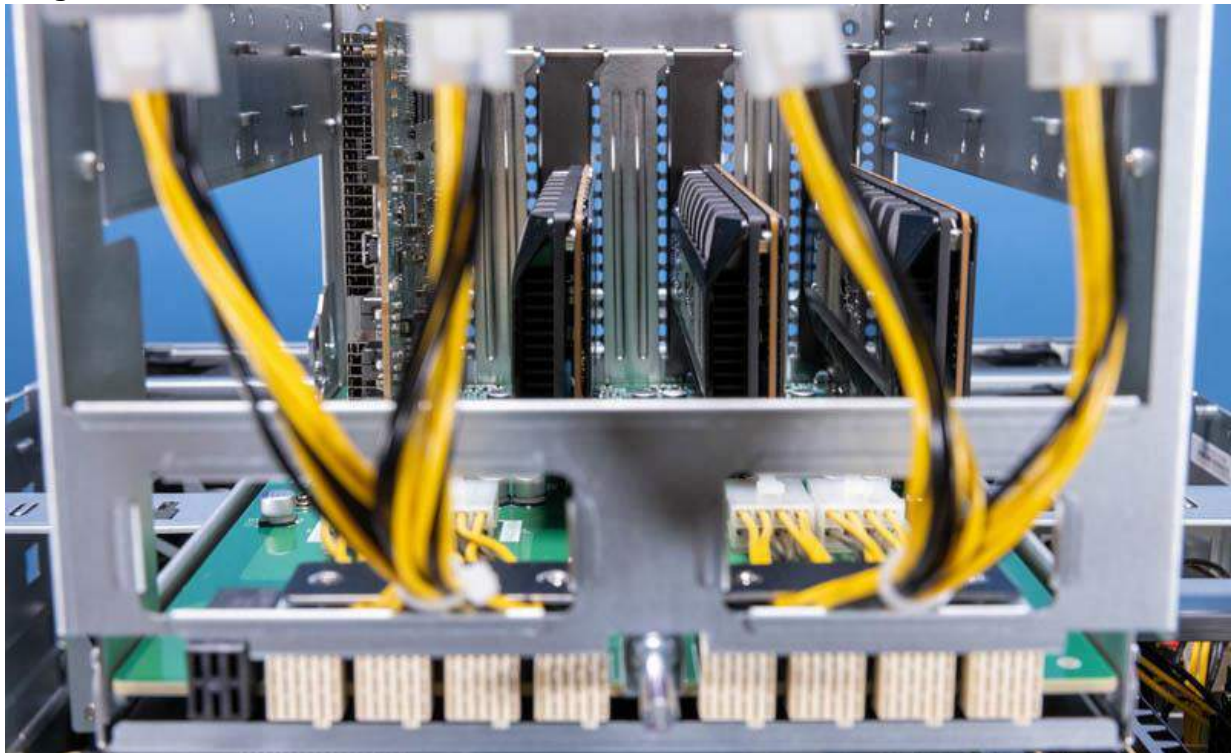
One small feature that we had no idea about until using this chassis occurred when we started using larger cards in the JBOX. Here is the double-width full-height NVIDIA A40 being connected via a data center power cable. You can see that there is plenty of room for cards with top-mounted power as well. Still, we had a challenge where the GPU power connector interfered with the power cabling. The three screws one can see between the four power headers can be loosened and the entire mounting assembly for the power headers can be moved. A quick shift and re-tightening and everything worked perfectly without interference. This is a small feature, but it just shows the level of thought that went into the JBOX.





*AIC JBOX J5010 02 NVIDIA BlueField 2 And A40 Installed 1*

Here is another view with a BlueField-2 DPU and three low-profile add-in cards that are high-performance SSDs. This is not using the entire width available. One could imagine how AIC could build a version of this chassis with 8x PCIe Gen4 x8 slots. That is really one of the concepts behind the JBOX. AIC has other versions it does not publicly list, but this chassis was designed to be flexible for custom customer designs.



*AIC JBOX J5010 02 NVIDIA BlueField 2 DPU With Three SSDs 1*

We used some Xilinx FPGA development boards loosely based on the Alveo U55 platform. These particular cards required the more consumer/ desktop style 8-pin connections. Since they are shorter cards, we needed a little bit more cable length but that is an advantage of a movable power header. We could both swap to the different power cables and get a little bit more distance.



*AIC JBOX J5010 02 Two Xilinx U55 Based FPGAs Installed With Consumer GPU Connector*

While one can use consumer GPUs in this, we will quickly note that many of today's consumer GPUs are not standard sizes. This is a NVIDIA RTX 3060 Ti and it was simply too long to fit in the system. Some GPUs are also triple-width or more than double-width so that would not be ideal in this platform either given the PCIe spacing.



