

Business white paper

Apple Mac Pro vs. The HP Z840 Workstation

For 4K Editing Workflow, by Jan Ozer





About Jan Ozer

Jan Ozer is video producer, streaming media producer, and author who has authored multiple books on to digital video, including Premiere Pro CC: Visual QuickStart Guide, and Adobe Digital Video How-Tos: 100 Essential Techniques with Adobe Production Studio. Jan also co-produced Adobe Premiere Pro CS5: Learn by Video, and was the sole producer of Producing Great Video with the Adobe Media Encoder, both for Video2Brain (now Lynda.com).

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Introduction

The hardware requirements for the film and professional video industries are on a sharp incline due to the dramatic increase of resolutions and frame rates. The industry has quickly moved from HD to UHD or 4K, and even higher in some cases. Frame rates have often doubled and even quadrupled in some segments such as action sports, not to mention the demands for new VR content. To compound things, production schedules have not changed and the expectations placed on studios are greater than ever. In these scenarios, hardware performance has become paramount and price has become much more a feature of overall ROI. Missing a deadline can cost thousands of dollars or more, and limiting creativity can even cost you the next project.

This is the spirit taken in this white paper where the fastest Mac Pro available is compared to a mid-range HP Z840 Workstation. When the project is on the line, which workstation completes the job the fastest, and what is the lifetime value of a super-computer? After describing the two systems, I will test five discrete areas involved in most projects; ingest, preview, rendering for preview, color grading, and output.

The Mac



The Mac in this benchmark was a fully loaded 2.7 GHz 12-Core Intel® Xeon® E5 with 64 GB of 1866 DDR3 running OS X 10.11.3 with two AMD FirePro™ D700 graphic cards each with 6144 GB or video RAM. As you'll see below, hyperthreading was enabled, and the system accessed as many as 24 cores depending upon the operation. The primary monitor was an Apple 24" LED Cinema display; as with the HP Z840, was paired with a full resolution HP Z32x DreamColor 4K monitor via HDMI.

The Mac Pro came with 500 GB internal SSD drive from which I performed most testing. With some projects, I supplemented this with a 1 TB Transcend StoreJet 500 SSD drive connected via Thunderbolt™ for caching the audio and video preview files. With the final project, I stored the project on the Transcend drive, and used the Mac's internal drive for caching.

The HP Z840 Workstation



Let's start by saying that a fully-loaded HP Z840 would not have been realistic scenario for a couple of reasons. First, it would have either 44 CPU cores (88 with hyperthreading) or three NVIDIA® Quadro® M6000 GPUs, along with 2 TB of RAM and up to 22 TB of storage. Secondly, such a configuration would be far beyond the financial reach of most studios and video professionals. This is why I selected a mid-range HP Z840 Workstation for testing, keeping in mind that it is very flexible in terms of getting even more performance out of it.

The Z840 tested came with two 2.6 GHz E5-2690 v3 CPUs, each with 12 cores, 24 with hyperthreading enabled, running Windows 7 with 128 GB of RAM. The graphics card was a single NVIDIA Quadro M6000 with 12 GB of video memory connected to an HP LP3065 display as the primary monitor, and the HP Z32x Dreamcolor for full resolution preview. The system drive was a 1 TB SATA SSD drive, with two 1 TB HP Z Turbo Drive Quad Pro 1 TB PCIe drives from which all tests were performed. With each project, the audio and video previews were sent to a cache folder on the other drive for storage.

Both computers ran the latest releases of the Adobe® Creative Cloud™, which included the 2015.3 release of Adobe Premiere® Pro CC (10.3.0, 202 build), the 2015.3 release of the Adobe Media Encoder® (10.3.0.185 build), the 2015.4 release of Adobe Prelude™ CC (5.0.0, 184 Build), and the 2015.1 release (Build 9.1x89) of Adobe SpeedGrade™ CC.

