# DaVinci Resolve 14
Build Guide for Threadripper + Windows 10 Pro

By Sareesh Sudhakaran | Date: 4th October 2017

This is a record of my Threadripper X399 workstation build, components, philosophies, etc. It was built to run DaVinci Resolve 14.

Important: *This document is for information purposes only. Do not use it as a detailed guide to build your own system. I might have made mistakes and I'm not responsible for any issues that might arise if you follow this guide. You are responsible wholly for your own actions and choices. Please consult a professional system integrator prior to purchasing, modifying or building your computer system.*
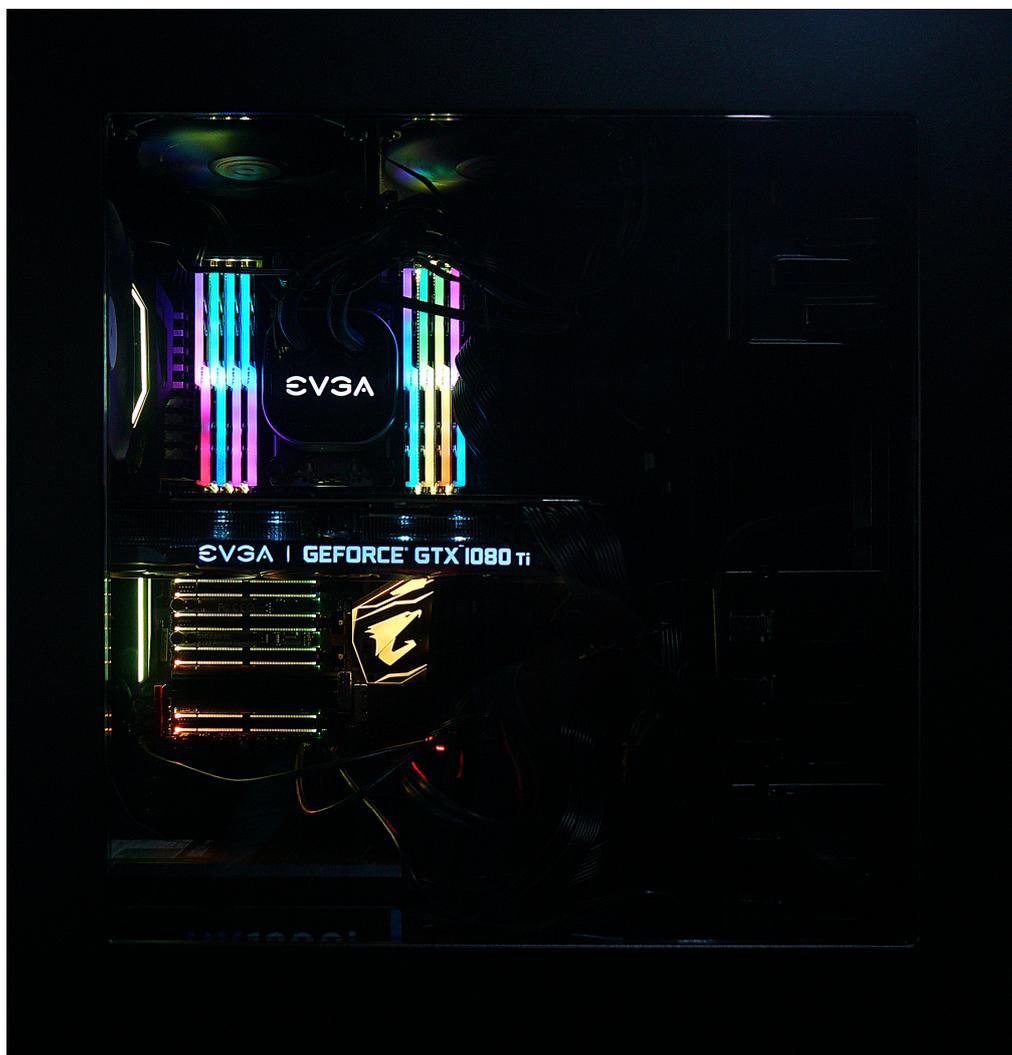
Goals for this workstation

It's always important to start by clearly listing your goals over a fixed time period. This will help you make smart choices down the line and you won't have to second-guess yourself later. Here are mine:

- The system must run DaVinci Resolve 14 in a stable manner.
- Designed for a 4K "real-time*" pipeline. This includes:
  - Real-time playback over multiple layers for smooth editing.
  - Easy scrubbing on the timeline for smooth editing.
  - Color grading with multiple power windows, FX, Noise reduction, ACES, etc., with no lags.
  - Fast render performance for export, caching, etc.
  - All this on a full resolution 4K timeline without creating optimized or cached media.
- Support for additional software like Premiere Pro, OBS, etc.
- Output delivery is Youtube/Vimeo/Facebook and possibly DCP for festivals. So DPX/OpenEXR isn't necessary.
- Color space: Rec. 709, 10-bit 4:2:2. Rec. 2020 is a long way off, and it will only be relevant at the end of life of this build. Same goes for HDR. Watch my video to learn more.
- Years of operation – At least 3 years. Hoping for 5.

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*This build is capable of playing back 8K footage, but that doesn't mean it will deliver a real-time 8K performance. It takes a system completely optimized with software for that to happen. E.g., SGO Mistika, etc.

It is important to understand that getting a full 4K real-time performance itself is a tall order. Many people confuse being able to playback one or two clips in 4K as 4K "real-time". When I say "real-time", I mean 4K "anything and everything you can throw at it". And we should be grateful we're even getting 8K playback here! Here's a list of 4K codecs and what you need for 4K real-time performance:

- 4K DPX/OpenEXR – Very fast RAID Array (SSDs, NVMe) – up to 38 MB/frame + Multiple GPUs
- 4K to 6K Redcode RAW – about 7 MB/frame – Fast Processor + Fast GPU
- 8K Redcode RAW – about 10 MB/frame – Super Fast Processor + Fast Multiple GPUs
- Arri Alexa Open Gate – fast RAID array (7200rpm is okay) + Fast GPU
- Arri Alexa 65 6K – 30 MB/frame – Very fast RAID Array (SSDs, NVMe) + Multiple Fast GPUs
- CinemaDNG 4.6K – 6 MB/frame – Fast Processor + Fast GPU – Resolve is optimized for CinemaDNG from BMD's cameras.
- 4K H.264 – Super fast Processor + Fast GPU

Depending on your choice of codecs, you can put your money into the right combination of components. For a full real-time 4K system able to handle all kinds of projects, you can't compromise on anything. The single biggest expense is fast storage. If you want to tackle feature length projects or long documentaries in 4K, you're looking at hundreds of Terabytes of storage. Be careful what you wish for!

This system is only designed to handle 4K real-time duties - whatever I throw at it. Nothing more, nothing less.

Parts and Cost

Here's a diagram of the ideal completed build, with those in white currently ready and running. The rest in blue is open to change as I understand and tweak my system better. Both RAID arrays are yet to be built.
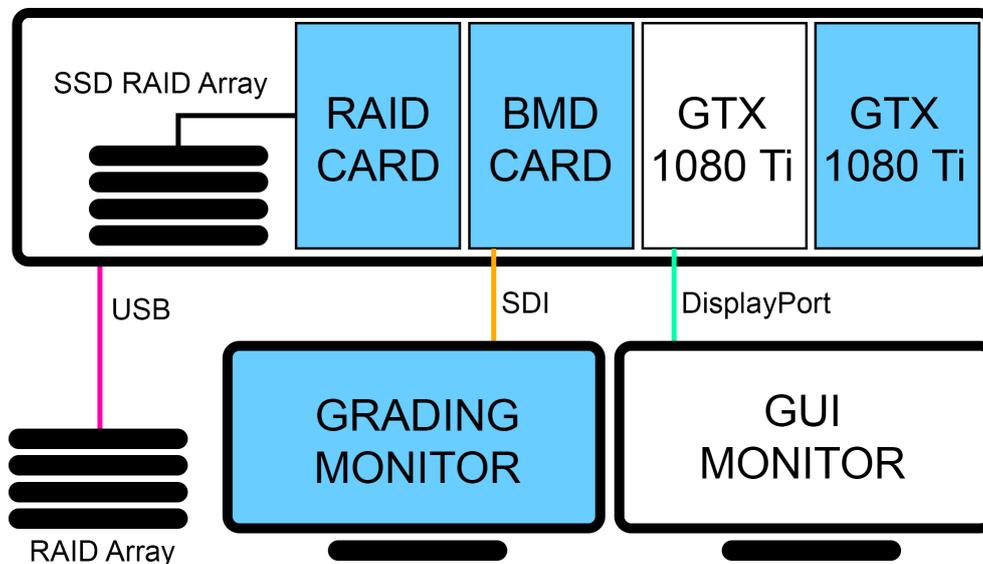
Here's a list of parts (PCPartPicker):

- CPU: AMD RYZEN Threadripper 1950X 16-Core / 32 Threads 3.4 GHz
- CPU Cooling: EVGA CLC 280 Liquid / Water CPU Cooler
- RAM: 8x8GB G.SKILL TridentZ RGB DDR4 3200 CAS 14
- GPU: EVGA GeForce GTX 1080 Ti FTW3 GAMING (11 GB)
- Motherboard: GIGABYTE X399 AORUS Gaming 7
- Primary Drive for OS: Samsung M.2 960 Pro 512 GB SSD (80mm)
- Case: Corsair Obsidian 750D Airflow Edition
- Power Supply: Corsair 80+ Platinum HX1200i
- OS: Windows 10 Pro 64-bit
- Additional cooler (unused): Arctic Freezer 33 TR
- Rosewill RTK-045 45 Piece Premium Computer Tool Kit

- Dell KB216 Keyboard, USB ($33)
- Logitech MX Master 2S wireless mouse ($108)
- UPS: APC 1500KVA (BR1500G-IN) ($225)

Total cost of build:

- In Indian Rupees: INR 306,857
- In USD: $4,720 and counting. (See later)

We'll go into detail on each part shortly, but here are some additional peripherals and things I have yet to purchase:

- 4K monitor – possibly BenQ or similar, around $1,000 to $1,500. This is good enough for Internet work.
- Blackmagic Design Decklink 4K card or Mini Monitor 4K^.
- SSD RAID Array for media storage, possibly 1 TB Samsung 850 Pro in RAID 0 + An external 16 TB RAID 5 system with 7,200rpm drives for Backup.
- Optional: Additional M.2 SSD for Cache drive, though I have to see how beneficial it is. See notes in the M.2 section below.
- Additional GTX 1080 Ti card if necessary ($800).
- RAID card (possibly Areca) - only if software RAID doesn't work out. You need this to get over the 2 GB/s bottleneck.

^The three cards I have in mind are:

- Decklink 4K Extreme, $945 – 1080p over SDI to FSI/Panasonic/Sony, and 4K over HDMI – 4K 60p (12G does 4K 60p, though there aren't many monitors that accept 12G-SDI).
- Decklink Studio 4K – 4K up to 30p, $566 – A medium solution with capture capability as well.
- Mini Monitor 4K, $186 - $4K at 30p – What I'm most interested in. It's HDMI 2.0 and should get the job done.

What does it take to run DaVinci Resolve well?

Here are some important suggestions from Blackmagic Design:

For GPU:

- All image processing is done by the GPU. RAM Debayer is in GPU.
- GPU cores + GPU RAM is important for 4K. You need more GPU RAM even for HD timelines.
- You need OpenCL 1.2 and CUDA 3.0 or higher.

- Temporal Noise Reduction, Optical Flow, Motion Effects, OpenFX – only use one GPU regardless of the number installed. Not sure if this is accurate, but it's in the official configuration guide.
- 8GB VRAM or more for 4K work.

For CPU:

- Compression – Decompression is CPU based. More cores the better.
- For the Supermicro Superserver, BMD recommends a 12-core dual Xeon (24 total cores).

For RAM:

- For the Superserver, BMD recommends 32 GB (2400) RAM.

For Primary Drive(s):

- Specs state 480 SSD, though 512 GB SSD System drive is ideal.
- First volume in the list will always store gallery stills and cache files so it must always be accessible to the system. Proxies and images, too. Must be the "fastest".
- Resolve ideally should reside in the default Programs folder in the startup disk, which means it resides alongside the OS.

Display:

- Resolve is optimized for 5120x2880 and scales well to 2560x1440. It also works in other resolutions of course.
- Ideally you need a BMD monitor card to get true 10-bit via SDI or HDMI. The higher-end cards also help in image processing, down conversions to 1080p, etc.

Windows version:

- Resolve currently supports Windows 10 Pro 64-bit Creators Edition or higher.

In summary:

- CPU: As many cores as you can afford. Above 3 GHz at least.
- RAM: 32 GB or higher.
- GPU: 8 GB or higher. More the GPUs, faster the processing.
- OS + Resolve: 512 GB SSD.
- Primary Drive: As fast as you need your media to be. As large as you need your media to be! More on this later.
- Decklink Card: To reduce load on the CPU.
- Windows 10 Pro 64-bit Creators Edition.
- Monitors: 27" for 2.5K (I prefer 32" for 4K).

So let's get started.

The steps I took for this build

1. Research – Took 7-10 days, plus I made a video for Youtube.
2. Purchasing – 1 day, used Newegg and Amazon.
3. Dealing with customs and shipping/Fedex – 2 months.
4. Building the PC – 4 hours, including watching videos to make sure I'm doing things right. Videos I watched:
    a. [PCWorldVideo: Watch us build…](#)
    b. [EVGA CLC Installation](#)
5. Firmware updates and BIOS – 1 hour (I read the manual)
6. Software installation – 2 hours (Windows and Resolve, plus a few other important apps)
7. Miscellaneous tweaking – 1 hour
8. Testing the system – 72 hours
9. First 'project' (see below) – 30 hours (I had to learn editing again!)