*AIC JBOX J5010 02 Consumer Card Too Long*

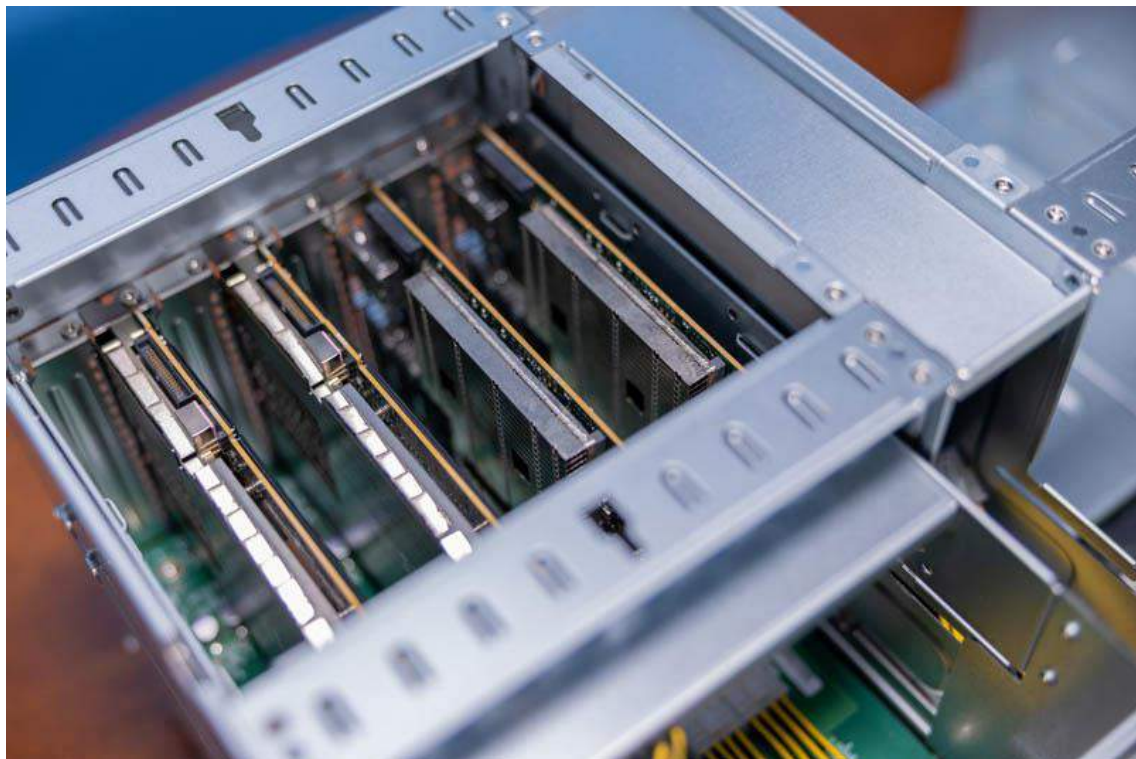


AIC actually bundled both the consumer GPU power (each with 2x 8-pin headers) and the data center accelerator PCIe power cables with the unit. It even comes with rubber feet for those that want to not put these systems in traditional racks.



*AIC JBOX J5010 02 Consumer And Data Center Power Inputs With Rubber Feet In The Middle*

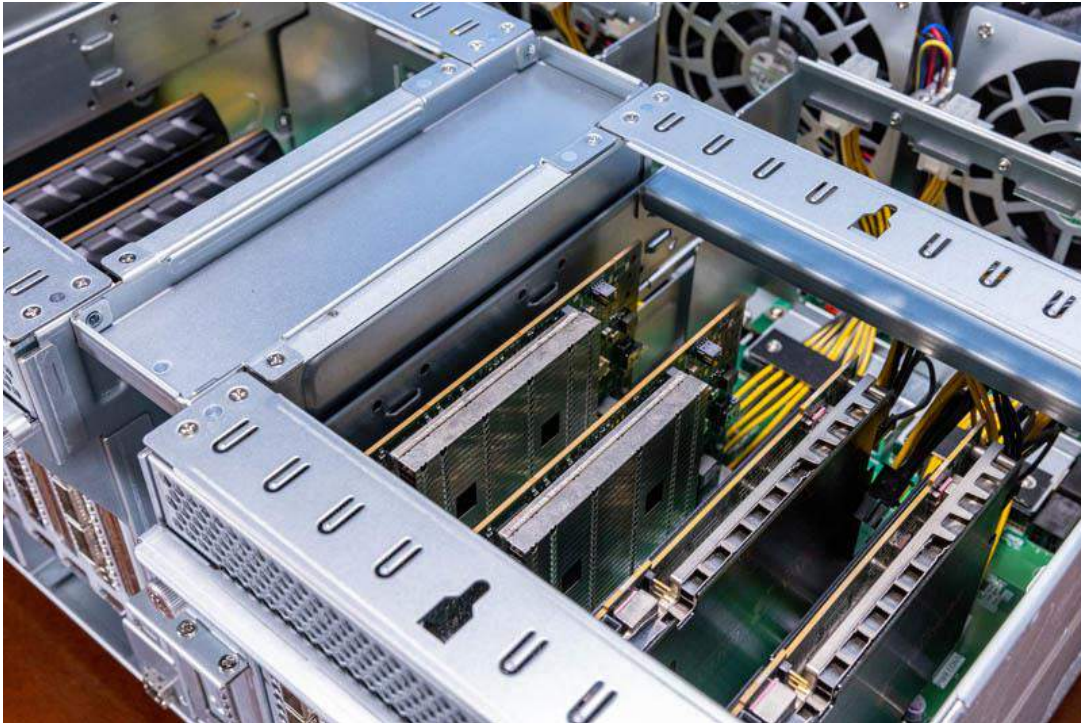
Here is a dual Xilinx FPGA and dual NVIDIA BlueField-2 configuration installed in the chassis.



