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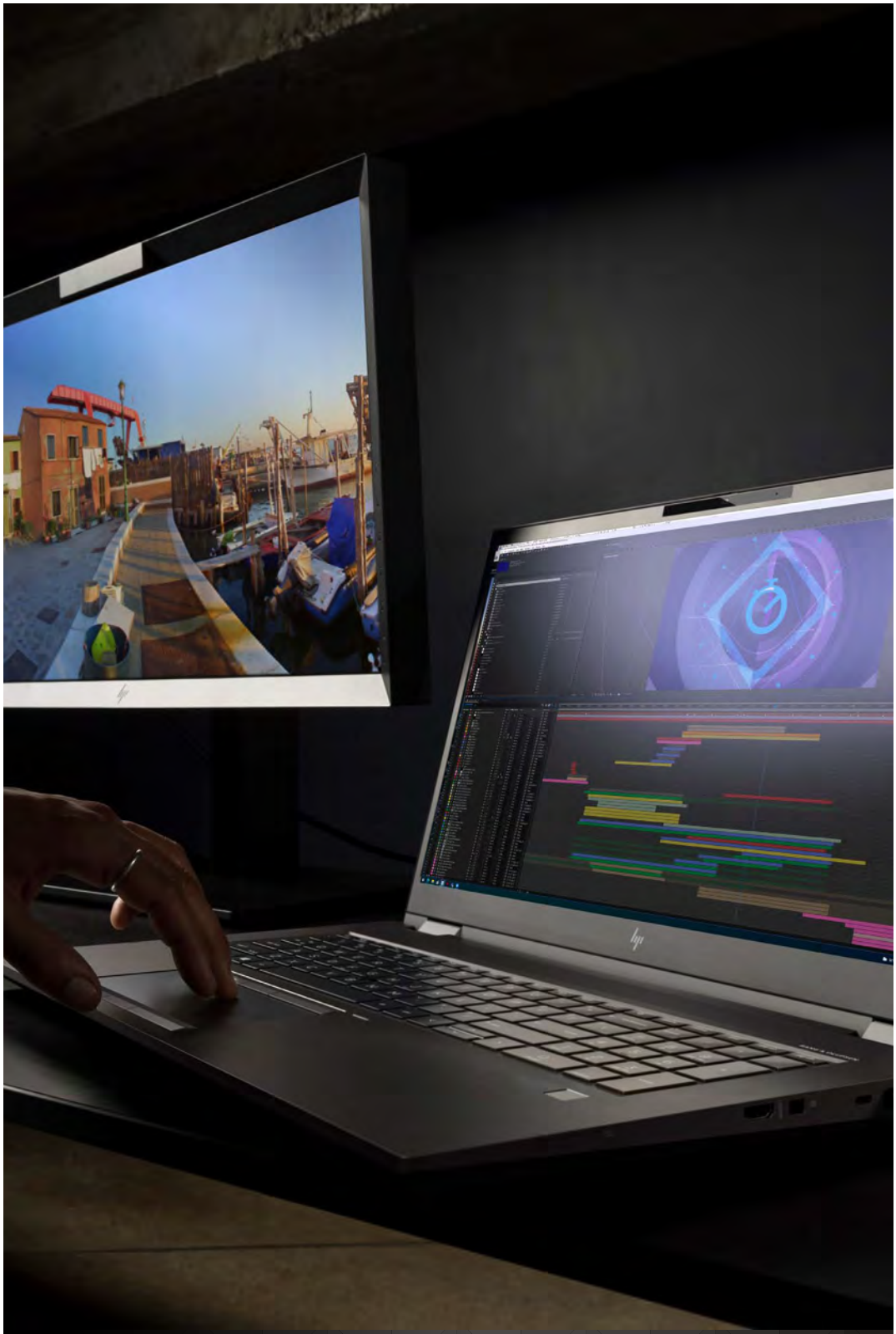

UNDERSTANDING MULTI-FRAME RENDERING IN ADOBE AFTER EFFECTS AND CHOOSING THE RIGHT HP Z PLATFORM

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INTRODUCTION

Tell me if this story sounds familiar to you.

You've been pushing through projects on an underperforming computer, hiding and/or soloing layers, reducing the complexity of effects and/or turning effects off entirely, just so you can have responsive interactivity while previewing your adjustments. You finally get your project looking the way you want it and kick off the export.