If your time is money, then you're better off handing this job to a systems integrator. Unfortunately for me there isn't anyone I'm aware of who can design and test a Resolve system in my part of the world.

What you'll need

- A clean table and clean hands. Make sure you touch something metallic (grounded) before you start building - to discharge static electricity.

- The only tool you need to build this rig: A Philips #2 screwdriver. I ordered a Rosewill kit. There are only a couple of tricky screws in this entire build, so you really don't need magnetic screw drivers.

- A USB drive to flash the BIOS (if necessary).

- A keyboard, either wired or wireless. I used wireless - the wireless antenna by Logitech was detected. A mouse helps too, though not mandatory.

- A monitor to see what you're doing.

Let's start building!

The Case

The case I opted for is the Corsair Obsidian 750D Airflow Edition. Reasons:

- I like the Spartan design.
- It's huge, and can hold large motherboards and full size GPUs.

- It is designed for air-cooling.
- Lots of space inside so installation is easy and painless.
- Lots of space for drive-bays. You can take them out too.
- Has a plastic side window so I can check for BIOS errors or any issues.
- Great for cable management.
- Lots of fans, all silent so far.
- Vents at top and bottom with magnetic dust covers. Easy to clean and maintain.
- Easy to install liquid cooling system.
- Comes with extra screws, removable drive bays, thumbscrews for case doors, cable ties, etc.

I've watched many case reviews over the years, and I always keep coming back to the 750D and 900D. The 900D is something I'll never need, so I opted for the 750D, which is just as good.

I can't think of a better case for workstation use. Obviously, I don't intend to game on this system!

Important build notes:

1. Fit the back connector/port plate for the motherboard *before* you put in the motherboard, because it fits from the inside.
2. You need to remove one screw from the top (top middle) backplate or the motherboard won't fit. Each motherboard comes with different number of holes so make sure you align them correctly. The 750D has a central thread so you can align it perfectly.
3. Keep the case flat while you're building, not standing up. If it's a stuffy environment and you're sweating, keep it standing up.

The Power supply

I opted for a power supply from the same manufacturer: The Corsair HX1200i 1200 Watt 80+ Platinum. This is a modular power supply, which means you can choose the number of cables and only connect those necessary. Earlier power supplies had one cable and lots of extra ends that would just be left dangling if you didn't need them.

**How to decide which power supply to get?**

This is a bit tricky. There are two main decisions to make:

1. How many watts, and
2. Gold, Platinum, Bronze or Titanium?

As to how many watts, there are a few steps to go through to simplify the process:

1. I used PCPartPicker to put together my system, and it gave me a rough indication of the wattage it might consume. My final build with 2 GPUs and a 4-way SSD RAID array will add up to 933 Watts. My current build should draw about 613 Watts. See later for real world results.
2. I used the Seasonic calculator (Corsair didn't have Threadripper listed) to calculate power supply just as a backup. It gave me 525 Watts for my current build. For my full build, it gave me 800 Watts.
3. My current system is designed to draw about 600 Watts, and with the additional GPU, etc. in the future will go as high as 850 Watts. I've designed it this way because my UPS, an APC 1500KVA (865 Watts), is limited to that. This will keep my computer going for a few minutes in the case of a power outage. Also, I get protected and conditioned power so no parts are blown.
4. Once you have calculated the power usage, DON'T buy a power supply *equal* to that. You ideally need to buy a supply between 1.5 to 2 times the estimated value (Why? See below). Here's data provided by Corsair on the efficiency of the HX1200i:

Corsair HX1200i power supply fan noise curve
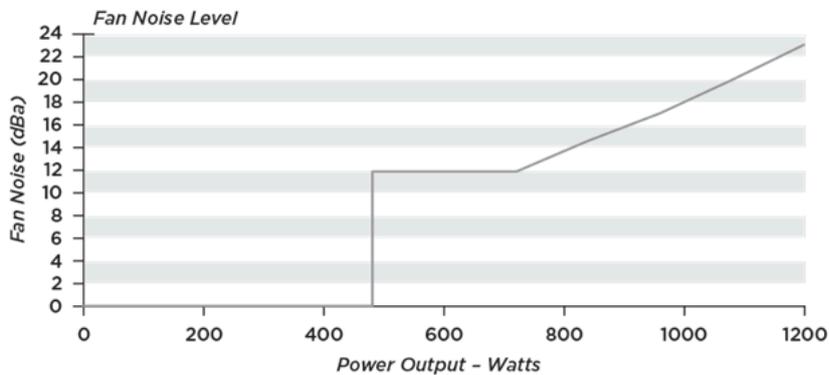
Corsair HX1200i power supply efficiency
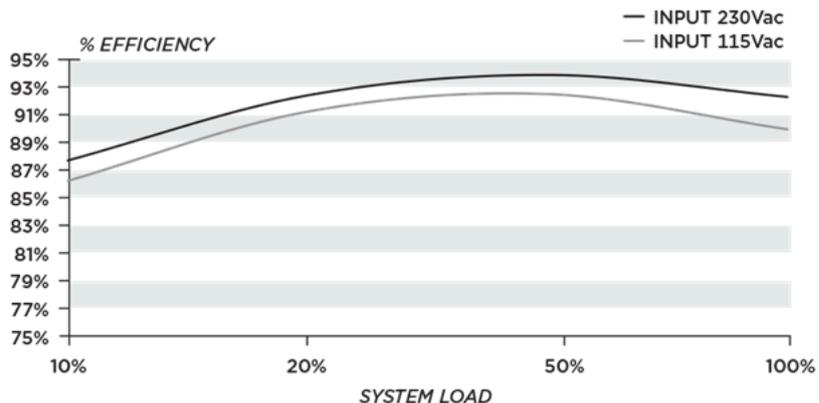
5. You can see it hits peak efficiency at about 50%. You can also see that at 800 rpm the noise is super quiet (anything below 20 dB is super quiet). The higher you go, the noisier it gets. Whatever brand you are planning to purchase, you need to get this data so you can understand how your power is being used, and how noisy the fan will get. By studying this I estimated my computer will run cool silently.

6. The computer will rarely run at the maximum power draw all the time. The worst times are when the CPU and GPU are at the limit, which happens only if you're rendering or if you're working with heavily compressed RAW footage. Even with a maximum rated load of 850 Watts, mostly my computer will run at about 600-700 Watts. This gives me a factor of 1.7x.

7. You need to understand that Threadripper + multiple GPUs draw a lot of power. However, spinning hard drives are bad, too. They are cheap, but if you stack them up they can easily add 100 Watts to your build. I do plan on having an SSD RAID array, but any major storage will have to be external, with its own power supply.

Important build notes:

- Fit the cables before you put in the power supply. The cable diagram I used can be found below.
- Keep the fan side under (down), but only if you have a vent/opening at the bottom. This is the correct orientation to keep it cool.
- Don't bunch up the power cord outside the case. It should be kept loose.

Friendly advice:

I had a *really bad* experience about 13 years ago when I built a then state-of-the-art PC. For some reason it crashed ten minutes after powering up. It fried the motherboard. Luckily I got it replaced under warranty. I spent weeks testing different configurations and at one point even had the motherboard lay flat open in the air. Ultimately I found out it was the cheap power supply, the only thing I compromised on. Don't cheapen out on your power supply!

The second choice you need to make is which metal to pick: Bronze, Gold, Platinum or Titanium?

Bronze is for gamers and home builds. Gold is good enough. Platinum gives you a well-conditioned power supply that should last you a decade. Titanium is overkill. For more information, you might want to read this excellent article on the subject.

Here's my connection diagram for the power supply:

GPU

F_USB2
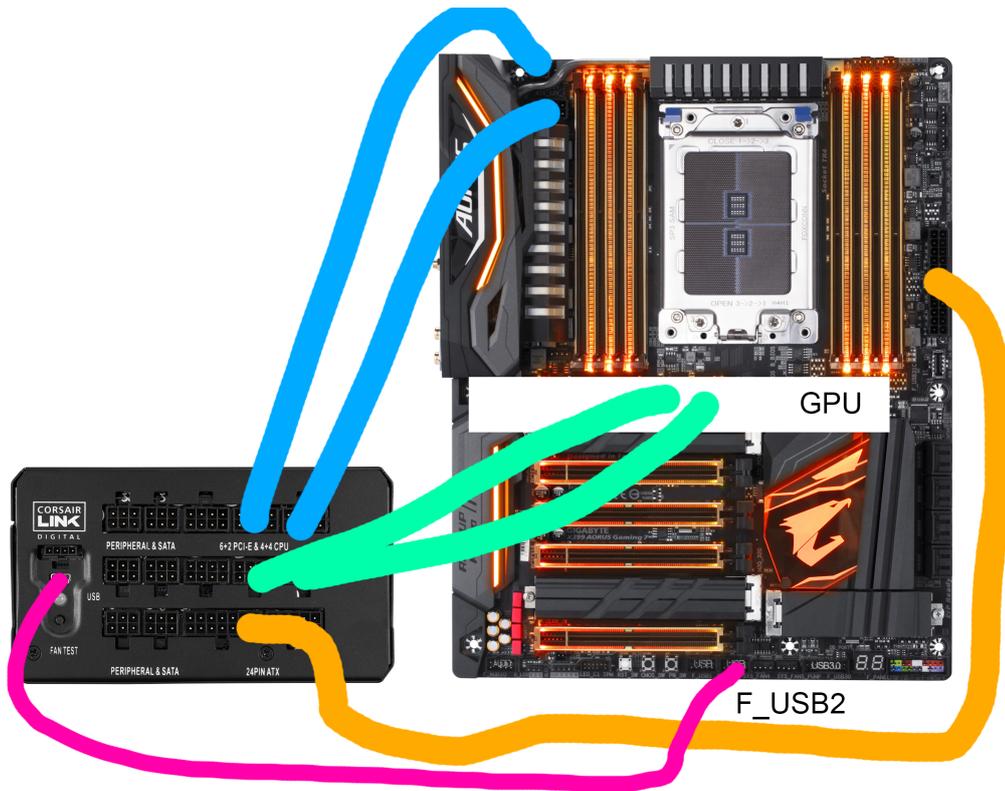
Important build notes:

- The 24-pin cable runs directly to the motherboard. You also need to make sure the two 12V pins go from supply to the motherboard. In this case it's in the top left corner. Make sure you tie these down or they'll hit the top fans of the radiator. You can split the connectors if there are too many. E.g., the top one is only 4 pins while the connector has 8 pins. Just use 4 pins and let the others be bare. I've hidden them behind the backplate.
- The only other major cables you need are for the graphics cards. The more GPUs you have, the more you'll need.
- I've connected the USB cable to the motherboard for monitoring purposes. Corsair provides free software called Corsair Link that helps you monitor the power supply. It gives you a good estimate of the wattage consumed.
- Lastly, connect the CLC headers and power supply header to the motherboard for monitoring purposes. I've connected it to the top right.

CPU and Motherboard

I went for the best Threadripper CPU possible: 1950X, with 16 cores, because Resolve digs more cores. This allows my system to come close to the ideal dual Xeon build.

The Xeons have three big advantages over Threadripper:

1. More CPU lanes (40+40).
2. More RAM (Terabytes if you want it!)
3. Easier cooling, though you need two.

But they also have a few significant disadvantages:

1. Lower clock speeds unless you go for the most expensive.
2. Very expensive for what it offers to content creators.
3. Expensive motherboards and ECC RAM.
4. The Supermicro builds are super loud!

If Threadripper survives a year without any major hiccups I think we have a winner here. If AMD hadn't released Threadripper, my build would have been a dual-Xeon Supermicro build, as per the official configuration guide.

Regarding the motherboard, I wanted to go with an ASUS, but the only one in stock at the time of purchase was the Gigabyte Aorus Gaming 7. It is a great motherboard, and has some really cool features:

- Heat sinks for all the M.2 drives.
- Easy installation for M.2 drives. Screws are attached to the sinks, so they won't get lost. But two of the drives are 22110 (see later).
- Great audio.
- Built-in Wireless.
- Dual BIOS, so you can fall back if a BIOS update fails. Great for newbies building their own systems.
- Well-designed PCIe lanes (more later).

The only major con is no support for Thunderbolt. It has USB 3.1 (including one Type-C connector).

Important build notes:

1. While installing the CPU, you can follow the video I linked to earlier. The only major confusion here is when you tighten the screws after it's done. I found AMD's official guide to be accurate, but they left out important information! You don't tighten the screws all the way. If you tighten screw 1, the back lifts up and you can't get a sufficient grip to tighten the other 2. The solution is to just barely tighten screw 1, then 2 and 3, and then complete the tightening the same way. Here's a great video from HardOCPTV that explains it, and it is what I followed.
2. Fit the back connector/port plate for the motherboard before you put in the motherboard, because it fits from the inside.
3. You need to remove one screw on the top (top middle) or the motherboard won't fit. Different motherboards might come with different number of holes so make sure you align them correctly. The 750D has a central thread so you can align it perfectly.
4. The CPU comes with a cooler adapter plate (X-plate) and you need to remove what's on your cooling system. Make sure the thermal paste is

untouched. You don't need to buy thermal paste. Mounting the radiator to the top is straightforward with the provided screws.

