Avid MediaCentral | Cloud UX™ v2022.3

Hardware Guide

Important Information

For the latest information on Avid MediaCentral Cloud UX, see the documentation available from the MediaCentral Cloud UX Documentation page of the Avid Knowledge Base. Updates are occasionally issued after initial release.

This document is intended for people who need to make MediaCentral Cloud UX (MCCUX) hardware purchasing decisions, or advise on this topic. This guide assumes that you have a basic understanding of server components (CPU, RAM, etc.). If you plan to install MediaCentral Cloud UX in a virtual environment, see the Virtualization Guidelines documentation on the Avid Knowledge Base (link above).

This document provides HPE and Dell part numbers as a reference. Part numbers and components might change without notification. Consult the manufacturer directly for updated information.

Revision History

Date Revised	Changes Made
October 25, 2022	Note regarding the assignment of the SDA and SDB volumes: Depending on your server's hardware, the operating system might assign SDB to the RAID-1 operating system volume, and SDA to the RAID-5 cache volume. While MediaCentral Cloud UX documentation refers to SDA as the operating system volume for consistency purposes, that drive letter assignment is not mandatory.
April 14, 2022	First Publication • Removed references and support for Avid ISIS shared storage.

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Overview

Before getting into the details of buying hardware, you should take a moment to learn more about MediaCentral Cloud UX. This will help you understand why it is important to make the right hardware purchasing decisions.

After reading this document you should be able to:

- Clearly identify the workflows in which you will use MediaCentral Cloud UX
- Determine the type of network interface card (NIC) required for your environment
- Determine whether or not you require additional hard drives for media caching

What is MediaCentral Cloud UX?

Avid MediaCentral Cloud UX provides a simple, user-friendly graphical interface that can integrate with MediaCentral modules such as MediaCentral Production Management, MediaCentral Asset Management, and MediaCentral Newsroom Management. You can access the Cloud UX user interface from anywhere in the world through a web client or mobile device.

Beyond the user interface, MediaCentral provides a platform for additional apps, modules, and services that can be leveraged by other connected systems — extending workflows and creating new collaborative solutions. To learn more about MediaCentral Cloud UX, see the following guides on the Avid Knowledge Base:

- *Avid MediaCentral | Cloud UX User's Guide*
- *Avid MediaCentral | Cloud UX Install Guide*
- *Avid MediaCentral | Cloud UX ReadMe*

Operating System

MediaCentral Cloud UX is supported on a community-driven, command-line based operating system called CentOS (Community Enterprise Operating System) — derived from the sources of Red Hat Enterprise Linux (RHEL). Unlike RHEL, you are not required to purchase a support subscription to be licensed to use CentOS. The operating system is supplied by Avid as part of the MediaCentral Cloud UX installation media.

For more information about CentOS, see https://www.centos.org/about/.

For information on supported CentOS versions, see the MediaCentral Cloud UX Compatibility Matrix on the Avid Knowledge Base.

Buying Hardware for MediaCentral Cloud UX

For the most part, the hardware provisioning process is straightforward in that it is easy to configure a basic supported server. However, varying workflows and optional video playback methods can add complexity to the process.

Avid performs all system qualification using Intel-based CPUs. Avid cannot ensure equivalent performance, functionality, or compatibility if your equipment includes processors from other vendors such as AMD, or others.

Hardware-based deployments of MediaCentral Cloud UX are supported on HPE and Dell servers only. For best results, Avid recommends that you purchase servers that have been qualified by Avid. For more information, see "Avid Qualified Servers" on page 19.

A number of factors might affect your hardware purchasing decision:

1. **Deployment Scale**: The type of deployment is the primary influence on server requirements. A Newsroom Management only deployment without video playback has the lowest processing needs. MediaCentral Production Management and MediaCentral Asset Management deployments require more CPU resources, due to the media transcoding requirements. If you include additional features such as Multi Platform Distribution (MPD) for Publish, the amount of required memory might increase.
2. **Media Formats**: The next biggest consideration is the source media format. For example, DNxHD is a resource-intensive media format while Avid JFIF is lightweight in comparison.
3. **Number of Users**: The number of expected users and the method through which those users connect to the system (desktop web client vs mobile device) might affect the hardware specifications.

The following table summarizes the basic cases for single-server and cluster configurations. For more information, see "Deploying Multiple Servers" on page 8.