The Benchmarks



Ingest in Adobe Prelude CC

Let's start with ingest via Adobe Prelude, which sets a useful tone for the technical analysis to follow. In this test, 74 seconds of RED 4K footage was ingested and converted to Cineform for editing, and to MP4 for internal distribution and viewing (Figure 1).

Figure 1. Ingest and convert to Cineform and MP4.

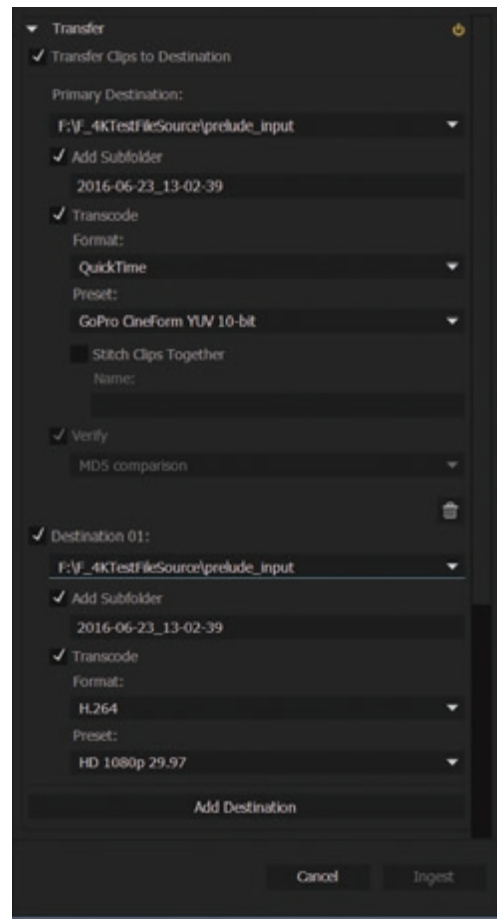


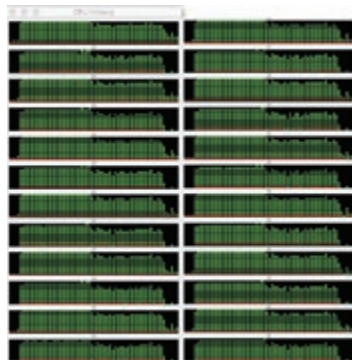
Table 1 shows the results, where the HP Z840 finished the task in 211 seconds (3:31) and the Mac Pro in 333 seconds (5:33), about 58% longer to wait to begin editing. If you extrapolate the difference to 30 minutes of ingest, you'll be waiting almost 50 minutes longer on the Mac Pro than on the HP Z840.

Table 1. Ingest and conversion to Cineform and H.264.

Ingest - Adobe Prelude	HP Z840	Mac Pro	Delta
Time to ingest 76 seconds of video (seconds)	211	333	57.82%
Extrapolate to 30 minutes of video	4,997	7,887	57.82%
In minutes	83:17	131:27	57.83%

Figure 2 shows why. Specifically, this is CPU History view of the Mac's Activity Monitor, showing that all 24 cores in the system are very close to 100% utilized for the better part of this operation (the view displays vertically but I've cut and pasted the bottom 12-cores next to the top for presentation purposes). Not only does the operation take longer, but you're effectively locked out of the system during ingest because there are few idle CPU resources remaining