Understanding PCIe lanes

One of the coolest features of Threadripper is the number of PCIe 3.0 (Gen3) lanes it gives - 64. The more you have, the more cards, drives, etc., you can connect. Here is Gigabyte's official diagram (don't worry, we'll make sense of it next), courtesy Anandtech:
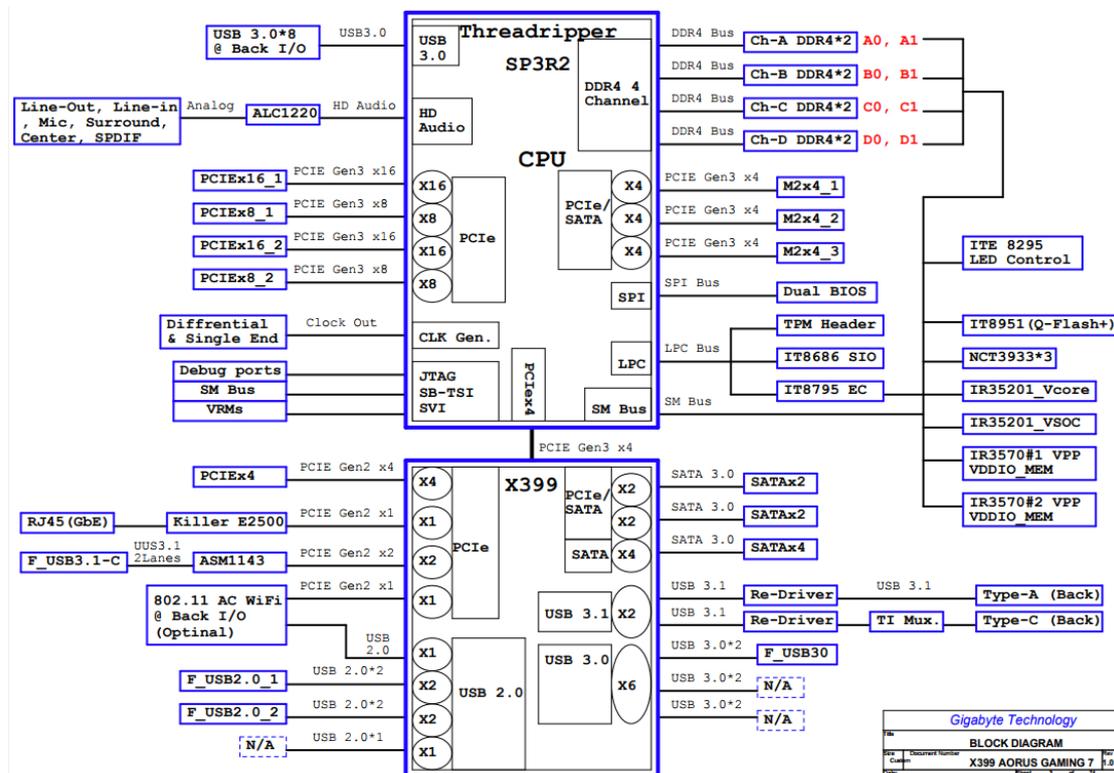
Out of 64, 60 are directly from the CPU and 4 are given to the Motherboard (Chipset). You can see the Gen3 x4 lane connecting the two big blocks.

What is the speed of one PCIe 3.0 lane? You get about 985 MB/s in one direction. Each lane has 2 directions, so the total for one lane is about 1970 MB/s. We'll only consider one direction here because for video that's most relevant. The three common PCIe 3.0 options are:

• x16 = 16 x 985 = 15.4 GB/s per direction
• x8 = 7.7 GB/s per direction
• x4 = 3.8 GB/s per direction

Now here's the first important thing to remember. Since only x4 (3.8 GB/s) is given to the motherboard, the maximum data it can deliver in one direction (read or write) is 3.8 GB/s. Now look at the box and see all the things that must exist in that one x4 PCIe connection:

- 1x PCIe 2.0 x4 (for 2.0 or Gen2 halve that of 3.0)
- Ethernet, Wireless
- USB 2.0 front side ports
- USB 3.1 ports
- USB 3.0 front side ports
- SATA drives (all your hard drives except M.2)

What does this mean? It's easier to understand with examples. Let's say you plan on having all of the following as part of your hard drive strategy:

- 4x SSD 2.5" in RAID 0 = 550 MB/s x 4 = 2 GB/s Read Speeds
- 8x 7,200rpm 3.5" External in RAID 5 = 150 MB/s x 7 = 1 GB/s Read Speeds, connected via USB-C/3.1
- A couple of 2.5" external drives connected to USB 3.0 at the back = 100 MB/s x 2 = 200 MB/s Read Speeds
- A couple of 2.5" external drives connected to USB 3.0 at the front = 100 MB/s x 2 = 200 MB/s Read Speeds

The total in one direction, either read or write, is 3.2 GB/s (the back side USB 3.0 is not considered because it's connected to the CPU). As we saw above, the maximum provided by x4 is 3.8 GB/s. This means both internal RAID array and external RAID can read data at the same time at maximum speeds. There's also some overhead, so these are just theoretical numbers.

Secondly, the USB-C connection is a PCI 2.0 x2, which maxes out at 1 GB/s. USB 3.1 has a total bandwidth of 1.25 GB/s so there's nothing wrong with the allocation. You shouldn't expect more than 1 GB/s from an external RAID array via USB 3.1. Having support for Thunderbolt 3 would be great, but it's not there. For blazing fast speeds, you need to stick to an internal SSD RAID array.

What is the maximum read speed you can expect from an internal SATA RAID 0 array?

There are a total of 8 SATA ports. From the above diagram, you can see 4 are maxed out at x2 and four are maxed out at x4. Here are two examples:

- 4x SSD 2.5" in RAID 0 = 550 MB/s x 4 = 2 GB/s Read Speeds. These are well below the 3.8 GB/s limit so this is the speed you can expect.
- 8x SSD 2.5" in RAID 0 = 550 MB/s x 8 = 4 GB/s Read Speeds. Here, since the four extra drives will max out at 1.9 you will be bottlenecked to this limit. This is what I have been able to understand. So you're still limited to under 2 GB/s.

Right, so far all these numbers have been theoretical. In the real world, there are multiple tests that show there's no benefit by going to 4 or more SSD drives in RAID via SATA ports. Here are a few videos with examples:

1. [Linus Tech Tips](#)

The maximum speeds it you can hit with SSD RAID, regardless of the number of disks, is 1.7 GB/s or thereabouts. I would recommend keeping the size down to 4 or less. 3 drives are the sweet spot, but adding a fourth drive also allows you to add more data, and you do get a higher read speed.

If you want faster speeds, you need to have a RAID card in the PCIe slot and then link your SSD to that. For my build, the data read rates for RAW footage are well within the 1.7 GB/s limit, so I don't think I'll opt for that unless I see a definitive bottleneck down the line.

Now let's move on to 60 lanes connected to the CPU!

M.2 Connection diagram
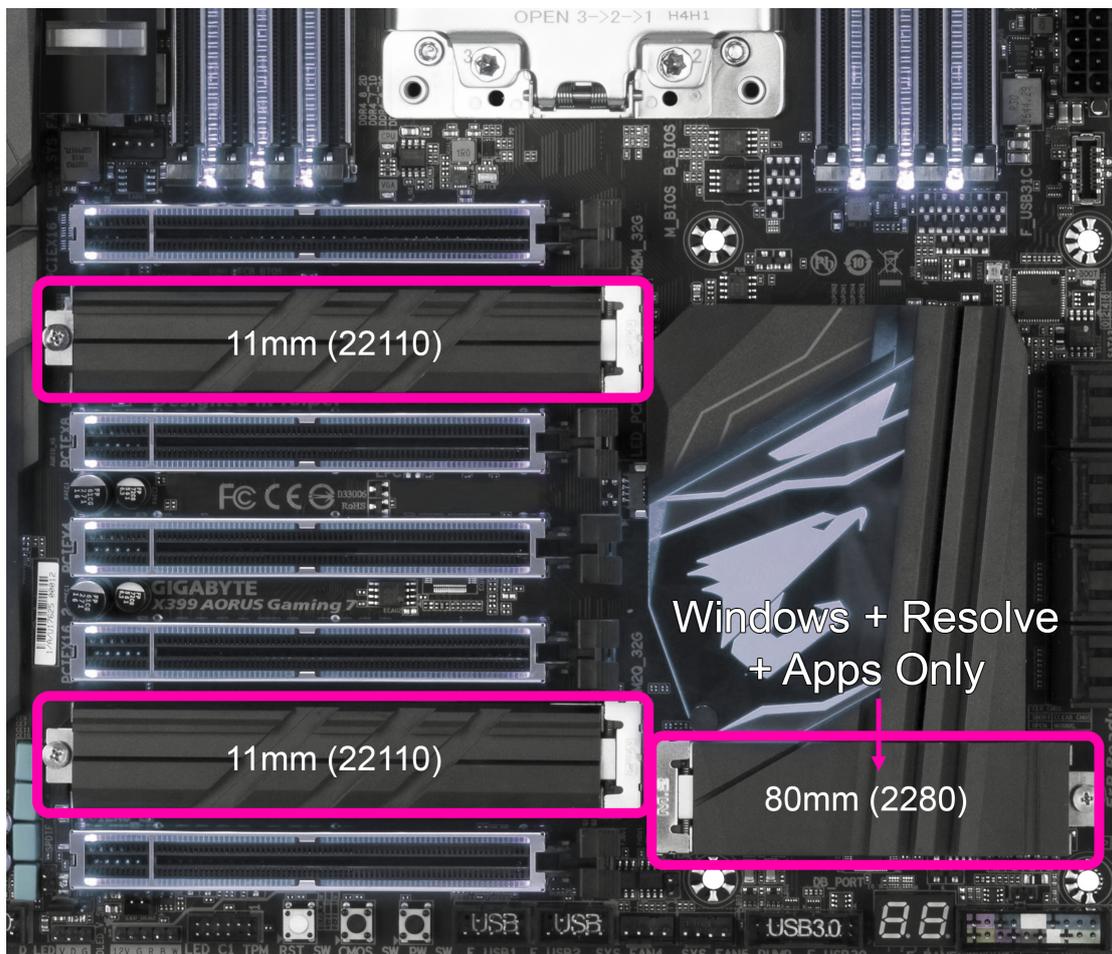
All three M.2 slots are directly linked to the CPU with 4 lanes each (PCIe 3.0 x4). Two slots are designed for 110mm drives and the third slot is designed for a 80mm drive (this is more standard). I decided to populate this slot with the OS drive. It stays away from the GPU and remains cool. M.2 drives have

thermal throttling issues. This means, if it gets too hot the performance drops. You don't want that.

The good news is you can populate all three M.2 drives without any PCIe hit. Each lane supports up to 3.8 GB/s in read and 3.8 GB/s in write, and the M.2 Samsung 512 GB SSD I have is limited to 3 GB/s read speeds:
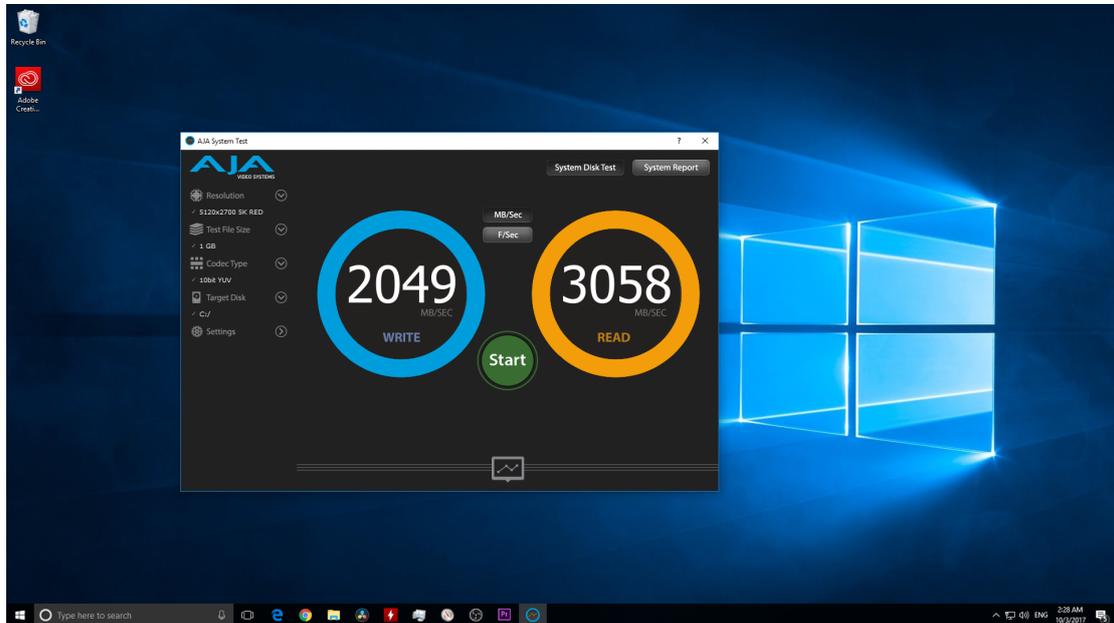
M.2 drives are addictive! But they are expensive in large sizes and not practical unless somebody is paying you good money for real-time 8K performance. For 4K work, an OS drive is more than enough to keep your system running super fast.

The only 'con' I could find here is that 22110 drives are rare at the moment. Which means two out of our three slots are practically useless until someone makes more 22110 drives. The longer length allows manufacturers to put greater capacities on the drive. However, M.2 2280 have 2 TB versions already, so I really don't know how this will pan out.