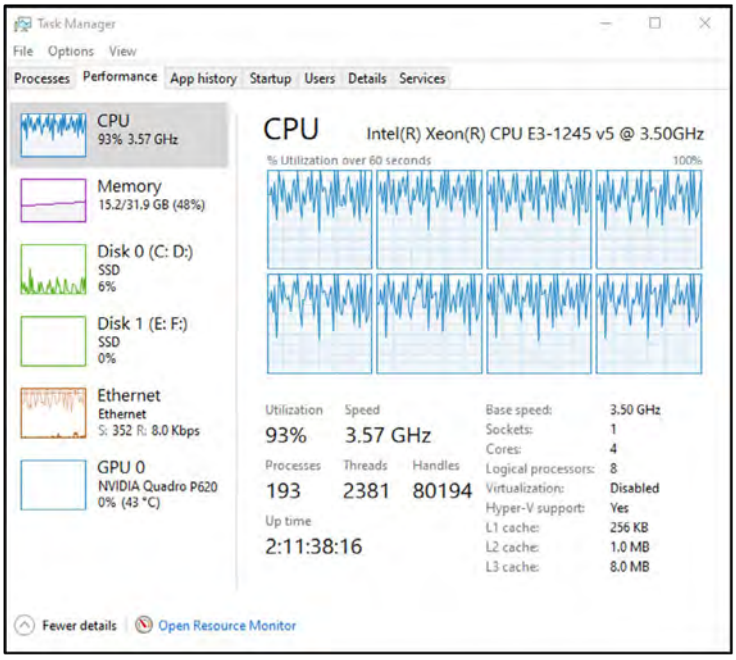

Figure 1. CPU activity during an export on a 4-core CPU.

When you return to your desk after brewing another cup of coffee, you see the file's not ready and wonder if your computer is even doing anything. All the CPU cores appear to be working pretty hard on your export (see Figure 1), but you've just had enough! You convince your boss it's time for a more powerful computer.

Skip ahead to when the new system is up and running to see your last project's render time cut down from thirty-one minutes to eighteen. Your throughput almost doubled by adding three times more logical processors (you went from 8 to 24). Was that the expected improvement? It seems reasonable, but the CPU activity is spiky with plenty of idle time where you'd think more work could be getting done (see Figure 2).

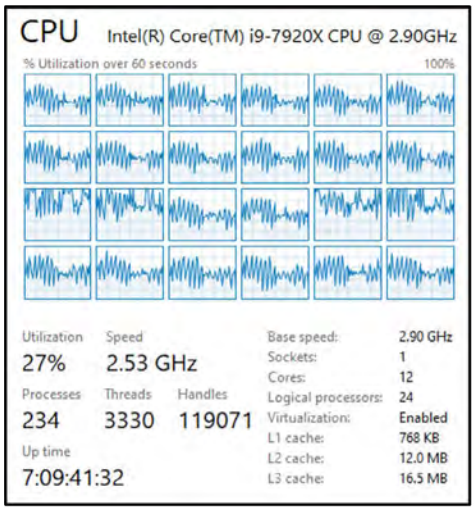

Figure 2. CPU activity during an export on a 12-core CPU without Multi-Frame Rendering.

When After Effects was first written, computers only had one CPU core and logically could only work on one video frame at a time. As core counts increased, After Effects was enhanced to divide the rendering work of each frame across all available execution cores. One execution thread directs the activity of the render threads by splitting up the work among the remaining cores and reassembling the partial frames before the next frame can be started. This explains the spiky shape of the CPU activity plots, as cores that have completed their portion of one frame sit idle waiting for their next assignment.

Adobe recognized that abundant CPU cores were not being pushed to their full capacity as computer hardware has evolved, but the enormous task of modifying all the rendering code to handle more than one frame at a time never made it to the top of their To-Do list, until now. The open Beta versions of Creative Cloud applications have enabled wide testing of new features, and plenty of people have been exploring the benefits of the Multi-Frame Rendering (MFR) functionality in After Effects.

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For example, using the Beta with MFR turned on sped up the render of the example mentioned above by 2.25 times, dropping the export time from eighteen minutes to just eight. Observing the CPU activity shows that there is far less idle time (see Figure 3). The MFR logic dynamically monitors progress and adjusts how the frames are distributed among the cores as the complexity changes through the composition.