Number of Servers	Deployment Model	Description
1	Single Server	The minimum deployment model, suitable for MediaCentral for Newsroom Management-only (browse and edit content with no media playback requirement) or environments with few users and / or undemanding transcoding requirements. This solution offers some hardware redundancy (dual power supplies, dual internal drives), but little redundancy for system services.
3 +	Cluster	This solution offers redundancy for both hardware and system services. Adds increased peak-usage and media transcoding capacity. Deploying multiple servers in a cluster is particularly important for sites with many users and/or resource-hungry media formats. For example, a single server can support the simultaneous playback of over 100 Avid JFIF media streams, but only 15 streams of AVC Intra 50.

Hewlett-Packard Enterprise (HPE) and Dell

Consult the manufacturer's web site for the most up-to-date for resources for researching and configuring the servers supported for MediaCentral Cloud UX.

- HPE website (US):

  https://www.hpe.com/us/en/home.html

- Dell (Enterprise) website (US):

  http://www.dell.com/us/business/p/enterprise-products

For more information on specific servers, see "Avid Qualified Servers" on page 19.

Memory Requirements

MediaCentral Cloud UX servers require a minimum of 128GB of RAM. If desired, more RAM can be added to the server to potentially support additional users or steam counts.

Drive and Caching Requirements

The majority of MediaCentral Cloud UX deployments are configured with two volumes:

- A RAID 1 volume consisting of a mirrored set of two physical drives. This is where the operating system and applications are installed.
- A RAID 5 volume consisting of three or more physical drives (usually 5 to 8 drives). These drives are used as a media cache volume.

Avid requires organizations to procure Solid State Drives (SSD) for the operating system volume. This requirement applies to both new installations and upgrades to v2021.11 or later. Solid state storage is encouraged for the RAID-5 (media cache) volume, but not required.

When selecting an SSD, you must ensure that the device's interface type (SAS, SATA, NVMe, or other) is compatible with your server. While certain technologies such as NVMe might offer a performance increase over some other interface types, all SSD storage is considered faster than traditional HDD. Therefore, Avid does not define or require a minimum transfer rate at this time. Avid recommends that organizations purchase storage that is optimized for mixed performance (read / write / delete) and not devices that are optimized for read-only. This is especially true if you are considering SSD for the sdb cache volume.

System Storage (sda)

When you deploy CentOS during the MediaCentral Cloud UX installation process, you have the opportunity to review the disk partitioning information. You might notice that `/var` is generally the largest partition on the disk by default. This partition is used to house various databases, as well as the asset indexes that are required for MediaCentral Search. If you plan to include your system in a Multi-Site environment, your local system will store index information for each remote site at this same location. For these reasons, you'll want to make sure that your sda drive is large enough to accommodate your workflow.

While the storage requirements can vary based on your workflow, you can use the following general guidelines on the search index requirements to help you determine your storage needs:

- Asset Management (1 million assets, no multi-site)
  - MongoDB: ~3.0 GB
  - Elasticsearch: ~6.1 GB (no replica shard) or ~12.2 GB (cluster with 1 replica shard)
- Production Management (1 million assets, no multi-site)
  - MongoDB: ~0.3 GB
  - Elasticsearch: ~2.1 GB (no replica shard) or ~4.2 GB (cluster with 1 replica shard)

If you plan to deploy System Monitoring and you plan to use a MediaCentral Cloud UX server as a logging node, Avid recommends that you mount the monitoring data root directory (`/var/lib/mon`) to a dedicated disk or a dedicated partition of at least 150GB of an existing disk. For more information on this feature, see "Enabling System Monitoring" in the *Avid MediaCentral | Cloud UX Installation Guide*.

Cache Storage (sdb)

In several workflows, MediaCentral Cloud UX generates and locally caches transcoded media assets and system files. These workflows include:

- Working with multi-cam assets from a MediaCentral Production Management system — JPEGs of the multi-cam frames are stored on the cache
- Media playback for iOS and Android mobile apps where the cache is used to store MPEG-2TS (Transport Stream) media files that can be streamed to the mobile app

In these workflows MediaCentral Cloud UX must locally generate a compliant copy of the source media asset. This asset is then served to the requesting application. The asset is also cached in anticipation of a subsequent playback request. In the case of multi-server deployments (a cluster), the cached assets are replicated across the servers to reduce future transcoding of the same asset on a different playback server.

Cached media assets are stored on the volume until space is required for new assets. MediaCentral Cloud UX monitors the storage and automatically removes older files when the disk space falls below 40% free space. This process is limited to media assets and does not affect non-media files such as Docker registry data.