PCIe Connection diagram

The motherboard has five PCIe slots, in this fashion:

1. Slot 1 – 16x
2. Slot 2 – 8x
3. Slot 3 – 4x
4. Slot 4 – 16x
5. Slot 5 – 8x

Total = 52 lanes

Here's a diagram of the PCIe layout:
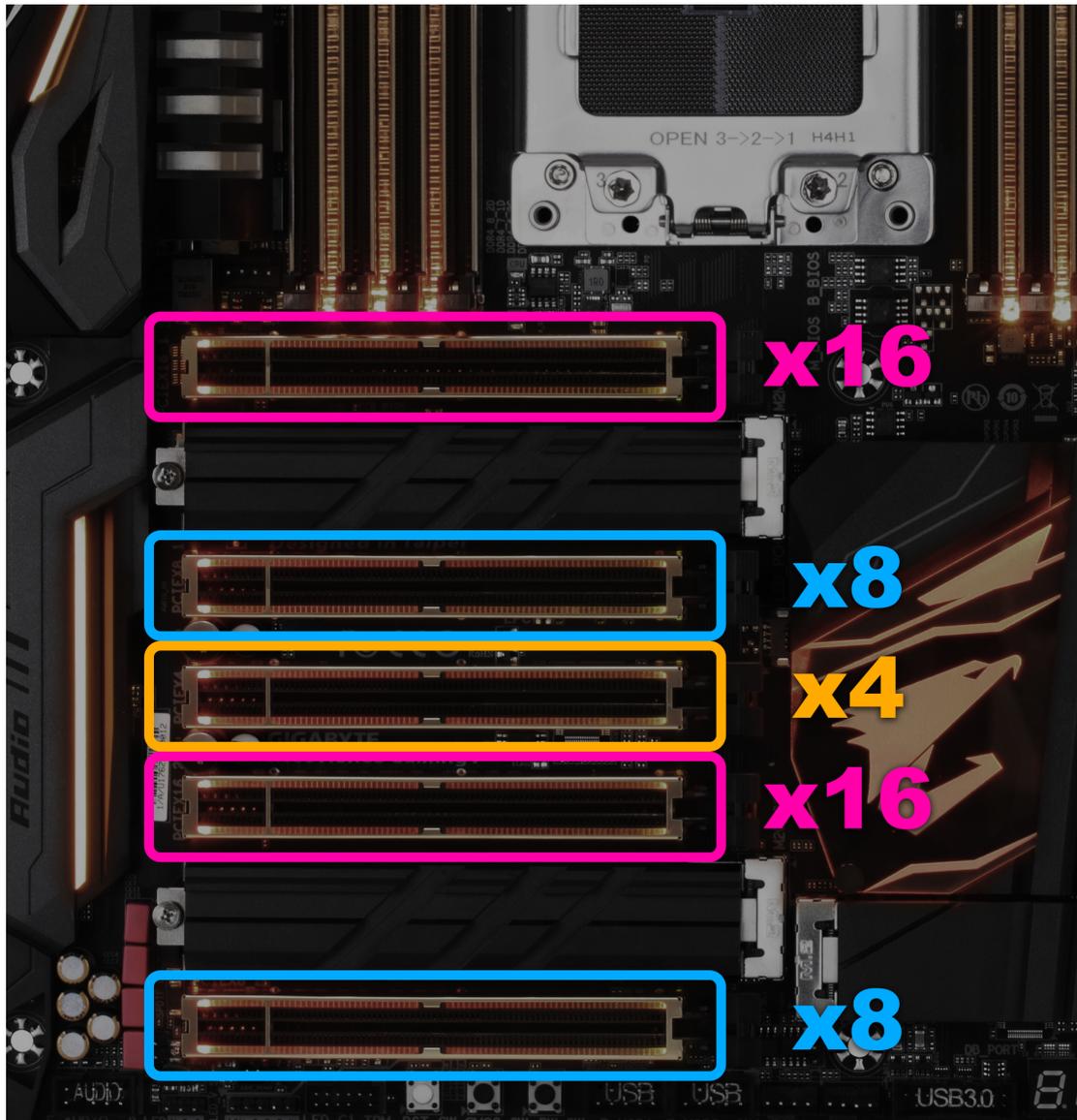
So even though technically you could fill it up with 4 dual width GPUs, you wouldn't have any space left for a Decklink or RAID card. Ideally you want to limit yourself to two GPUs here, and this is what I've designed this system for.

Since both 16x lanes have M.2 bays below them, it can easily accommodate full width GPUs like the one I'm using. The second GPU would go into the fourth PCIe slot, which is 16x as well (pink in the above image).

The last lane is where the Decklink card can go. There's enough clearance even for the 4K 12G Extreme card if that's what I go for. These cards are known to have noisy fans so you don't want to bunch them up against hot GPUs if you can help it. In the future, if I need to, I can populate slot 2 with a third GPU or a RAID card.

Slot 3 (x4) shall remain empty. Both RAID and Decklink need x8. Here's the final plan:

- Slot 1: GTX 1080 Ti
- Slot 2: RAID card, if necessary
- Slot 3: Empty
- Slot 4: GTX 1080 Ti, if necessary
- Slot 5: BMD Monitoring card, if necessary

Case Connection Diagram

Here are the rest of the connections for the front panel, power, etc.:

Case Fans

Front Audio   Front USB 2.0   Front USB 3.0

Power
Reset
LEDs

Important build notes:

The arrow on the Power and Reset cables indicates Positive. Don't make a mistake here! A flashlight might come in handy.

Make sure you use cable ties to tie up cables neatly once the system is up and running. However, don't bother with this until you know for sure the system is fine. It's frustrating to have to remove everything on top of knowing there's something you did wrong; or worse, some part has failed.
Run the large cables to the back of the motherboard backplate and you can tie them neatly there.

GPU

The GPU I opted for was the 11 GB EVGA GTX 1080i FTW3, with three fans. This was because my system is primarily an air-cooled design.

Why not the 16 GB Vega Frontier Edition?

Here are some important reasons:

1. At the time it wasn't available. But still, in hindsight, I'm glad I didn't.
2. It draws 365 Watts, equivalent to two 1080 Tis!
3. It gets a lot hotter, and with multiple GPUs you might need liquid cooling. I don't want to get into that.
4. Performance isn't better than the 1080Ti in most benchmarks, though it does have a 16 GB VRAM advantage (not that big of a deal, people have been doing high-end work with 11 GB 1080 Tis and 12 GB Titans).
5. Vega has a 10-bit output, but if you're using a BMD card then this isn't an issue.

The reason I didn't buy two GPUs together is because I wanted to make sure I didn't make a mistake. Once I start working on projects I'll know the limits of the 1080 Ti. It's easier to course-correct by selling off the 1080Ti for a better GPU later. Results with this current system are at the end of this guide.

Note: The GPU fans only start spinning once it reaches a certain load threshold, so don't freak out if it doesn't spin. If it lights up, you're gold.

The BIOS

The first step after you've completed the build is to fire up the PC and make sure everything's working. The RAM, Motherboard, CPU cooler and GPU all light up. If there are any errors in the motherboard it will show you, and you can use the manual to find out what's wrong. To enter the BIOS hit DEL continuously on startup.

The second step, for me at least, was to update the BIOS firmware. The first versions of most X399 boards (mine was F1) had issues with memory, Windows installations, etc. So I decided to download the latest update (F3d in my case, latest as of this writing is F3g) and flash the BIOS. Instructions can be found here. It took me only 3 minutes from start to finish.

Once you have the latest version, you can make some changes in the BIOS to taste. If you're interested in overclocking you can read this. Until I'm fully certain my system is stable, and I need the extra speed boost, I will not be overclocking. Also, overclocking increases power draw, and I have to ensure I stay within my 850 Watt design spec. I've heard it's possible to get 3.9 to 4 GHz in a stable configuration, so if you're confident, why not?

Here are my BIOS settings with notes:

The first thing to do is to change the Memory Frequency. By default it was 2400, if I remember correctly. The memory I purchased is 3200 MHz and Threadripper is capable of supporting these speeds, according to various sources. Officially though, AMD only supports up to 2667 MHz:

AMD Ryzen™ Threadripper 1950X

− Specifications	# of CPU Cores 16	# of Threads 32	Base Clock Speed 3.4GHz
	Max Turbo Core Speed 4GHz	Total L1 Cache 1.5MB	Total L2 Cache 8MB
	Total L3 Cache 32MB	Unlocked Yes	CMOS 14nm
	Package sTR4	PCI Express Version PCIe 3.0	Default TDP / TDP 180W
	Max Temps 68°C		
− System Memory	Max System Memory Speed 2667MHz	System Memory Type DDR4	Memory Channels 4

I changed to Profile 1 and with a 32 Multiplier the motherboard does allow you to go as high as 3200 MHz. The number on the right might not change at the beginning, but it will eventually. On the left it should read 3200 once you're done (assuming you have a 3200 MHz RAM of course):

You can use an app like CPU-Z to verify. Here are the voltages for my system (If you notice anything wrong please let me know! AFAIK CPU Vcore should be below 1.5V):
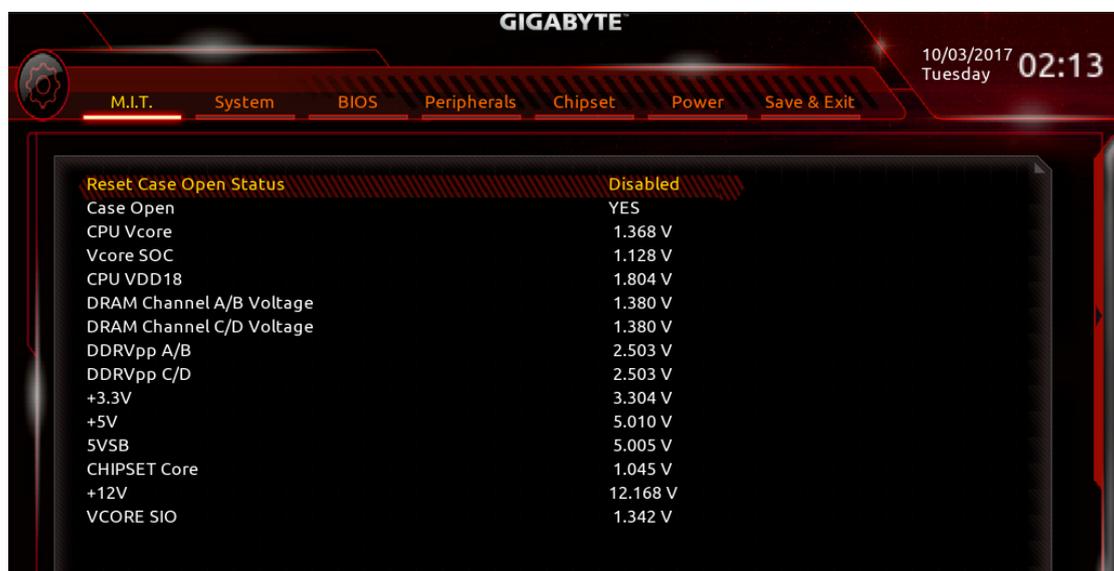
In this next screen you can see I've updated the BIOS Version to F3d:

I have an external DVD drive connected to run Gigabyte's software:

Note, in the above image, Fast Boot is Disabled. In the next screen, make sure Initial Display Output is PCIe 1 Slot, because my GPU is in the first slot.

This option is interesting – 'Above 4G Decoding':

By default it's Disabled. Blackmagic Design does recommend enabling it in the configuration guide, but only in the Supermicro build. I did quite a bit of research and could only find two possible solutions:

1. You don't need to enable it for GTX or AMD GPUs at the moment.
2. I found this answer from a Supermicro forum:

So it seems you only need to use it if multiple GPUs aren't working as intended. If you have any more information on this please let me know. For further reading as to what this means, this Wikipedia article is one of the easiest to understand. For now, leave it Disabled.

Next up we have Chipset:

If you haven't updated your BIOS, you might have to change IOMMU settings to get Windows 10 to install correctly. Check out this article for more information:
http://www.guru3d.com/articles_pages/gigabyte_x399_aorus_gaming_7_review,1.html

Next, Power:

Without anything running, you can see the CPU idles at 37° C. That's good. If you check out the AMD chart I had shown above, the maximum temperature for Threadripper is 68° C. If you find blogs or articles with higher temperatures, that's because they've added a 27° C offset (there are multiple ways to read CPU temperatures). Just go by what I'm showing in this guide and you can avoid confusion.
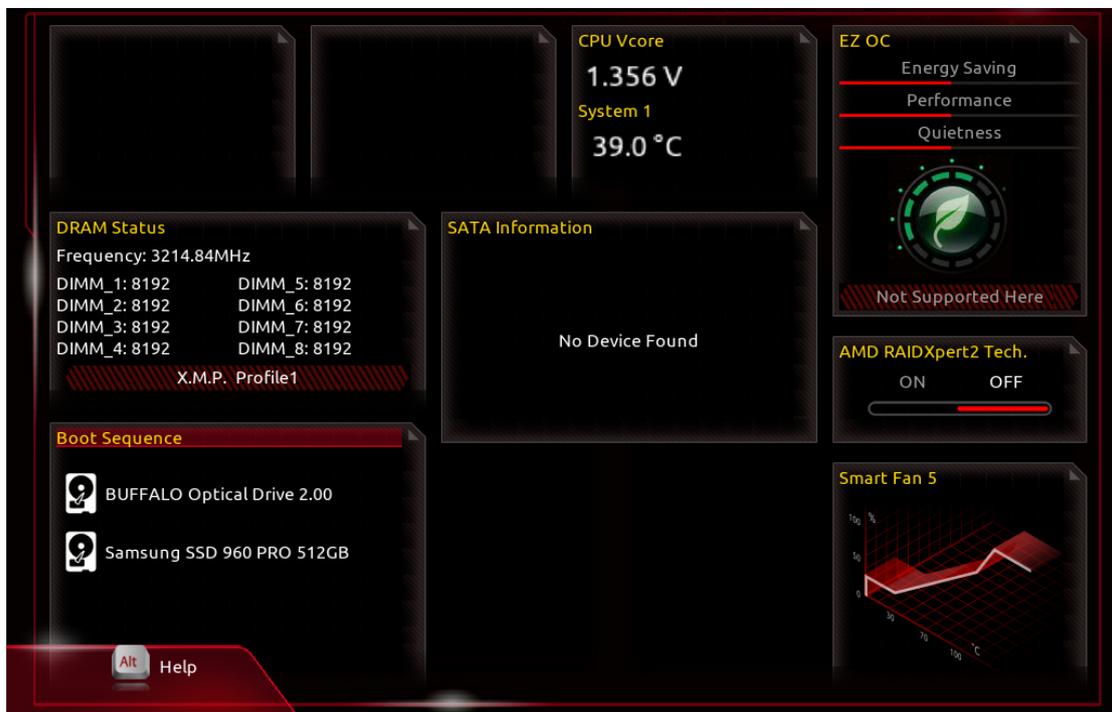
Make sure the BIOS is reading your RAM correctly. You can see 8x8 GB at 3200+ MHz frequency in the above image. *Please note:* I've purchased the CAS 14 version as it is the fastest.