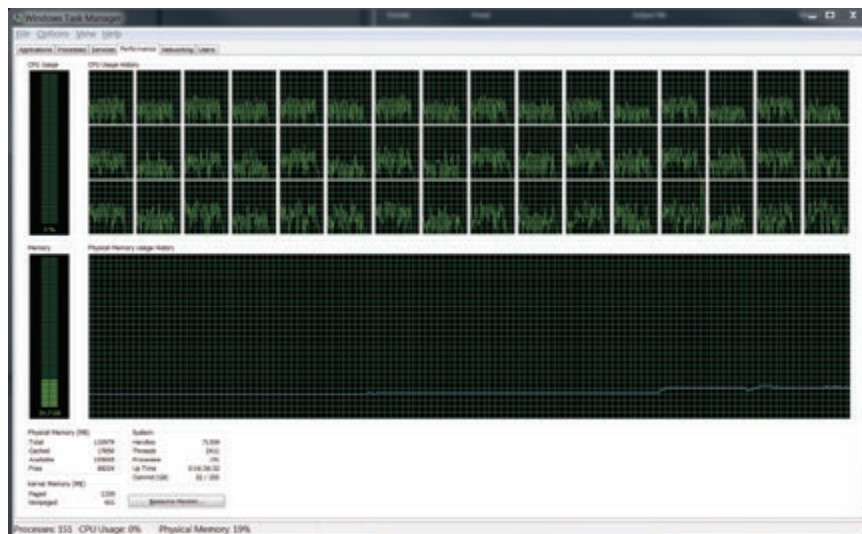
Figure 2. The Mac is running full bore during ingest. More cores can definitely speed the process.



“...the HP Z840 has plenty of cycles to spare, not only ingesting faster, but also allowing you to edit or perform other work on the system during the process.”

Contrast this with Figure 3, which shows Windows Task Manager just after the same operation. As you can see, the HP Z840 has plenty of cycles to spare, not only ingesting faster, but also allowing you to edit or perform other work on the system during the process.

Figure 3. Windows Task Manager during ingest on the HP Z840.



Consider Figure 2 one of the barometers of whether a dual-core HP Z840 system can accelerate your workflows over a single-core Mac Pro. If Activity Monitor looks anything like Figure 2, it's likely that throwing additional cores at the problem will accelerate the result.

Preview in Adobe Premiere Pro CC



Once you've ingested your footage, it's time to take it to the timeline and start editing. Typically, this involves a quick preview, then adding color correction or similar tweaking, and then previewing again. Preview relies upon both the CPU and GPUs in the system, plus hard disk performance. How do the two systems compare?

Before I show the results, let's discuss the premise behind the testing, which was to keep it as simple as possible and relevant to the largest numbers of potential readers. While it's possible to tweak a timeline with multiple effects to coax almost any desired result from the testing, I decided to keep it basic. Most tests involve a single clip on the timeline with and without slight color correction or a Lumetri preset, and perhaps a logo. I supplement this with a more complex rendering test at the very end.

Table 2 provides the results from my first set of tests. Briefly, for each test, I created the timelines by dragging the video file onto the New Item icon in the Project panel to create a sequence that matched its configuration. Then I previewed with each system at full resolution out to the HP Z32x 4K monitor, monitoring playback rate using Premiere Pro's Render Information feature shown in Figure 4. As mentioned, I performed all these tests from the Mac's internal SSD drive and one of the HP Z Turbo drives on the HP Z840.

Table 2. Preview performance.

Preview in Premiere Pro	HP Z840		Mac Pro		Mac is slower by
	Display FPS	Drop Frames	Display FPS	Drop Frames	
75 second Cineform file - preview (no render)	29.5	0	29.5	0	0.00%
Add color correction (no render)	29.5	0	25	347	15.25%
43 second 4K RED File - preview (no render)	29.5	0	19.5	464	33.90%
Add Lumetri Effect/Logo (no render)	29.78	0	16.5	587	44.59%
15 second 6K RED File - preview (no render)	23.5	0	20.32	55	13.53%
Add Lumetri Effect/Logo (no render)	23.5	2	18.23	87	22.43%

Where the ingest test was almost exclusively a measure of CPU performance, the preview test was focused on the GPU. More specifically, in both systems, CPU utilization averaged under 20% for the bulk of the preview, indicating that the heavy lifting was performed by the GPU(s).

The first test involved the Cineform file created during ingest; with the HP, preview was flawless both with and without the Lumetri color tweaks. This begged the question of what would happen if I tried editing in native RED format. I answer this in the second test, where I substituted the original RED file trimmed to 43 seconds. As you can see, with the HP Z840 and NVIDIA Quadro M6000 graphics card, performance was also perfect. Then I tried with a short 6K RED file, which the HP Z840 handled almost flawlessly.