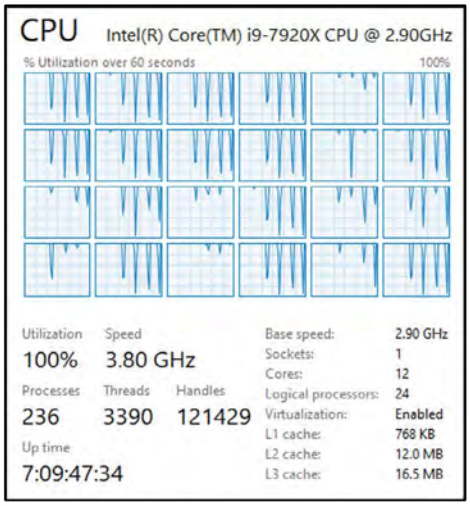

Figure 3. CPU activity during an export on a 12-core CPU with Multi-Frame Rendering turned on.

Applying MFR on the four-core machine from the beginning of our story helps only slightly because the Task Manager showed us there wasn't very much available processing capacity (the space above the spikes); when the Beta was installed on that machine, its render time only dipped slightly from thirty-one minutes to twenty-nine.

The Adobe engineers recognized that some users will not want one hundred percent of their CPU resources consumed by After Effects doing multi-frame rendering, so they introduced a setting which reserves a configurable percentage of the CPU power for other processes running on the computer, similar to the reserved memory setting (see Figure 4). The default value of the reserved CPU percentage is ten and it can be adjusted from zero to seventy percent.

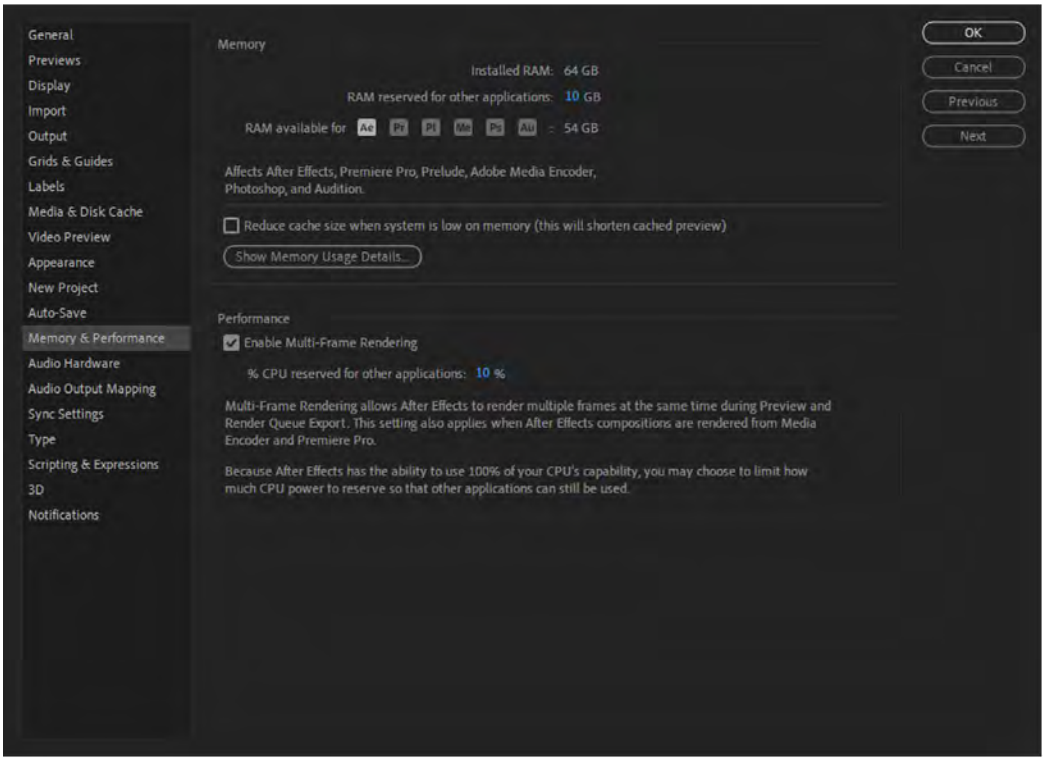

Figure 4. After Effects Preferences dialog window where Multi-Frame Rendering can be enabled and adjusted.

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The chart in Figure 5 shows the rendering performance improvement MFR delivers for an assortment of Intel CPUs available in recent generations of Z by HP desktop and mobile workstations. The data reinforces the experience described above by showing greater improvement using MFR on higher core count machines. However, it also reveals a limitation of Windows that restricts applications from utilizing more than sixty-four logical processors for a given task without additional recoding, something Adobe is considering for a future release.