The primary drives are shown (the boot sequence is prior to me changing it). If your system hovers around the 40° C mark when idle you should be okay.

Windows + Software Installation

I purchased the USB version of Windows 10 Pro 64-bit and it had to be mailed to me. Once installed, I updated it to the latest version, which includes the Creators Update as well. This is what Resolve officially supports.

It took a total of 20 minutes to install Windows.

I installed the following apps along with the windows update. I did everything at the same time to see how much stress the computer can take. Now's the time to test everything!

In this order:

1. Gigabyte apps from the CD (provided with the motherboard) – this installs Wi-Fi, audio drivers, other important drivers to get going, etc.
2. Google Chrome – Optional. I wanted to make sure the Ethernet and Wi-Fi were both working.
3. CUDA driver installation from Nvidia – latest version:
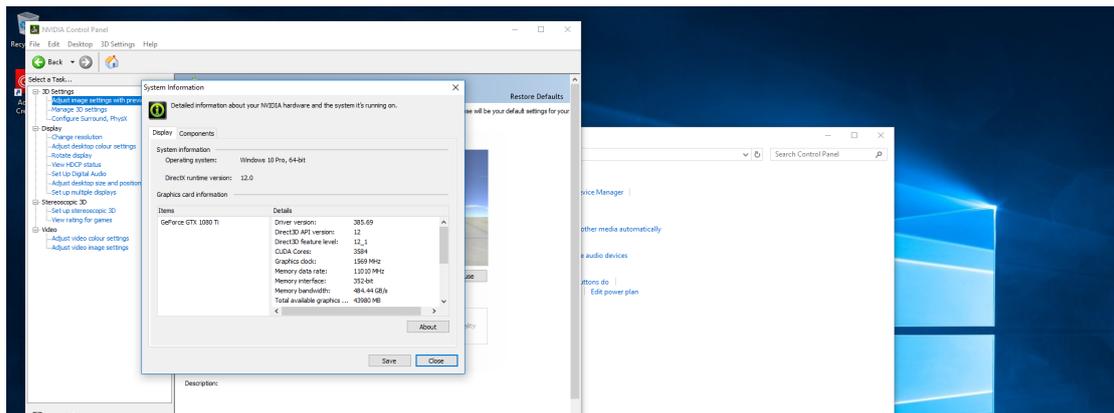
4. DaVinci Resolve 14. Once I get used to it I will be purchasing Studio.

   Note: From version 14, Blackmagic Design is shipping a key instead of a dongle. Make sure you don't purchase the dongle.

5. Adobe Premiere Pro and Creative Cloud CC 2017
6. Aja Systems Test (Blackmagic Disk Test is only available for Mac, or if you purchase one of their cards)
7. HWMonitor – to test system resources. I also downloaded CPU-Z but didn't use it.

8. [AMD Ryzen Master](#) – this will help you overclock if you need to, but I primarily used to get [the most accurate CPU temperature (Tdie)](#).
9. [Corsair Link](#) – This is applicable only if you have a Corsair power supply. This gives me another perspective on the system and power usage directly from the supply.
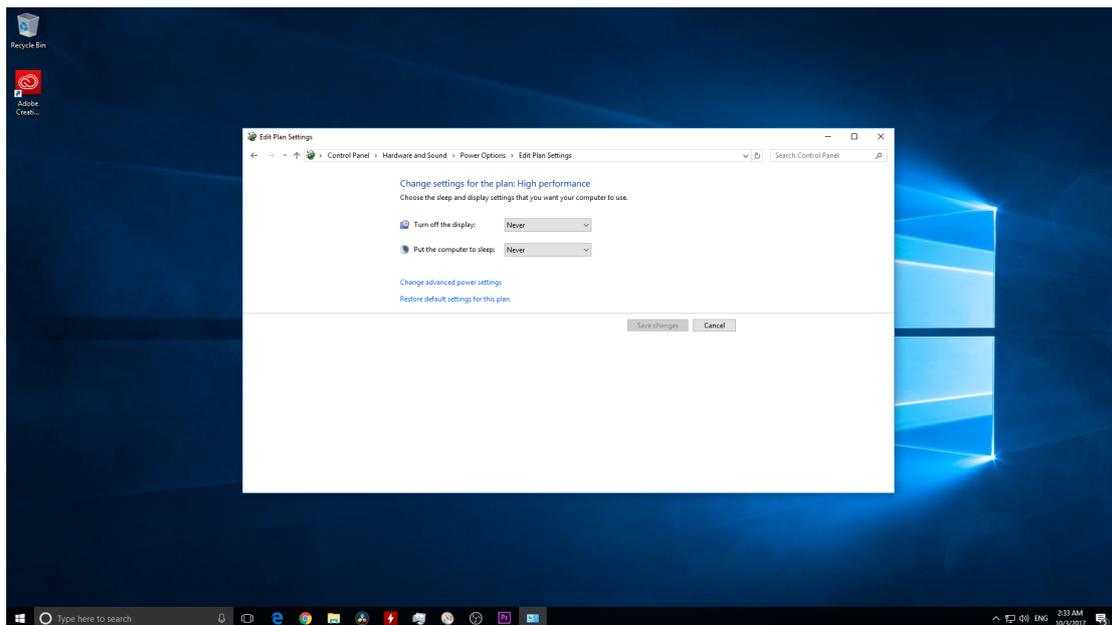
Optimizing Windows for Performance

According to the Resolve configuration guide, it's important to set the right power savings option in Windows. From the Control Panel:
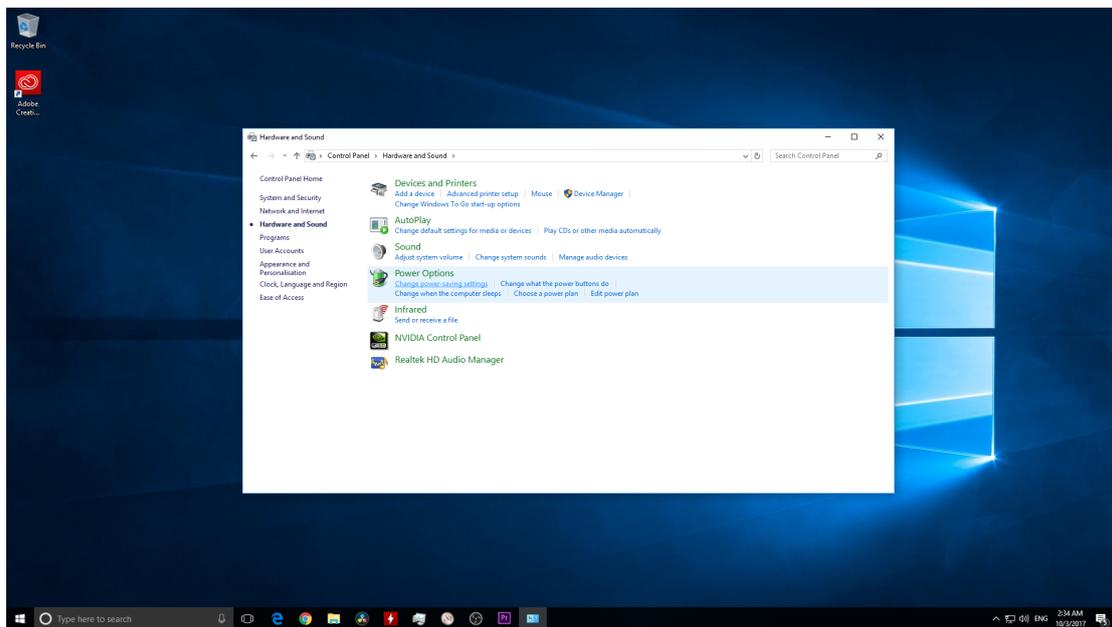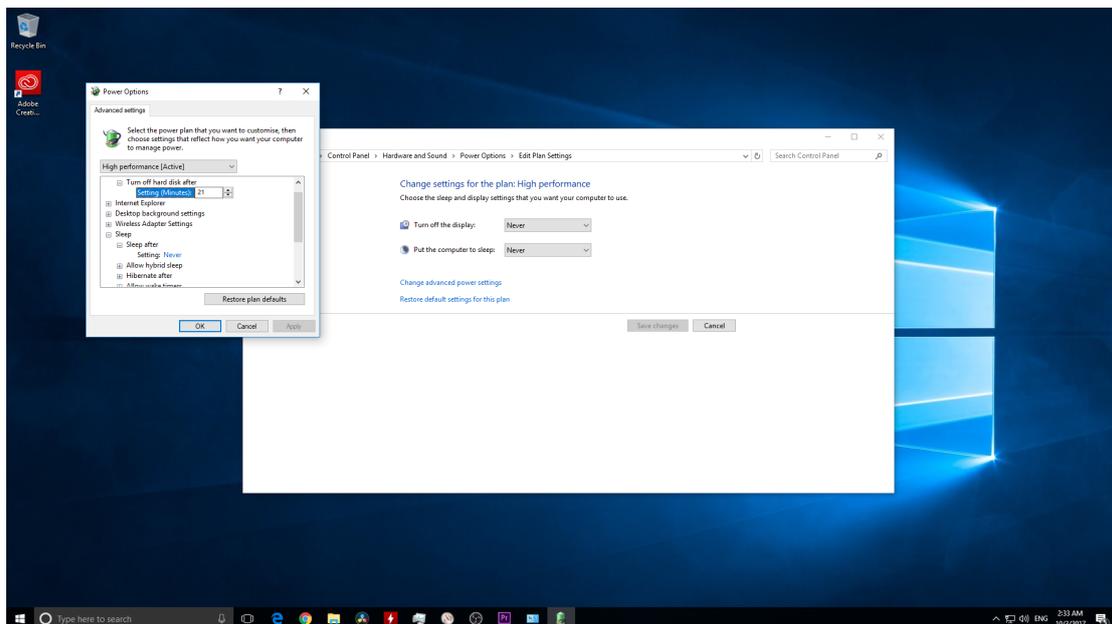

Choose Change power savings settings:
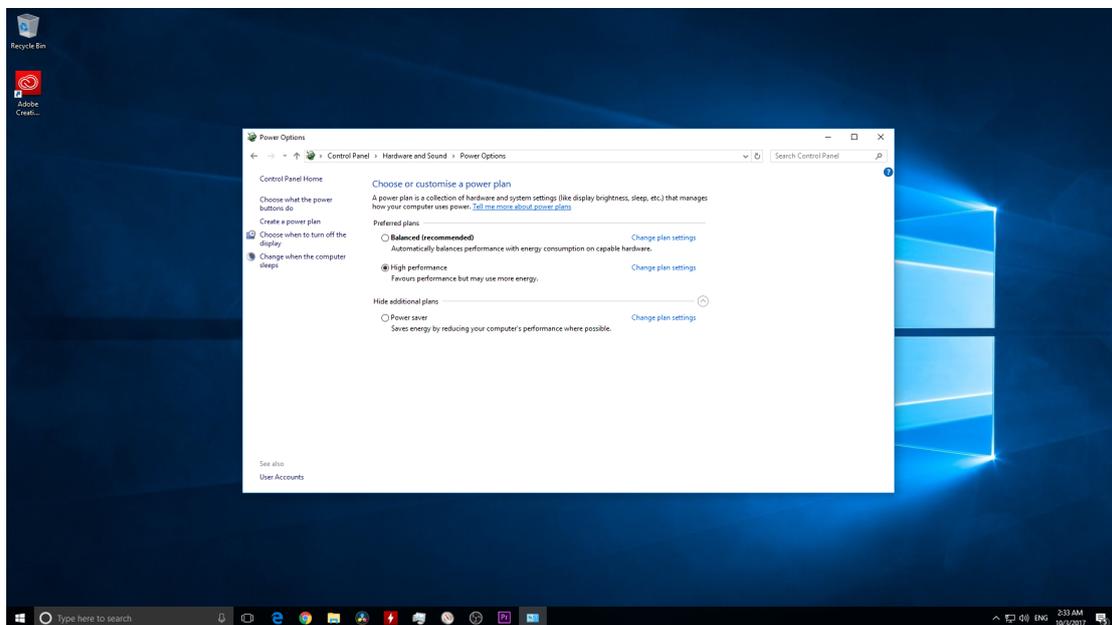
Choose Additional Plans if necessary, but you need to select 'High Performance'. Then click on 'Change plan settings' next to it:
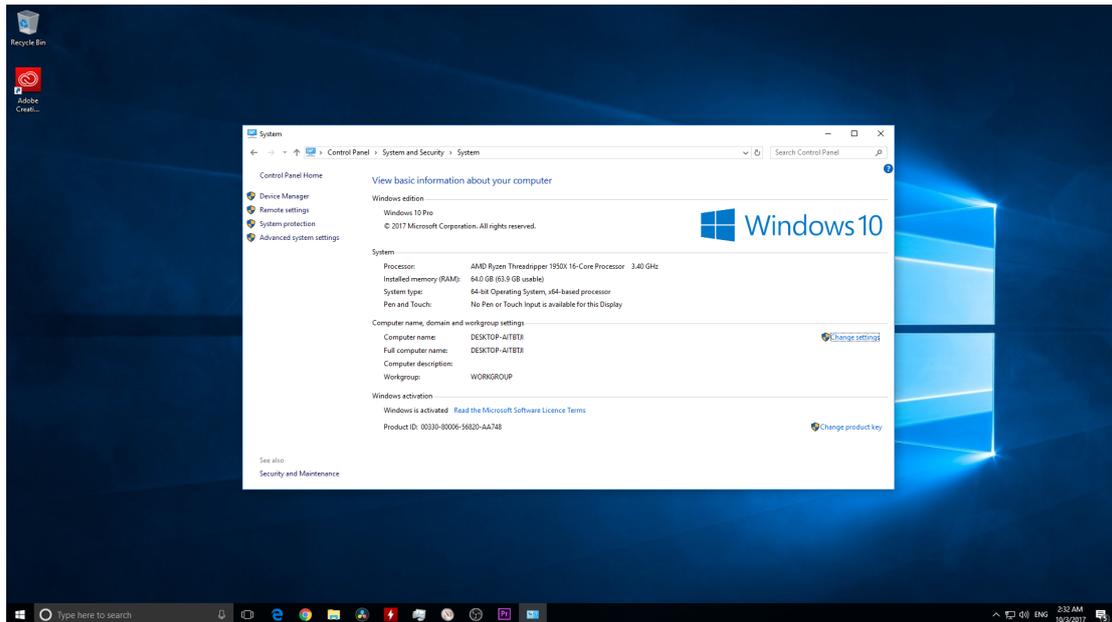