Figure 4. Premiere Pro has a display mode that monitors display FPS and dropped frames. To access, click Ctrl+Shift+F11.



“While different projects will call for different strategies, the HP Z840/M6000 platform gets much closer to native 4K editing today than the Mac Pro.”

In contrast, particularly with the longer RED 4K file, the Mac Pro dropped significant frames, even before applying the color correction. This means that you’ll have to render for preview on the Mac Pro much more frequently, which is time consuming and interrupts the creative flow.

One of the fundamental premises of Adobe Premiere Pro is native format editing, which saves the transcode time and voluminous file sizes of intermediate formats like Cineform or ProRes. At one point, this seemed as unlikely with SD and HD formats as it does with UHD today, though, of course, native SD/HD editing is now commonplace. While different projects will call for different strategies, the HP Z840/M6000 platform gets much closer to native 4K editing today than the Mac Pro.

Rendering for Preview in Premiere Pro

Whether you’re working with native files or files in an intermediate format, at some point you’ll likely add so many tweaks or additional content to the timeline that you’ll need to render for full frame rate preview. Previewing involves both the CPU and the graphics card, and to a lesser degree, disk performance, particularly on single file projects such as these. Table 3 shows comparative results with the three scenarios discussed in Table 2, with results shown in seconds.

Table 3. Rendering for preview, time in seconds.

Render for preview in Premiere Pro	HP Z840	Mac Pro	Mac is slower by
75 second Cineform file - render for preview	33	108	227%
43 second 4K RED File - render for preview	24	46	92%
15 second 6K RED File - render for preview	8	13	63%

Whichever format you’re working with, you’ll spend a lot more time waiting for preview on the Mac than you will on the HP Z840. In particular, working with the Cineform codec seems much more efficient on Windows than on the Mac, which is important given that Adobe now includes full/output support for Cineform (and Avid DNxHR/DNxHD).

Basically, these last two tests tell us that you’ll have to render for preview much less frequently with the HP Z840, and when you do, rendering time will be much shorter.

Color Grading in SpeedGrade CC



SpeedGrade is a color grading solution in the Adobe Creative Cloud suite. You can access much of the SpeedGrade toolset by applying Lumetri effects in Adobe Premiere Pro, or you can export completed projects for color finishing in SpeedGrade. To test performance in Speedgrade, I inputted two different clips, choose a preset and rendered using the default settings. Table 4 shows the results.

Table 4. Rendering times in SpeedGrade.

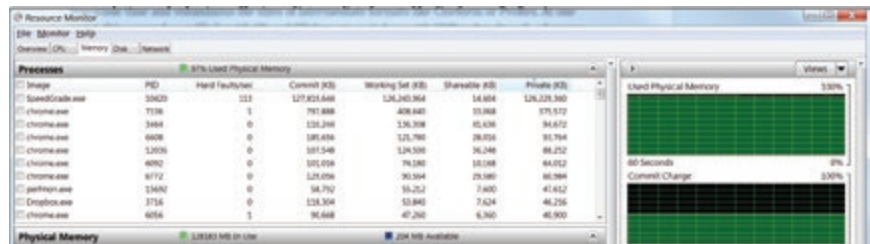
Color Grading in SpeedGrade	HP Z840	Mac Pro	Mac is slower by
85 seconds - 4K RED Input - Clean Punch	715	1806	153%
15 seconds - 6K RED Input - Blue Moon	284	408	44%

“...the HP Z840 offers multiple additional expansion options, including a second graphics card that allows creative professionals to configure a workstation customized to their specific tasks.”

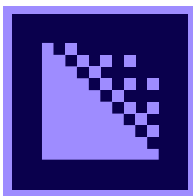
If you observe CPU utilization during these renders, you’ll note less than 20% utilization on both systems. Clearly the bottleneck is elsewhere. A quick check of Windows Resource monitor (Figure 5) shows that the bottleneck is memory, with SpeedGrade consuming essentially all that’s available. On the HP Z840, that was 126 GB out of 128 GB; on the Mac, it was 58 GB of the 64 GB available.