In addition to the above workflows, the sdb volume might also be used for the following:

- AAF sequence data from MediaCentral Production Management
- (Enterprise Editing) Draft sequence data
- Non-media files such as Docker registry data, Helm chart repos, and more

Media Cache Drive Configuration

When a media cache is required, the following options are supported for the cache volume:

Drives	Volume Configuration and Notes
1	A single solid state drive (SSD) configured as a separate volume (500GB or greater recommended). This configuration provides no redundancy in case of hard drive failure.
2	2 solid state drives (500GB or greater recommended) configured as a RAID-1 volume. This configuration provides redundancy in case one of the hard drives fails.
6 or 8	Solid state (preferred) or spinning disk drives configured as a RAID-5 volume. This configuration provides redundancy in the event of a drive failure. It also provides increase I/O for a higher volume of proxy generation and serving.

Important: In all cases, the media cache volume is separate and distinct from the RAID 1 volume that is configured for the operating system.

Networking Requirements

Avid supports the on-board 1 Gb network adapter in many HPE and Dell servers. However, certain workflows require the increased bandwidth of a 10 Gb network adapter. For example, a 10 Gb connection is required for any MediaCentral Cloud UX deployment that intends to use 100+ Mbps video formats such as AVC-I 100, DVCPro 100, and DNxHD 145. 10 Gb connections might also be desired or required to enable increased client connections or playback streams.

If you plan to connect to an Avid NEXIS system, you must consult the Avid NEXIS documentation to verify the network adapter(s) supported with your version of Avid NEXIS. The adapter that you purchase must be compatible with both the shared storage, and your selected hardware vendor. For more information, see the following link to the Avid Knowledge Base:

http://avid.force.com/pkb/articles/en_US/User_Guide/Avid-NEXIS-Documentation

Zone Recommendations

You can connect to Avid NEXIS using a 1 Gb or greater connection in Zone 2 or Zone 3. A Zone 3 connection is recommended for all configuration types.

- **Zone 2**: Connected through a 1 Gb or 10 Gb port on an Avid qualified layer-2 switch (non-routed).
- **Zone 3**: Connected to an Avid qualified layer-3 switch (routed) with known Quality of Service (QoS); traffic routed to Avid shared storage (one hop).

MediaCentral Newsroom Management

Newsroom Management-only deployments do not require a connection to a storage system as there is no video playback component. The network connection is at the user's discretion as long as it is 1 Gb or better.

MediaCentral Production Management

In this workflow MediaCentral Cloud UX decodes the source media format on Avid NEXIS and streams images and sound to the clients. Zone 2, or Zone 3 (recommended) connections are supported.

MediaCentral Asset Management

In this workflow MediaCentral Cloud UX provides playback of video assets registered as browse proxies by Asset Management. The zone is determined by the location of the browse proxies:

- For non-Avid storage, the network connection is at the user's discretion as long as it is 1 Gb or better.
- For Avid NEXIS, Zone 2, or Zone 3 (recommended) connections are supported.

Over-Specifying and Under-Specifying the Hardware

Over-Specifying Hardware

If you need to provision a system for a large number of users or high-density media formats (e.g. AVC-I 50/100), you might want to obtain a more powerful server that would be more appropriate for these workflows. Over-specifying hardware is supported in all cases.

Customers can provision additional RAM, solid state drives with either larger capacity or higher I/O ratings, or more powerful CPUs to increase the performance of their MCCUX system. However due to the near infinite number of combinations of asset codecs, hardware options, and other variables, Avid cannot provide precise performance measurements.

Under-Specifying Hardware

In some cases a price-sensitive customer that requires a deployment with fewer users or playback streams might want to provision a more cost effective server because they do not need the capacity of the servers specified in this document. Under-specifying hardware is supported in *some* cases.

- **MediaCentral (Newsroom Management only)**: For more information, see "Determining Scale: Newsroom Management Only" on page 10.
- **MediaCentral (Asset Management only)**: In cases where not many connections are required, a single processor (minimum 8-core) and 64GB of RAM can be provisioned. Consult Avid Product Management.
- **MediaCentral (Production Management or mixed deployment)**: All deployments must provision no less than the following specifications:
  - 2x Intel Xeon E5-2650 8-core 2.0 GHz (2.0GHz/8-core/20MB/95W) CPU

    Intel Xeon E5-26xx v3 or later required for all configurations
  - 128 GB of RAM

If your configuration allows for under-specified hardware, adhere to the following rules:

- **Storage**: Your sda volume must include at least 500GB of usable space. Due to the loss of space incurred during the formatting process, this likely means that you need to provision drives that are over 500GB.
- **CPU**: CPUs must be non-energy saving models (e.g. a performance model). Certain approved Haswell and later processors are exempt from the non-energy saving restriction.

