**Word Count: 1324**

Video, Part 2: In-depth insights into the hardware features of the Raspberry Pi 4 Model B

In this video, we will have a more in-depth look into other hardware features of the Raspberry Pi 4 Model B, like Ports, Connectors, Networking Chip & Controller Chip.

First, let's take a look at the USB Type C power port, which is used to connect the Raspberry Pi to a power source. The USB Type C port is a common sight on many mobile devices nowadays. You can use a mobile charger with 5V 3A rating to power the Raspberry Pi 4. The presence of USB C Port allows for more power delivery, which allows for better overclocking capabilities. Many enthusiasts were able to overclock the Pi 4 to above 2 GHz with proper cooling, which is quite impressive. Moreover, the USB-C connector also supports OTG, that allows you to connect the Pi directly to your PC's USB port and access the device locally.

Please be aware that the current model of Raspberry Pi 4 has a design flaw due to a missing resistor. Thus some USB C cables won't power the device. This happens if you use an "e-marked" USB Cable. Usually, e-marked cables are more expensive and come with larger, higher-powered items, like a USB-C laptop. A normal amazon basics USB C cable will work just fine. Since the Pi 4 USB-C port is wired incorrectly, these smart cables will detect the Pi 4 as an "Audio Adaptor Accessory" and refuse to power them. If you want to know more about this issue, please check out the links in the resources.

A small black chip can be found a little bit above the USB Type C port. This chip is known as a power management integrated circuit, and it handles the power that comes in. The chip is from the MxL7704 family. It is an all in on regulator chip that has features like high switching frequency, dynamic voltage scaling, fault protection, under-voltage lockout, overcurrent protection, & thermal protection.

Now let's have a deeper understanding of the Networking Chips in the Raspberry Pi 4. We have a Radio Chip and an Ethernet Controller Chip on the Raspberry Pi 4. The Raspberry Pi 4 has the Dual-band 802.11ac Wi-Fi, and throws in Bluetooth 5.0 support, an improvement over the Bluetooth 4 on prior models. More importantly, the Ethernet port now has more bandwidth, which allows it to offer a full gigabit of throughput, whereas prior models could only achieve about 330 megabits. The Gigabit Ethernet controller is located behind the RJ45 ethernet port just below the PoE header pins. It theoretically supports up to 1000 Megabits of bandwidth.

So what do these stats mean in real-life applications?

The support for dual-band WiFi means that you can now connect to a faster 5GHz WiFi Access point. This will significantly reduce the latency for remote access and improve overall networking speed. Bluetooth connectivity is very important for IoT applications. The obvious advantage of Bluetooth 5.0 is its ability to transfer data at double speed & four times the distance as compared to Bluetooth 4.2. Bluetooth 5.0 also allows us to pair and communicate with multiple devices independently. Bluetooth 5.0 can also replace WiFi implementation for small IoT Edge devices in some applications with Bluetooth Low Energy, due to its longer range & ability to communicate with multiple devices independently.

The wired gigabit connection speed reaches well over 930 Megabits per second in real-life applications. This is especially useful for applications, where we have to handle large quantities of data inside a LAN network of an office or a factory, like in the case of Network Attached Storage solutions.

Next, we can take a look at the USB Ports available for the Raspberry Pi For the Pi 4, a fully-featured USB controller called Via Labs VL805 drives the USB ports. It supports two USB 2.0 ports and two USB 3.0 ports. This is connected to the BCM2711 SoC through a PCIe link, which is extremely fast. This means that there is no bottleneck, and the USB Ports can work at there rated throughput speeds. This is one of the biggest features of the Raspberry Pi 4, in terms of performance, because we have seen well over speeds of 340 MegaBytes per second with a solid-state drive on the USB 3.0 Port. This also means that we can connect USB 3.0 compatible devices directly to Raspberry Pi 4. For example, we can connect the Google Coral USB Machine Learning Accelerator to the USB 3.0 to get double the performance of its USB 2.0 counterpart.

Just behind the USB 2.0 Ports, at the bottom edge, you can see what appears to a headphone jack. It's actually a 3.5 mm Audio Visual Jack. It's usually used as a headphone jack or used to connect to amplified speakers. It also has a trick up its sleeve. This jack can output video signal, which can be connected to TVs, projectors, and any displays that support a composite video input with a TRRS adapter. So technically speaking, the raspberry pi 4 has three video outputs and not just 2.

Next comes the camera connector, which is also known as the camera serial interface, which allows you to connect & use the Raspberry Pi Camera Module. The CSI Port is based on the Mobile Industry Processor Interface standards. Thus you can connect any conventional mobile camera modules with the proper adapter. You might be wondering why to use CSI Port for the camera, while we can use a high-resolution USB Camera. The CSI port uses an industry-grade interface technology that supports up to 4 Gigabits throughput. This allows for high-quality, interfacing cameras.

Moreover, it's directly interfaced to the GPU. Thus there is minimal load on the CPU. If we use a USB Webcam, the CPU will be on constant pressure due to encoding, and the frame rate will be considerably low. Thus for computer vision applications, its highly recommended to use the CSI port instead of the USB Webcam. If you have no other choice than to use a USB Webcam, please use a webcam with hardware encoding inbuilt and connect it to USB 3.0 instead of USB 2.0.

Just left of the CSI port, you can see that there are two micro High Definition Multimedia Interface Ports. This means that you can connect 2 displays at the same time for a multi-monitor setup. All previous Raspberry Pi Models had a single HDMI port. In Pi 4 they were able to cram 2 display ports in the space of one big HDMI port. The only problem is that micro HDMI connectors have not become as prevalent as HDMI connectors, so you may have to use an adapter if you don't have one. The two micro-HDMI connectors enable Raspberry Pi 4 to drive two 4K displays at up to 30 frames per second, or a single 4K display at up to 60 frames per second. The native support for dual displays with 4K on a single board brings out many different applications for the Raspberry Pi 4, like in Banks, Factories, Cashier Machines, Advertisement Panels, etc.

The final port we will take a look at is the Display Interface Port, which is at the left extreme edge of the board. This port is similar to the Camera Port but is used to interface external display modules. It's made with Mobile Interface standards, just like the CSI port, so that for applications that are very CPU intensive, the driving of the display is offloaded to the GPU, thus freeing up the CPU.

Summary

In this video, we have covered the following topics

* Ports
* Networking Chip
* Controller Chip
* Connectors

In the next video, we will take a look at the essential accessories for the Raspberry Pi 4 and Set up the hardware.