Significantly, you can configure the HP Z840 with up to 512 GB DDR4-2133 (8x64 GB) RAM, which likely would have accelerated SpeedGrade rendering times even further. This highlights the fact that while the Mac Pro is truly tapped out in the tested configuration, the HP Z840 offers multiple additional expansion options, including a second graphics card that allows creative professionals to configure a workstation customized to their specific tasks.

Figure 5. Speedgrade consumes all available memory, and more memory seems to translate to higher performance.



Rendering in Adobe Media Encoder CC



Rendering is a frequent and final task of all projects, from outputting scenes to share around the office, to outputting low res versions for web sharing and distribution, and full resolution versions for archive. Table 6 shows the results of rendering-related trials with two simple test cases, the 43 second 4K RED file, and the 15 second 6K RED file.

To perform these tests, I used existing presets from Adobe Media Encoder, with small changes like using Maximum Render Quality for all encodes and upping the data rates to reasonable levels. All files were exported from Premiere Pro and rendered in Media Encoder, rather than rendering directly in Premiere Pro.

As you can see, I output each project four times. First was to an H.264 Match Source preset suitable for internal viewing, the second a 1080p output file suitable for 1080p distribution. The third file, which is a bit exotic in 2016 but will be increasingly relevant over time, is output in HEVC format at a high data rate for archival or distribution. For the final test, I output three files to H.264 format in parallel, a highly useful Media Encoder feature.

“...the HP Z840 shaved anywhere from 26% of encoding time for the shorter file to over 100% in several instances.”

Table 6. Rendering times in seconds in Adobe Media Encoder.

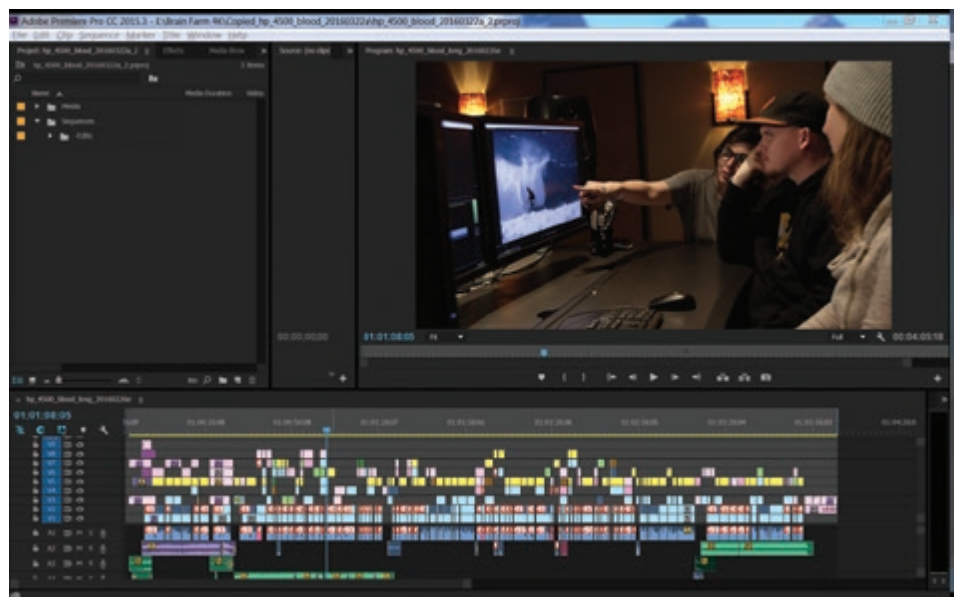
Rendering in Adobe Media Encoder	HP Z840	Mac Pro	Mac is slower by
43 second 4K RED File - Match Source H.264	112	228	104%
Render - 1080p - H.264	143	185	29%
Render - 4K UHD HEVC	221	450	104%
Render - 3 File (Archive, 1080/720) - H.264	212	440	108%
15 second 6K RED File - Match Source H.264	58	73	26%
Render - 1080p - H.264	20	28	40%
Render - 4K UHD HEVC	33	67	103%
Render - 3 File (Archive, 1080/720) - H.264	64	91	42%