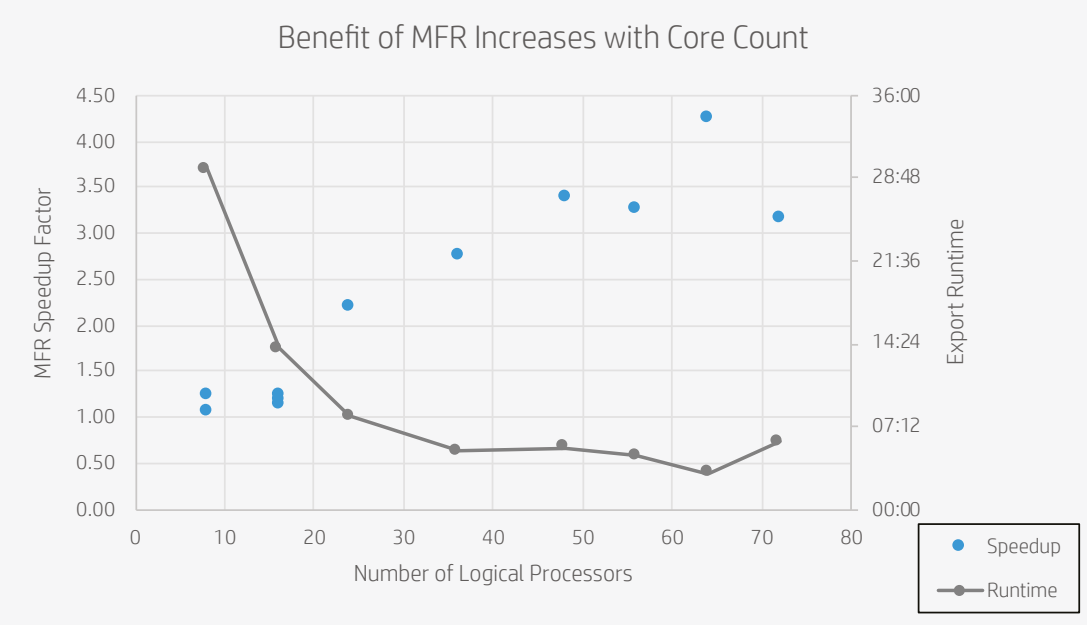

Figure 5. Chart showing average runtimes and performance improvement factors for several different CPU core counts.

Until that time, the best rendering performance will be observed with a total of sixty-four logical processors. This is achievable, for example, in HP Z6 G4 or HP Z8 G4 dual-socket workstations with two Intel® Xeon® Gold 6246R processors, each with sixteen physical cores that are doubled to thirty-two logical processors with Intel Hyperthreading enabled. On such a machine with sufficient memory, an export of the project mentioned earlier takes just over three minutes, compared to the thirty-one minutes on the original four core (eight logical processor) machine.

CONFIGURATION RECOMMENDATIONS

Not everyone needs that amount of processing power, so let's look at the different types of After Effects users and what computer configuration would suit their workflows. But first, a word about memory... No matter what type of work you do there aren't too many people that run only After Effects. As a leading compositing and animation tool, the items being composited and animated are usually created or manipulated in some way in other Adobe and third-party applications. To maintain a creative flow, there can't be any lags when switching between applications, so users should be sure to include ample memory to hold the apps and their datasets. A base recommendation for an After Effects power user would be 32 GB, but more will come in handy for RAM previewing longer-form compositions. It's important to balance the memory across all the CPU's memory channels for maximum theoretical bandwidth. For example, if you are considering an HP Z4 G4 desktop workstation, its CPUs have four memory channels. Don't order two 16 GB DIMMs because that will only utilize half the memory bandwidth; choose four 8 GB DIMMs instead.

Here are solid starting points for desktop and mobile platforms for general types of After Effects creators, presented in increasing order of performance capacity. Of course, a specific workload or anticipated project size could necessitate bumping up the specs to a higher level if future-proofing your rig is a concern.

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Graphic Designer

The motion design aspects of a Graphic Designer's job usually aren't too demanding, and aside from using MFR while RAM previewing and exporting, most of the other typical applications they'd use involve linear, single-threaded tasks. For those reasons, I'd be comfortable recommending lower core count/higher clock speed CPUs.