*AIC JBOX J5010 02 Xilinx FPGAs And NVIDIA BlueField 2 DPUs*

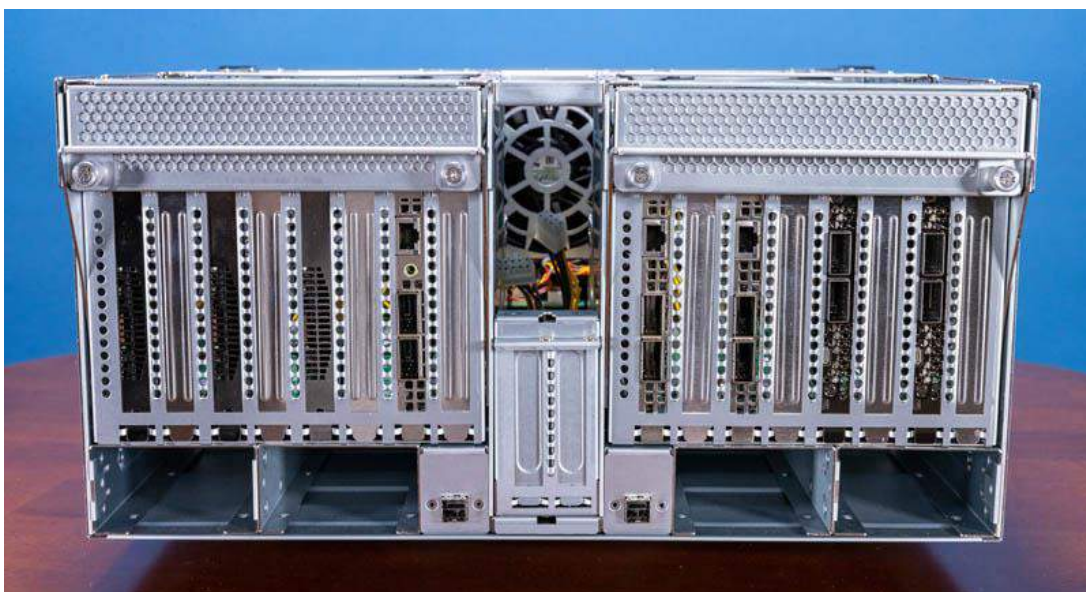


Here is a version with storage, networking, FPGAs, Arm CPU cores, and there is even a GPU installed on the far side of the system.



*AIC JBOX J5010 02 Many Different PCIe Cards Installed*

Here is again the shot with the heavier networking view. There are a total of eight full-height PCIe cards with three DPUs and two FPGAs that have their own HBM2 memory. We have a storage node on the left, and a networking and accelerator node on the right. There is also the ability to add two more low-profile cards in the center section. That gives a sense of just how flexible this system is.



*AIC JBOX J5010 02 Rear With Different Types Of PCIe Cards*



## Final Words

One thing we can say for certain is that not every server rack will need an AIC JBOX. If you are using traditional GPU servers, or if you do not need accelerators, then the AIC JBOX is not something you will need. Still, this has the possibility to provide an easy way to add PCIe devices to a system or multiple systems. There is so much that fits on the PCIe bus these days that just having a chassis with PCIe switches and slots is awesome. The shorter depth also means that one can potentially use lower-power 1U/2U short depth servers, and then use external cabling to a chassis like this to get massive PCIe expandability with plenty of power and cooling.



*AIC JBOX J5010 02 Rear PCIe Sled Out And On Top*

We will quickly note that AIC has other variants of this JBOX that they make for customers, but this should be fascinating to many of our readers. AIC has a number of customers for the JBOX and it shows. We first saw this in November 2021, and it took a few months to actually get one because they are in such high demand. The easy-to-service and flexible design show why AIC sells a lot of these JBOXes.



*AIC JBOX J5010 02 NVIDIA BlueField 2 And A40 Installed 2*

Later in 2022, we will embark on the PCIe Gen5 and CXL era. Boxes that are like future versions of this JBOX will change computer architecture. For now, the AIC JBOX is just an awesome way to add flexible PCIe expansion to a number of servers or to simply create exciting PCIe-based systems.

Again, as you can probably tell from some of the photos, there are some setups that are for show, and there are some setups we hope to show you more of in the next few weeks and months. Get ready.