- **RAM**: For each core, 4 GB RAM must be installed. For example:
  - 1 x 6-core CPU x 4 GB RAM = 24 GB RAM
  - 2 x 4-core CPU x 4 GB RAM = 32 GB RAM
  - 2 x 6-core CPU x 4 GB RAM = 48 GB RAM
  - 2 x 8-core CPU x 4 GB RAM = 64 GB RAM
  - 2 x 12 core CPU x 4 GB RAM = 96 GB RAM

If you under-specify your hardware configuration, you might experience negative system performance. This could result in reduced FPS (frames per second) during playback, delayed response time for the user interface, or system instability as the services fight for under-provisioned system resources.

Deploying Multiple Servers

The resolutions and playback methods available through MediaCentral Cloud UX have very different CPU and I/O footprints. Therefore, determining the number of servers required for a given installation can be challenging. The two factors that determine the quantity of servers required for a MediaCentral Cloud UX deployment are *redundancy* and *horizontal scale*.

Redundancy

Each MediaCentral Cloud UX deployment requires at least one server. However, in most cases Avid recommends deploying three or more servers to obtain high-availability and service redundancy.

So, the first question you have to answer when trying to determine how many servers are needed is:

Is high-availability required?

- If no, then one server might be sufficient. Additional servers are required if concurrent usage peaks are not satisfied by the playback capacity of a single server.
- If yes, then three or more servers are required. Additional servers are required if concurrent usage peaks are not satisfied by the playback capacity of the first three nodes.

  Each MediaCentral Cloud UX server is identified as a *node*. In a cluster configuration, you can have Master nodes, Worker nodes, or a node that fills both roles. Master nodes are responsible for coordinating activities across the cluster. Worker nodes are generally more passive in that they run pods, but do not manage them. Nodes that are identified as both a master and a worker have enough resources to both coordinate activities and run pods. In a MediaCentral Cloud UX cluster, the first three servers operate as both Master and Worker nodes. All other nodes are simply worker nodes. **When creating a MediaCentral Cloud UX cluster, Avid requires a minimum of three cluster nodes. Two node configurations are not supported**.



While most MediaCentral Cloud UX systems and services are highly available through a cluster configuration, some systems are not. In some circumstances, a system outage could occur through the loss of a Master node. For more information, see "MediaCentral Cloud UX Clustering" in the Avid MediaCentral | Cloud UX Installation Guide.

Horizontal Scale

The playback services are the most CPU and memory intensive component of the system. They are designed to run on all servers in the cluster such that playback sessions are distributed, or load-balanced, across all servers. This allows for horizontal scale—adding servers in a cluster to accommodate increased capacity.

Adding Servers to an Existing Installation

Over time, an organization might wish to expand a single server to a cluster configuration or potentially add nodes to an existing cluster. When making a purchase, the organization might not be able to obtain server hardware that matches the specifications of the original hardware. Avid supports mixing server hardware for a cluster configuration as long as the following criteria are met:

- Mixed processor speeds and RAM are supported between the servers. However, all servers should meet the "Memory Requirements" on page 4.
- Mixed server generations are supported. For example, an HPE Gen 9 server and an HPE Gen 10 server are supported together in the same cluster.
- Avid supports mixing servers from different hardware vendors such as HPE and Dell in the same cluster.
- If you mix different server types within a cluster, some nodes might include more CPU cores than other nodes in the cluster. In this case the node with the fewest number of cores can limit the overall scalability of the whole system. Kubernetes distributes CPU intensive pods across all nodes equally and it does not take the individual core-count into consideration. To avoid impacting system performance — especially to the player and search services, Avid recommends that you maintain an equal number of CPU cores across all nodes.
- RAID-1 (OS) and RAID-5 (cache) drive sizes do not need to be identical between the old and new servers. If the new servers include larger drives, some space will be left unused. For example if Server-A includes a 2TB cache volume, and Server-B includes a 3TB cache volume, 1TB of space will be left unused on Server-B.
- The network interface card does not need to be of the same type, but the name of the interface must be the same. For example, the default naming convention for the network adapters in an HPE server is "eth*x*", while Dell servers use "em*x*" and "p*x*p1". When creating or expanding a cluster, special care and additional steps are required to ensure that all NICs use the same interface name.