As the table shows, the HP Z840 shaved anywhere from 26% of encoding time for the shorter file to over 100% in several instances. In particular, the CPU intensive HEVC file showed the most consistent improvement. Essentially the more complex the encoding chores, the more profound the benefit of throwing additional cores, and a more powerful GPU at the task.

Rendering in the Real World

This is highlighted in our final project, where I encode a 4:00 minute project into HEVC format using the 4K UHD HEVC preset. As shown in Figure 6, this is complex, real world project, with multiple layers of primarily 4K content. By way of background, this was a video produced by HP and NVIDIA to highlight how working with HP Z Workstations, and NVIDIA graphics have saved production professional significant time and allowed them to more fully explore their creative visions.

Figure 6. The final project; a complex 4 minute video rendered to HEVC.

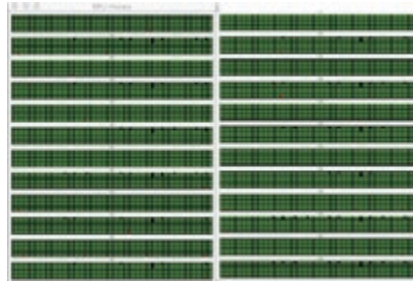


“It took 4 hours and 50 minutes to render on the HP Z840, compared to 7 hours 39 minutes on the Mac Pro.”

“HP Z840 Workstation allows high-end producers to precisely configure the perfect workstation for their specific production needs.”

It took 4 hours and 50 minutes to render on the HP Z840, compared to 7 hours 39 minutes on the Mac Pro. During encoding on the Mac Pro, CPU utilization was almost totally red-lined (Figure 7), even beyond what is shown in Figure 2. It’s hard to imagine anything more discouraging than Figure 7 for a producer on a deadline, realizing that time is slipping by, but that the system is totally maxed out. In comparison, CPU utilization on the HP Z840 ranged from around 46% to 75% during the encode, leaving sufficient remaining resources for editing or other creative tasks.

Figure 7. Outputting HEVC from a complex project consumed virtually all CPU resources on the Mac Pro.



Why didn’t I explore the other performance aspects like preview with this project? Because while this real world project fit comfortably on the 1 TB HP Z Turbo SSD drive, it wouldn’t fit on the 500 GB internal drive of the Mac Pro. Though I had a Thunderbolt-based external drive for my tests, comparing the HP Z840 to the Mac Pro in this configuration for real time operations like preview wouldn’t have been a fair fight.

I could have sourced a faster external drive for the Mac Pro, but this highlights another key difference between the HP Z840 and the Mac Pro. The HP Z840 is a tower with multiple slots and internal drive bays that can contain capacious SSD-based storage, including at least 4 TB of PCI-based SSD storage using the HP Z Turbo Drive Quad Pros, as well as other SATA-based internal SSD drives that can be configured as RAID drives for faster operation. In contrast, the Mac Pro peaks at 1 TB of internal storage, forcing virtually all 4K producers to deploy external storage. While feature length films may require external storage on both computers, most shorter projects can more easily and affordably be produced using internal storage on the HP Z840 Workstation.

Summary and Conclusion

There’s a saying in professional sports that the playoffs reveal a team’s true weaknesses, and you can definitely say the same about workstations and high-end 4K production. At some point in a 4K project, each component will be sorely tested, and each weakness will be exposed. The physical design of the Mac Pro places inherent limitations in CPU, graphics, RAM, and disk space creating a bottleneck for high-end producers who need power and creative options and deliver their projects on time and on budget. In contrast, the capacity and flexibility of the HP Z840 Workstation allows high-end producers to precisely configure the perfect workstation for their specific production needs.

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