Desktop Workstation	Mobile Workstation
HP Z2 Mini G5	**HP ZBook Power G8**
• Intel® Core™ i5-10600K (6C, 4.1 GHz)	• Intel® Core™ i5-11500H (6C, 2.9 GHz)
• 2x 16 GB DDR4-3200 nECC SO DIMM (32 GB)	• 2x 16 GB DDR4-3200 DIMM (32 GB)
• NVIDIA® Quadro® T1000 Graphics (4 GB)	• NVIDIA® T1200 Graphics (4 GB)
• HP Z Turbo 1 TB TLC SSD	• 1 TB PCIe NVMe M.2 SSD

UX Designer

These artists will need a little more horsepower, so I will increase the core count and GPU.

Desktop Workstation	Mobile Workstation
HP Z2 Small Form Factor G5	**HP ZBook Power G8**
• Intel® Core™ i7-10700K (8C, 3.8 GHz)	• Intel® Core™ i7 11850H (8C, 2.5 GHz)
• 2x 16 GB DDR4-3200 nECC UDIMM (32 GB)	• 2x 16 GB DDR4-3200 DIMM (32 GB)
• NVIDIA® Quadro® T2000 Graphics (4 GB)	• NVIDIA® RTX A2000 Graphics (4 GB)
• HP Z Turbo 1 TB TLC SSD	• 1 TB PCIe NVMe M.2 SSD

Animator

Projects and compositions here tend to be bigger than the previous workflows, so again we increase the capacity of both the platforms and the components within them. Here at ten cores in the HP Z2 Tower, Multi-Frame Rendering is starting to show its benefits as the idle time of the larger number of cores can be exploited to take on more work during exports and RAM previews. I recommend the HP ZBook Studio here because it supports the RTX A3000, however it is limited to 32 GB of system memory, so if there's a chance more memory will be required, look at the HP ZBook Power (max memory 64 GB) or HP ZBook Fury (max memory 128 GB).

Desktop Workstation	Mobile Workstation
HP Z2 Tower G5	**HP ZBook Studio G8**
• Intel® Core™ i9-10900K (10C, 3.7 GHz)	• Intel® Core™ i9-11900H (8C, 2.5 GHz)
• 2x 16 GB DDR4-3200 nECC UDIMM (32 GB)	• 2x 16 GB DDR4-3200 DIMM (32 GB)
• NVIDIA® RTX A2000 Graphics (6 GB)	• NVIDIA® RTX A3000 Graphics (6 GB)
• HP Z Turbo 1 TB TLC SSD	• 1 TB PCIe NVMe M.2 SSD

Motion Designer

There is a wide range of requirements here based on the specific types of motion design going on. For mostly flat (2D) projects, the graphics card isn't as important, but more and more designers are using 3D to add realism and have the computer do the hard work when scenes need to be reframed. Traditionally it has been convenient to have a second high-speed storage drive for cache and precomps that can be wiped clean between projects; these machines have the capacity to add more storage as required for your workflow.

Desktop/Rackable Workstation	Mobile Workstation
HP Z4 G4 or HP ZCentral 4R	**HP ZBook Fury 15 or 17 G8**
• Intel® Core™ i9-10940X or Xeon W-2275 (14C, 3.3 GHz)	• Intel® Core™ i9-11900H (8C, 2.5 GHz)
• 4x 16 GB DDR4-2933 RAM (64 GB)	• 2x 32 GB DDR4-3200 DIMM (64 GB)
• NVIDIA® RTX A4000 Graphics (16 GB)	• NVIDIA® RTX A3000 Graphics (6 GB)
• HP Z Turbo Drive 1 TB TLC SSD	• 1 TB PCIe Gen4 NVMe TLC SSD

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Video Editor

A huge portion of the rendering process is coloring in each pixel based on the raster, vector, and effect instructions from all the layers in the composition, and that work predominantly takes place on the CPU cores even when some of the effect calculations beforehand were done on the GPU. Premiere Pro leans more heavily on the GPU than After Effects does, to decode video files, apply effects and transformations, and keep the sequence playing in the Program monitor. In these systems I recommend moving up a level on the graphics card and adding two more cores to the HP Z4 platforms. Finally, I added the second drive mentioned above to keep the scratch files and media off the Windows drive.