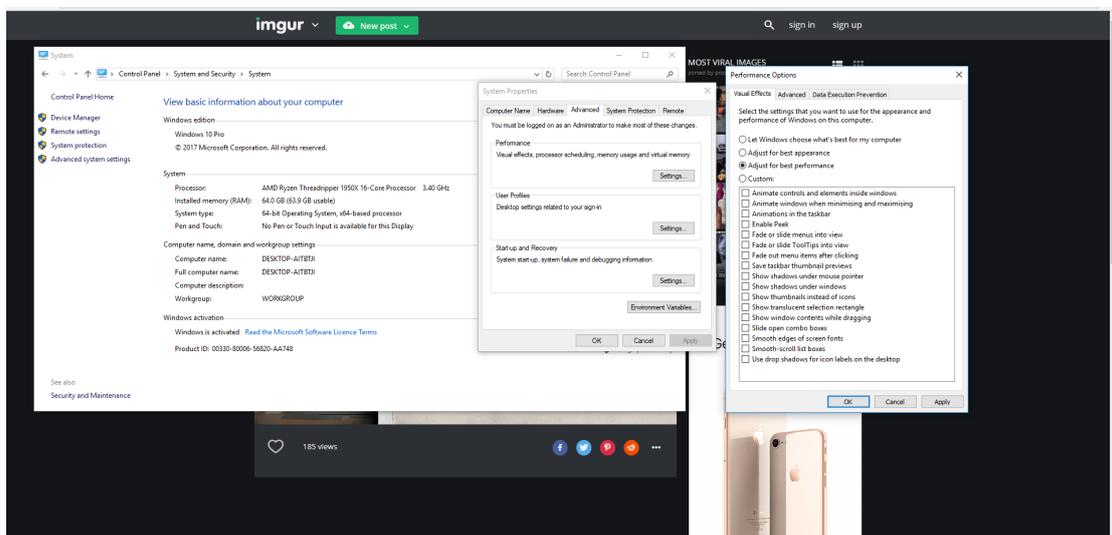Make sure you choose 'Never' for both, and select 'Change advanced power settings':

Make sure it's 'Never' under sleep and everything else. Click OK and Save Changes.

Here are my system specs from Windows:

Next up you want to select Advanced system settings:

Choose the 'Advanced' tab and under 'Visual Effects' make sure you select 'Adjust for best performance'. Hit Apply and OK.

Since this is a new computer you don't need to optimize anything else in Windows.

Side note:

AMD recently announced a firmware update to allow RAID via NVMe. You can read about it here. This will allow you to use a PCIe card that can take 2 or 4 NVMe M.2 SSDs and configure them in RAID. If one of them can give you 3000 MB/s, imagine what four can do!

The only problem with NVMe is the price to storage ratio. It's too expensive. You're better off either having SSDs in RAID or if you're into feature films,

then definitely 7,200rpm HDDs in RAID. I use a 4-bay Areca 5026 in RAID 10 (12 TB), and I'll probably buy something similar in the new build.

For your reference:

- NVMe M.2 SSDs = 3000+ MB/s read speed
- SSD 2.5" = 500 MB/s read speed
- 7,200rpm 3.5" = 150 MB/s read speed

If you're using footage from high-end cameras, you'll need faster storage. As an example, here are the rough data rates for some popular cameras (at 24 fps):

- Arri Alexa 65 (RAW) – 30 MB/frame – 720 MB/s
- Arri Alexa Open Gate (RAW) – 11 MB/frame – 264 MB/s
- Red 8K (RAW) – 9 MB/frame – 221 MB/s
- URSA Mini 4.6K (RAW) – 6 MB/frame – 140 MB/s
- Prores HQ 10-bit 422 – 3.8 MB/frame – 92 MB/s
- Panasonic GH5 Intraframe Internal – 2 MB/frame – 50 MB/s
- Sony a7S II Internal – 0.8 MB/frame – 19 MB/s

As an example, if you're shooting Alexa Open Gate or Red 8K, you're looking at something in the region of 250 MB/s or so (approximately). So, if you're shooting a project, one hour at that rate will require just shy of 1 TB.

I typically do small projects, shooting just one or two hours for a few final minutes. I might be able to get away with a few 512 GB SSDs in RAID 0. Four drives will give me 2 TB, just enough to get by. Your hard drive strategy might be different. It's a constantly evolving thing, so you don't want to overspend or overestimate right from the beginning.

Right now for testing purposes I've connected two Intel 480 SSDs in a RAID 0 (software RAID) configuration. This will allow me to work on a couple of projects while not having to use the primary M.2 drive for media.

Thoughts on stress-testing software:

I don't see the point in running stress tests simply because if there's something wrong you'll know about it in Resolve. Why waste time looking for errors or problems when not everything is broken? The best thing to do is just run your computer for 72 hours continuously and work on a heavy project.

In case you're interested, here are some popular and free stress-testing software (run at your own risk): Prime95 for CPU, Memtest86 for RAM, Furmark for the GPU.
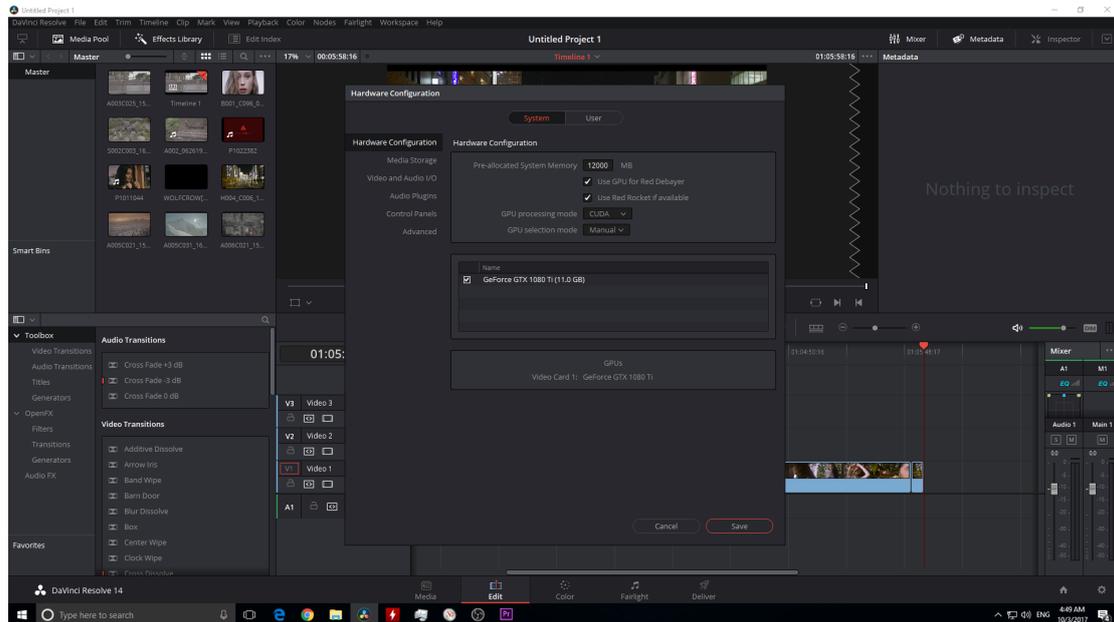
Let's move to DaVinci Resolve.

Configuring DaVinci Resolve

Finally, we fire up Resolve and change some things for optimum use. I've only followed what's already in the configuration guide.

Resolve fires up and is ready in about 10 seconds without any tweaks. Go to **DaVinci Resolve > Preferences… (Ctrl+,)**:

Under System, click on 'Hardware Configuration':

Since I have an Nvidia card I've selected CUDA. I've also chosen 'Manual' selection. If you have more than one GPU you can decide whether to use one for GUI/Compute, etc. Finally, I've allocated 12 GB for System Memory. I've read somewhere Resolve only needs about 16 GB in total.

Anyway, it only allows you to go up to 12 GB. BMD advises you should only increase this if you have more than 64 GB of RAM. Otherwise leave it as is. Since I have 64 GB I've gone for the maximum.

Next, click on Media Storage:
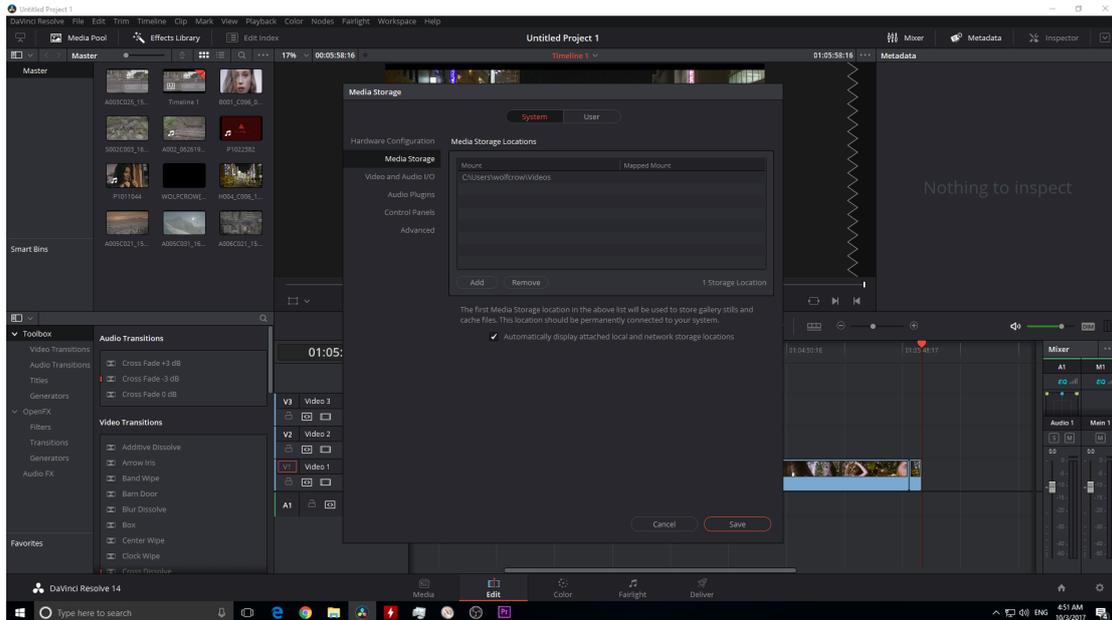
Pay attention to the note in the box. Your media drive should be separate from the OS drive. You want to select the correct drive here for maximum performance.