  For more information, see "Renaming the Primary Network Interface" in the *Avid MediaCentral | Cloud UX Installation Guide*.
- While mixing 1 GB and 10 GB network adapters between the servers is possible, it is not recommended. Avid has not specifically tested clusters containing a mix of 1 GB and 10 GB adapters.

Determining Scale: Subscription License Server

With the introduction of subscription (Flex) licensing for MediaCentral Newsroom Management, organizations that do not already own a MediaCentral Cloud UX system might want to deploy a server that is dedicated to this task.

If you need to deploy a MediaCentral Cloud UX server for the sole purpose of running the licensing service, you can use the following minimum specifications to complete this task. This assumes that you have not deployed any additional feature packs, and that you do not have any clients signing into the MediaCentral Cloud UX system (other than an administrator).

- CPU with 8 cores at 2GHz+
- 32 GB RAM
- 200GB HDD

If you want to enable any workflow in which clients connect to the server, these specifications no longer apply.

Determining Scale: Newsroom Management Only

If you configure MediaCentral Cloud UX with only the MediaCentral Newsroom Management module, video playback is not invoked by this configuration. In this case the CPU and memory requirements are reduced. Hardware for this configuration must meet the following minimum requirements:

- Processors: Your server must include CPU's with a total minimum of four cores. Avid recommends quad-core Intel Xeon CPU @ 1.8 GHz or higher.
- Memory: 4GB of RAM per core, but not less than 64GB of RAM.

  If you plan to use the MediaCentral Cloud UX Publish app, you must install at least 128GB of RAM.

As a reminder, Avid supports HPE and Dell servers only for all MediaCentral Cloud UX hardware-based deployments.

Determining Scale: Asset Management Only

MediaCentral Cloud UX can be leveraged as a player for the MAM Desktop application in MediaCentral Asset Management systems. In this case the MCCUX user interface might be accessed only for certain administrative tasks and not by a larger user base. MediaCentral Cloud UX provides playback of different video asset formats registered as a browse proxy in the Asset Management database and residing on standard file system storage or proprietary storage that provides a standard system gateway.

Unlike MediaCentral Cloud UX, playback in MediaCentral Asset Management is very rarely I/O bound. Most Asset Management deployments are on a network that can sustain many, many playback requests.

Typically the MediaCentral Cloud UX servers specified in this document can:

- Support ~120 frame-based playback streams (growing files) of most Asset Management proxy formats. (Variable speed playback reduces the number of streams per server by ~50%.)
- Serve ~4000 H.264 proxy files (provided there is enough outbound network connectivity and proxy storage disk I/O).
- Process ~30 video analysis requests.

General Project Information

Avid Sales and Product Management are generally consulted for each MediaCentral Asset Management deployment. In some cases (very small deployments), a smaller, less expensive server specification will be recommended (fewer, lower frequency cores, less RAM).

Having answers to the following questions will help Avid Product Management asses the project:

1. Provide a brief description of the project with specific goals.
2. Does the project require high-availability?

   This is separate from adding servers to accommodate capacity.
3. On which storage solution and/or file system are the proxies stored?

   If the storage system is proprietary, please indicate the standard file system gateway through which MCCUX will mount it (e.g., Omneon MediaGrid via CIFS).

For each registered browse proxy format, answer the following questions:

1. What is the proxy format?

   This relates to the file container and the codecs used for video and audio essences.
2. What is the expected peak of concurrent streams for this format?

   For example, there may be 100 users, but only 25 users at any given time will be working with assets using this proxy format.
3. Do users of this format require playback of growing files?

   Only MPEG-1 and Sony XDCAM Proxy formats are supported for this workflow.
4. How many streams of variable speed playback are required?

   MediaCentral Asset Management can provision permission to use variable speed playback. As it is a CPU intensive playback method, it should only be provisioned to users who really need it.
5. What is the maximum video image resolution?

   For example, 720x406 pixels.
6. What is the maximum proxy bit rate?

   For example, 3.0 Mbps.

Determining Scale: Production Management or Mixed Workflows

This section details how the video resolution can affect the system performance and the number of users that can connect to the server. Although this section is focused on MediaCentral Production Management workflows, your configuration might also include integration with MediaCentral Newsroom Management, or other workflows.