Desktop/Rackable Workstation	Mobile Workstation
HP Z4 G4 or HP ZCentral 4R	**HP ZBook Fury 15 or 17 G8**
• Intel® Core™ i9-10980XE or Xeon® W-2295 (18C, 3.0 GHz)	• Intel® Core™ i9-11900H (8C, 2.5 GHz)
• 4x 16 GB DDR4-2933 RAM (64 GB)	• 2x 32 GB DDR4-3200 DIMM (64 GB)
• NVIDIA® RTX A5000 Graphics (24 GB)	• NVIDIA® RTX A4000 Graphics (8 GB)
• HP Z Turbo Drive 1 TB TLC SSD (Windows)	• 1 TB PCIe Gen4 NVMe TLC SSD (Windows)
• HP Z Turbo Drive 1 TB TLC SSD (Media & Cache)	• 1 TB PCIe Gen4 NVMe TLC SSD (Media & Cache)

CG / VFX Artist

These guys and gals are running multiple resource hungry applications simultaneously, editing and playing high-resolution DPX or OpenEXR image sequences, exporting multiple lighting, normal, bump, etc. passes out of their modeling application and bringing them all into After Effects. They need lots of memory and lots of cores, so I have included 192 GB and two Xeon® Gold 6246R CPUs to reach the 64-core maximum that After Effects can utilize (2x 16 cores each, times two again for Hyperthreading). The NVIDIA® RTX A5000 is a very capable card, but it could be upgraded to one or two RTX A6000 cards if the other apps and renderers you use can take advantage of them. To finish it off, the machine includes three NVMe drives: one for the OS and applications, and two more that can be striped together for high-bandwidth access to those large, uncompressed media files.

The HP ZBooks cannot possibly catch up to that amount of performance, but the maximum configuration here can be a great self-contained desktop replacement for remote projects. Just remember to plug it in when you need top performance, because the battery alone cannot drive the CPU & GPU at their highest rated clock speeds.

Desktop Workstation	Mobile Workstation
HP Z6 G4 or HP Z8 G4	**HP ZBook Fury 15 or 17 G8**
• 2x Intel® Xeon® Gold 6246R (16C, 3.4 GHz)	• Intel® Core™ i9-11950H (8C, 2.6 GHz)
• 12x 16 GB DDR4-2933 RAM (192 GB)	• 4x 32 GB DDR4-3200 DIMM (128 GB)
• NVIDIA® RTX A5000 Graphics (24 GB)	• NVIDIA® RTX A5000 Graphics (16 GB)
• HP Z Turbo Drive 1 TB TLC Z8 G4 SSD Kit (Windows)	• 1 TB PCIe Gen4 NVMe TLC SSD (Windows)
• HP Z Turbo Drive 1 TB TLC Z8 G4 SSD Kit (RAID0 Data)	• 1 TB PCIe Gen4 NVMe TLC SSD (Data)
• HP Z Turbo Drive 1 TB TLC Z8 G4 SSD Module (RAID0)	

True Multi-Frame Rendering has been on the community's wish list for many years now. Kudos to the engineering team at Adobe for finally implementing this time-saving feature, and for releasing it through the public Beta program so the community can explore the edges of its capabilities. If you haven't yet tried it for yourself, you can install it from the Beta section of Creative Cloud Desktop app. You can also visit Adobe's Multi-Frame Rendering FAQ to learn more and even download the sample project used to benchmark the performance improvements.

For more information about the family of Z by HP workstations, please visit http://www.hp.com/z.

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APPENDIX A - Performance Data

The data collected to create the plot in Figure 5 is in this table:

Workstation Model	HP Z240 SFF	HP ZBook Firefly 14 G8	HP ZBook Studio G7	HP ZBook Studio G8	HP ZBook Fury 15 G8	HP Z4 G4	HP Z4 G4	HP Z6 G4	HP Z8 G4	HP Z8 G4	HP Z8 G4
CPU	Xeon® E3-1245 v5	Core™ i7-1185G7	Core™ i9-10885H	Core™ i7-11850H	Core™ i7-11850H	Core™ i9-7920X	Core™ i9-10980XE	Xeon® 6136	Xeon® 6132	Xeon® 6246R	Xeon® 6154
Launch Year	2015	2020	2020	2021	2021	2017	2019	2017	2017	2020	2017
# Logical Processors	8	8	16	16	16	24	36	48	56	64	72
Base Clock (GHz)	3.50	2.40	2.40	2.50	2.50	2.90	3.00	3.00	2.60	3.40	3.00
MFR Speedup	1.07	1.24	1.24	1.14	1.20	2.21	2.76	3.39	3.26	4.27	3.18
Avg. MFR Runtime (mm:ss)	28:49	30:15	17:37	12:37	12:09	08:04	05:04	05:23	04:36	03:05	05:54

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