Next up, we have Video and Audio I/O:
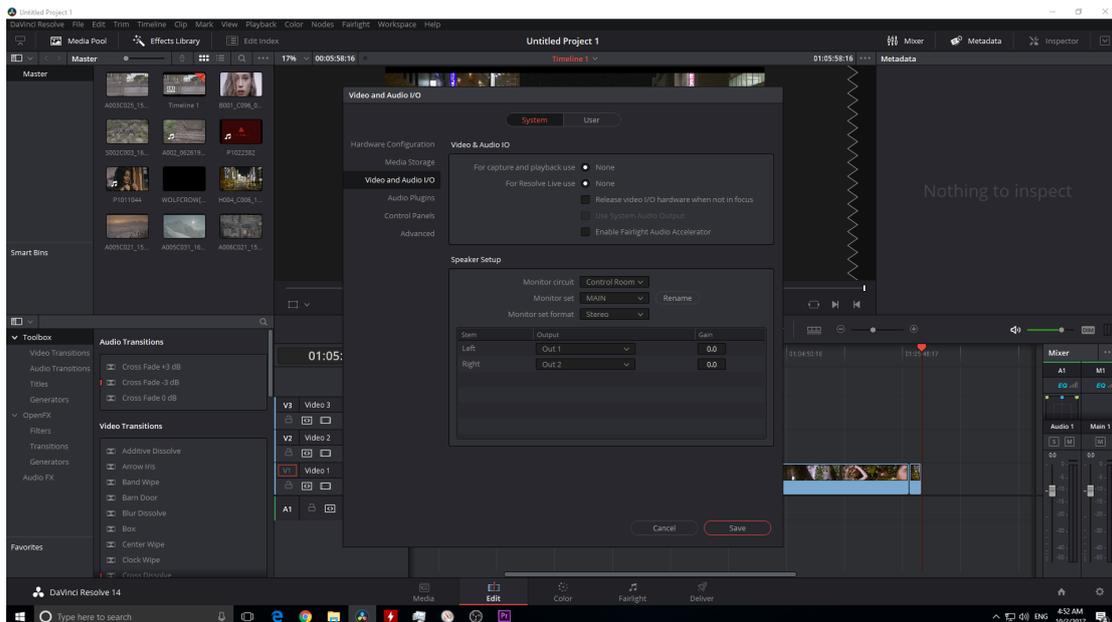
I don't have any capture/playback card so there's no option. If you have a Decklink or Monitor PCIe card attached it should show up here.
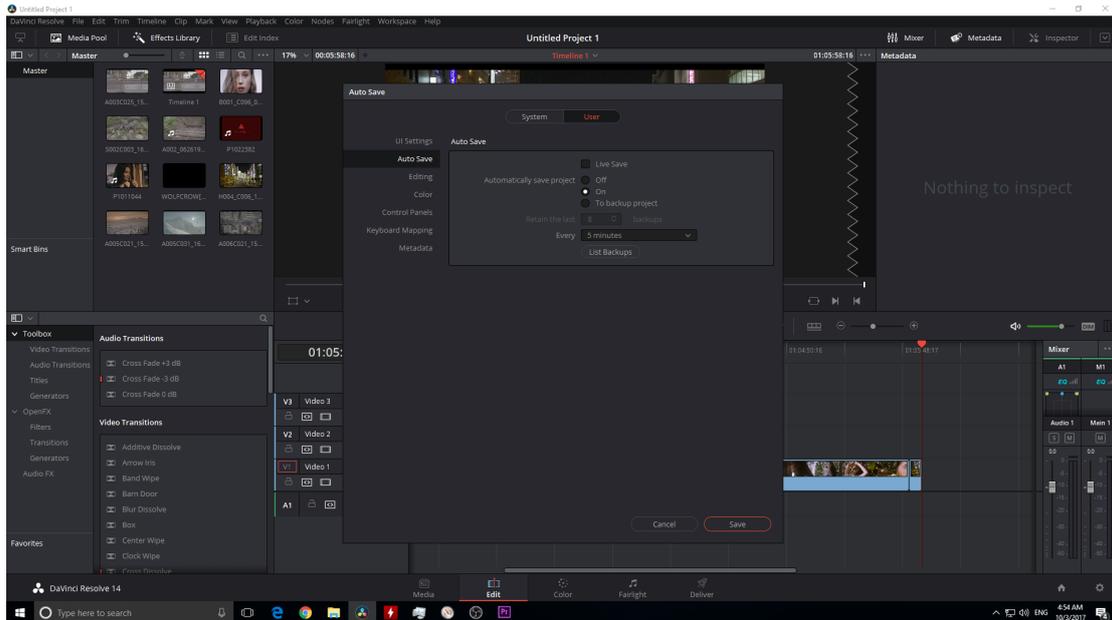
Then we go to Control Panel:
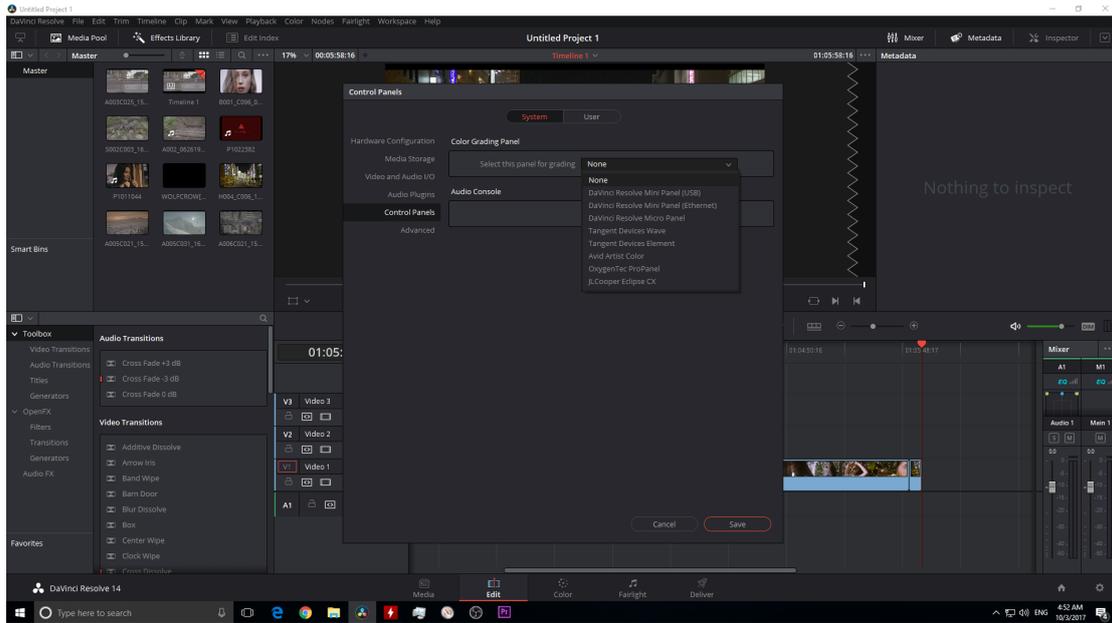
Resolve lists all the supported panels. I don't use one, so there's nothing to select. BMD asks you to ignore the 'Advanced' option.

Then we click the User tab and start with UI Settings:
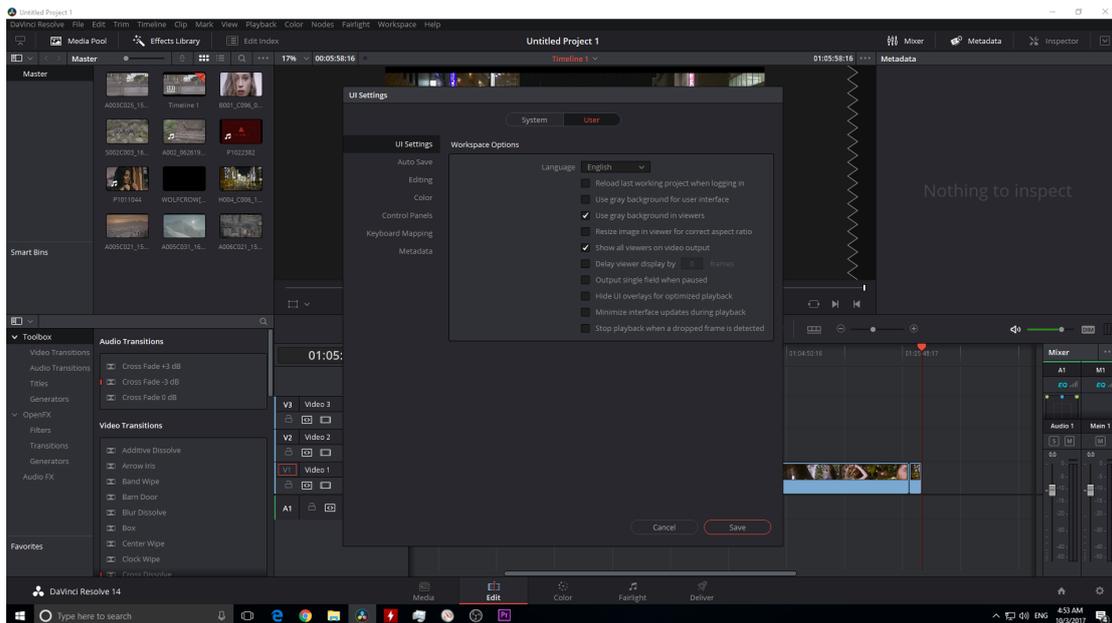
The only thing I've unchecked is 'Resize image in viewer for correct aspect ratio'.

Next, Auto Save (important!):

Autosave is always on, for 5 minutes or so. No exceptions for me. It's a lifesaver.

'Editing and Color' are left as-is. Same goes for 'Control Panels'. Then we have 'Keyboard Mapping':
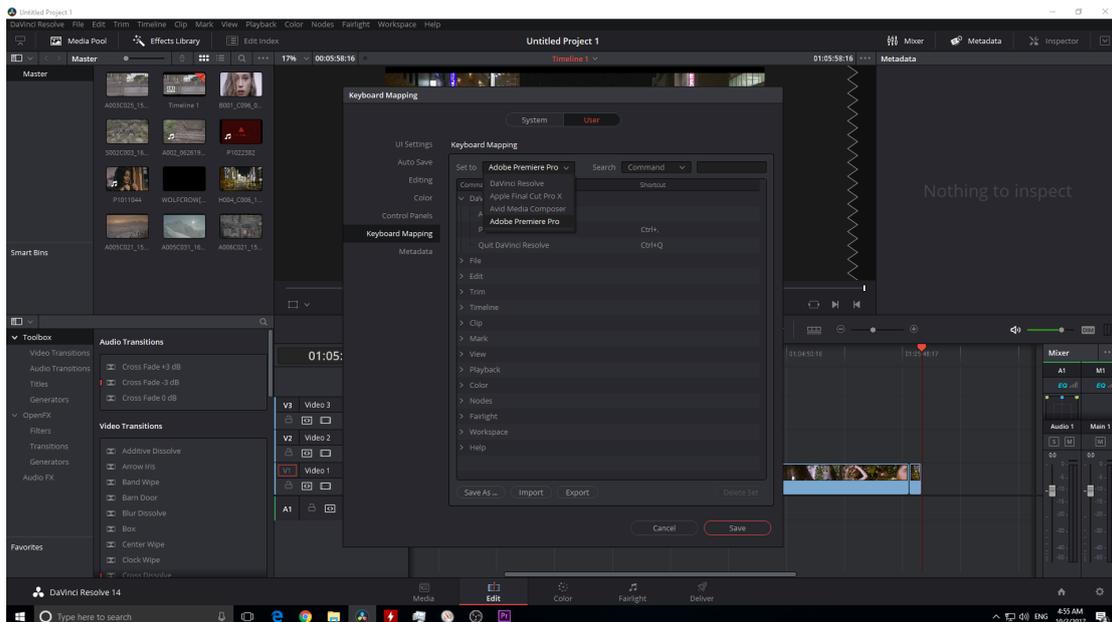
I come from a Premiere Pro background and Resolve maps shortcuts to what I'm supposed to be used to. However, many of the shortcuts are absent, so I guess I'll have to slowly save and build my own shortcut system. If you're totally new you can choose 'DaVinci Resolve' here.
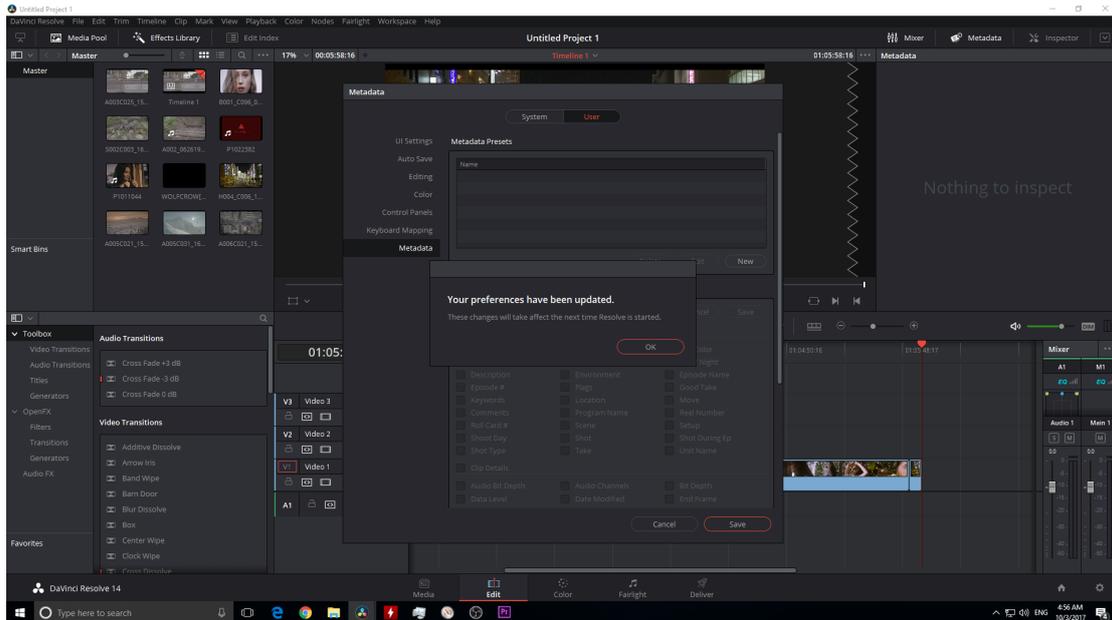
Finally, don't forget to Save. You need to restart Resolve for these settings to take effect.

Whew! Our system is now ready for action.

Results – Was it all for this?

I created a simple project with the following codecs:

- Arri Alexa 65 6K RAW 12-bit
- Arri Alexa Open Gate 3.4K RAW 12-bit
- Red Epic-W 8K RAW 16-bit
- Red Weapon 8K RAW 16-bit
- Blackmagic Design URSA 4.6K RAW 12-bit
- Panasonic GH5 4K H.264 8-bit
- DJI Phantom 4K H.264 8-bit
- iPhone 8 Plus 4K H.264 8-bit
- Various 4K MP4 (H.264) 8-bit

The project was on a UHD (3840x2160) timeline** in 25p.

What you should do for maximum quality

Here are some other important settings I made to ensure the maximum quality with no compromises:

1. Retime process changed to Optical Flow for maximum CPU usage. This helps with different frame rates and resolutions.
2. Motion Estimate Mode is set to Better.
3. Resize filter: Sharper. Scaled entire image to fit.

4. Project was DaVinci YRGB Color managed. Set to Rec.709 Gamma 2.4.
5. Camera RAW was set to Full Res. Decode premium (16-bit for Red).
6. Playback > Performance mode is checked.
7. Use Optimized Media is unchecked.
8. Enable background caching is unchecked.
9. Viewer > Show all video frames. This gives priority to frames over audio.
10. I completed the audio in Premiere Pro because I have yet to learn Fairlight. Didn't want to complicated matters. The audio was rendered as an uncompressed WAV file and imported into Resolve.

**C4K is only available in the Studio version. I've read forum posts on BMD that the free version is much slower with H.264. You really need Studio. This could affect my performance. Also, 10-bit footage from the Panasonic GH5, as well as a few other codecs, are not supported in the free version.

I kept both HWMonitor and Ryzen Master running the entire time to check for CPU, RAM and GPU temperatures. I also had OBS running occasionally to screen-capture what I was doing.

The video I published on YouTube gives you a good idea of the results, but here they are in a nutshell:

Editing at Full Resolution Debayer			
Footage	**Playback**	**Scrubbing**	**Notes**
Arri Alexa 65 6K RAW 12-bit (25 fps)	Yes	Yes	Wow!
Arri Alexa Open Gate 3.4K RAW 12-bit (25 fps)	Yes	Yes	
Red Epic-W 8K RAW 16-bit (23.976 fps)	Stuttering at 10-15 fps	Nope	At this point the single GPU is the bottleneck. The 23.976 clip stuttered more. The 25 fps clips did much better.
Red Weapon 8K RAW 16-bit (25 fps)			
Blackmagic Design URSA 4.6K RAW 12-bit (23.976 fps)	Yes	Yes	
Panasonic GH5 4K H.264 8-bit (25 fps)	Yes	Yes	
DJI Phantom 4K H.264 8-bit (23.976 fps)	Stuttering at edit points	Stuttering	Something wrong with this particular encoding
iPhone 8 Plus 4K H.264 8-bit (25 fps)	Yes	Yes	
Various H.264 8-bit	Yes	Yes	

The takeaway here is that the GPU was being a bottleneck for 8K footage from the Red Epic-W and Weapon. Overall, the performance could improve drastically.

From this point on, I changed only one major thing:

1. Camera RAW Decode was set to Half Res. Good 10-bit for Grading.
2. Camera RAW Decode was set to Quarter Res. Good 10-bit for Editing.

It was only under these two conditions I could get real-time 4K. I believe if I add another GPU I will easily get 4K real-time at Half Res. Good. Half Res of 8K is 4K – which is what this system was designed for. Looking good so far.

I also ensured there weren't any other bottlenecks. For fun I ran a few benchmarking apps and here are the results for your benefit:

1. Cinebench R15: 2990
2. Geekbench 4: 31676
3. DaVinci Standard Candle Test:
    a. 37 blur nodes: 24 fps
    b. 42 blur nodes: 20 fps
    c. 54 blur nodes: 16 fps
    d. 66 blur nodes: 13 fps
    e. TNR is unavailable in the free version

All the benchmarks are in keeping with what others have achieved. So regarding the GPU, adding another one would definitely help me work on 8K, but right now I don't need it. So it's a relief to know I don't have to waste money on a second GPU until the time comes.

After I made the changes to RAW decode things went smoothly, and here are the results:

Editing in Quarter Res. Good			
Footage	Playback	Scrubbing	Notes
Arri Alexa 65 6K RAW 12-bit (25 fps)	Yes	Yes	
Arri Alexa Open Gate 3.4K RAW 12-bit (25 fps)	Yes	Yes	
Red Epic-W 8K RAW 16-bit (23.976 fps)	Yes	Yes	
Red Weapon 8K RAW 16-bit (25 fps)	Yes	Yes	
Blackmagic Design URSA 4.6K RAW 12-bit (23.976 fps)	Yes	Yes	
Panasonic GH5 4K H.264 8-bit (25 fps)	Yes	Yes	
DJI Phantom 4K H.264 8-bit (23.976 fps)	Stuttering at edit	Better	Something wrong with this particular encoding

Footage	Playback	Scrubbing	What I did
	points		
iPhone 8 Plus 4K H.264 8-bit (25 fps)	Yes	Yes	
Various H.264 8-bit	Yes	Yes	
Grading in Half Res. Good.			
Footage	**Playback**	**Scrubbing**	**What I did**
Arri Alexa 65 6K RAW 12-bit (25 fps)	Yes	Yes	Grading, Gradients
Arri Alexa Open Gate 3.4K RAW 12-bit (25 fps)	Yes	Yes	LUT, zoom
Red Epic-W 8K RAW 16-bit (23.976 fps)	Yes	Yes	Added a layer of graphics, Grading
Red Weapon 8K RAW 16-bit (25 fps)	Yes	Yes	LUTs, grading, power windows, tracking
Blackmagic Design URSA 4.6K RAW 12-bit (23.976 fps)	Yes	Yes	Grading, added layer of footage
Panasonic GH5 4K H.264 8-bit (25 fps)	Yes	Yes	Grading
DJI Phantom 4K H.264 8-bit (23.976 fps)	Stuttering	No	Grading
iPhone 8 Plus 4K H.264 8-bit (25 fps)	Yes	Yes	Grading, Stabilization
Various H.264 8-bit	Yes	Yes	Grading, Titles, Chroma Keying

Final Takeaways about editing and grading

- I believe if I upgrade to Studio it will handle H.264 and a few other codecs better. This should help with the DJI footage.
- A second GPU will make this workstation sing with 8K footage. It handles 6K easy with just one GPU.

A note about using your GPU for GUI or compute

For older versions of Resolve, Blackmagic Design recommended having a low power GPU just to drive your GUI and a high power one for compute. As of Resolve 14, it is recommended officially that you install only one high-power GPU and it will handle both. Resolve is snappy and a joy to work with in v14.

If and when I add the second GPU, nothing else will change:

- GPU #1: GUI + Compute
- GPU #2: Compute

By the way, no SLI! Resolve does not support or care for SLI or Crossfire. Don't even bother with that.

Render time and performance

The project video timeline is 48 seconds long. The render settings were:

- 3840 x 2160 25 fps
- MP4 - H.264 at Best Quality
- High Profile
- Data Levels – Auto
- Force Debayer to Highest Quality

It took only about 76 seconds to render this 4K timeline! That's just 1.6x!! So if you have a two-hour movie it will be done rendering with the grade in 3 hours. I can tell you high-end Baselight facilities deliver the same results – near real-time! This is mind-blowing performance.

You can download and watch the final video on Vimeo:
https://vimeo.com/237256246

Here are some other miscellaneous data from this test:

- CPU temperature consistently stayed at about 65°C, and never went above 68°C. HWMonitor reported a maximum of 73°C but it didn't match what Ryzen Master was reporting.
- All 16 cores were utilized at 100%.
- Maximum GPU temperature was 65°C.
- GPU was utilized to 96%.
- GPU Memory was only up to 61%, which shows 11 GB is not the bottleneck here.
- Maximum RAM temperature was 80°C, well below the 85°C maximum.
- M.2 and SSDs were not even taxed.
- The system was super quiet and cool during everything.
- Total power draw was between 415 to 485 Watts only. This shows the PCPartPicker estimate was incorrect, and the Seasonic calculator was more accurate. I also tested this using the readout from my APC UPS, which displays wattage consumed. I'm at 88% efficiency at this rating. I have to consume more power to reach 91%!!

Here are some screenshots:

Here are the CPU-Z benchmarks (Note the HWMonitor and Ryzen Master panels showing temperatures and usage):

Note: RAM speeds will always show half of the total. Looking good!

So, am I happy?

Did this system build achieve all its goals? Yes, and a whole lot more. Let's see:

The system must run DaVinci Resolve 14 in a stable manner.

Does it? Yes. It only crashed once, and that too because I kept scrubbing the blur effect up and down about 20 times.

Real-time 4K playback and scrubbing over multiple layers for smooth editing.

Without breaking a sweat. It only begins to get taxed at 8K, and that too a second GPU (which is part of the plan) would easily solve.

Color grading with multiple power windows, FX, Noise reduction, ACES, etc., with no lags.

I graded at half res. debayer. It's only when I switched to editing I needed to go quarter res. Whatever I threw at it, it handled with ease. Seriously, I was grading 6K and 8K material like it was 720p!

I couldn't test noise reduction because it's not available in the free version. ACES is left for when I have a decent monitor.

Does it do all of the above on a full resolution 4K timeline?

Yes!! The project was on a 4K timeline from start to finish, no shortcuts. No optimized media and no caching.

How does it perform in Adobe Premiere Pro?

Similarly. Adobe handles DJI footage smoothly. On the other hand, I couldn't get the ARI files to import in Premiere Pro (both on this build and my iMac). Same goes for the CinemaDNG files from the URSA Mini 4.6K.

I would have loved to test both rendering performances but overall I'd say they handle similarly as far as editing is concerned. Adobe does not handle more than 6 to 8 cores well, so Threadripper is wasted on it.

If you are using AE or Fusion I would max out the RAM at 128 GB.

Years of operation – at least 3 years.

I hope so!

What next?

How can I improve this system? Let's break it down:

GPU

Would I be adding a second GPU soon? Not really. The system handles 4K like butter with just one. However, if I started shooting 6K and 8K consistently I probably will. It would make a big difference. If so, I'd have to add $800 to the cost.

Decklink Card

Having the GPU drive the Viewer always consumes some resources. It has to scale 8K and 6K down to 1080p (in this case) and 4K (when I get the monitor). This is better left to a separate hardware card.

Right now I'm thinking of the Blackmagic Mini Monitor 4K, as it has HDMI 2.0 with HDR so it should be more than sufficient for the life of this build. That would add about $278.

Grading monitor

I did this first project with an old 21" Dell I had lying around. However, it is woefully inadequate for color grading work. A 27" monitor would have been better for the GUI, but having gone through this project I don't think I need to buy another monitor just for the GUI.

As for grading and monitoring, there are two choices for me:

1. Get a 32" 4K computer LCD monitor. This will cost me from $1,000 to $2,500. The disadvantages of this are you can't load 3D LUTs, the panels are not consistent in quality, no SDI, 8-bit + FRC only, have unknown response to different frame rates and mostly only accept RGB signals.
2. Get an FSI 1080p LCD monitor (like the BM210 or DM240). This makes up for all the disadvantages of the computer monitor, but has its own issues. It's not a good idea to judge 4K grading on 1080p. You miss a lot of things. The price is three times, for me (including taxes). The size is smaller as well, and I need more advanced calibration tools (I have an X-Rite i1 Display Pro) and software to make full use of it. The biggest issue though, is that in three years these monitors won't be that useful anymore. I don't think it's wise to spend on these monitors if the returns are slow.

So bottom line is, since I'm only going to grade for the Internet anyway, I'll probably go for the best 32" 4K computer monitor I can afford. Right now I'm thinking of the BenQ PV3200PT. I wish I could afford the Eizo 318, but there's no return on investment there.

CPU

I could overclock it. Right now I'm already at the maximum safe temperature. With a better cooling solution I can push it up to 4 GHz. However, the performance is stellar as-is, so why bother?

Hard drive strategy

Right now, this is what I'm thinking about:

- Current M.2 512 GB SSD stays as OS + Resolve + Projects + Output Render Drive.
- I don't need a Cache drive because I'm working in RAW directly.
- A 4x 1 TB SSDs (probably Crucial X300s) in RAID 0 (Software RAID via Windows) for my primary media server. This will cost about $1,403 approximately. If I add a RAID card that's extra, but I doubt I'd need it.
- And possibly a 4x (8 TB) or 8x (4 TB) 7,200 rpm (Seagate Barracuda most likely, as that's what I'm using now) in RAID 10. I'll get 16 TB in RAID 10. The enclosure is the main concern. I have an Areca 5046 right now but it's Thunderbolt. Need to research this. The media will reside here as a redundancy in case the internal RAID fails. No RAID 5. It's faster to transfer footage than to rebuild a RAID 5, me thinks.

So, if I add an extra GPU, a Decklink Mini Monitor and an internal RAID 0 array the total cost of the system would add up to about $7,200 + Whatever the monitor costs + External RAID array.

It seems decent 4K real-time needs an investment of at least $10,000. Somewhere down the line you'll need to add a grading panel and additional gear as well. Will this make you an additional profit and get your more jobs? Only you can tell. For me it's a no brainer.

I will be testing this system with Resolve in the coming months, until my Adobe Creative Cloud license is set to expire (sometime in April 2018). At that point I'll probably give up CC. So far, working in Resolve has been an easy transition. I just have to get the audio workflow down before I can feel completely confident.

If you know of any important settings or tips I've missed please share your knowledge. I'm always looking to tweak my system for maximum efficiency and reliability.

I hope you have found this guide useful. If you have any questions please feel free to send me an email at support@videoproduction.training. I'm not that experienced when it comes to building computers and tweaking software, and I couldn't have done it without the articles and videos I've mentioned in this guide. Still, I'll be happy to point you in the right direction if I can.

Any updates or additional information can be found on the main page after you have logged in: http://videoproduction.training/cs/davinci-resolve-14-threadripper-build-guide

That's it!