To determine the number of servers you need to support your deployment of MediaCentral Cloud UX, you need to know the following information:

- Which media formats are in use (e.g. DNxHD 145, XDCAM50, H.264 800Kbps proxy)?
- How many users (peak usage) are expected for each format?
- Are any users connecting through the MediaCentral Cloud UX mobile app?
- What is the speed of the network interface that is used to connect to Avid NEXIS (1 Gb or 10 Gb)?
- Do you require a clustered configuration?
  - You must provision a minimum of three servers to enable a MediaCentral Cloud UX cluster.
  - (n + 1) An additional server that allows for peak expected capacity even if one server fails.

About Video Playback

MediaCentral Cloud UX supports playback of a variety of video formats registered by MediaCentral Production Management and residing on Avid NEXIS shared storage. MCCUX decodes the source format and streams images and sound to the MediaCentral Cloud UX client.

MediaCentral playback capacity is limited by one of two factors:

- *CPU bound*: after a certain number of playback streams, the server has no more CPU cycles left
- *I/O bound*: after a certain number of streams, the server's network bandwidth becomes saturated

Different source formats have different CPU-decode profiles, and different I/O footprints. Typically: low bit rate source formats are CPU bound; high-bit rate source formats are I/O bound.

The other factor that determines whether a source format is CPU or I/O bound is the network connection, which could be 1 Gb or greater.

Media Format and Stream Count Assessment

To determine the number of users you can support, you need to know which media formats are in use, as the server can support a certain number of concurrent playback streams per format.

Some notes about the following two tables:

- The first table provides values for a server populated with Intel Xeon E5-2650 v1 (**Sandy Bridge**) CPUs. The second table provides information on many of the same formats with the server populated with Intel Xeon E5-2650 v2 (**Ivy Bridge**) CPUs.
- Stream counts with green shading indicate a CPU bound limit (the server is using its full compute capacity).

- Stream counts with orange shading indicate an I/O bound limit (the server can process more streams, but is limited by the 1 Gb network connection).
- 100+ Mbps formats are not supported (NS) over a 1 Gb connection to Avid shared storage, as not enough streams can be processed to be cost effective.
- Mobile encoding always points to high-res media to ensure good quality for the WiFi-stream. Information on low-res proxy formats is provided in case high-res media is unavailable
- Information on some formats was not available (NA) at time of publication.

Intel Xeon Sandy Bridge CPU

	MCCUX Users		Mobile Users	
Format	**1 Gb**	**10 Gb**	**1 Gb**	**10 Gb**
DNxHD 80-145; DVCPRO-HD	NS	16	NS	16
AVC Intra 100	NS	10	NS	10
AVC Intra 50	10	10	10	10
Avid JFIF 1:1	NA	27	NA	27
Avid JFIF 2:1/3:1	NA	90	NA	50
Avid JFIF 4:1/8:1/15:1	NA	190	NA	50
Avid JFIF 10:1/20:1	NA	124	NA	50
DNX 36-45, XDCAM HD 50	12	24	12	24
XDCAM EX 35, IMX50	16	42	16	42
XDCAM HD 17.5/35	18	36	18	36
DV50	12	56	12	50
DV 25; IMX 30/40	20	42	20	42
Proxy H.264	120	120	50	50
Proxy H.263	80	80	50	50

Intel Xeon Ivy Bridge CPU

	MCCUX Users		Mobile Users	
Format	**1 Gb**	**10 Gb**	**1 Gb**	**10 Gb**
AVC Intra 50	10	15	10	10
AVC Intra 100	NS	14	NS	10
Avid JFIF 2:1/20:1	NA	110	NA	50
DNxHD 145	NS	20	NS	16
DNxHD 220x	NS	16	NS	16

	MCCUX Users		Mobile Users	
Format	1 Gb	10 Gb	1 Gb	10 Gb
DNxHD 100	NS	22	NS	16
DNX 45	12	24	12	24
DV 25	30	85	20	42
DV50	12	53	12	50
XDCAM EX 35	16	40	16	42
IMX 30/40	28	68	20	42
IMX 50	28	70	16	42
XDCAM HD 17.5/35	18	40	18	36
XDCAM HD 50	12	34	12	24
Proxy H.264	120	120	50	50
Proxy H.263	80	95	50	50

Intel Xeon Haswell and Broadwell CPU

For stream counts on supported MediaCentral Cloud UX servers equipped with Intel Xeon Haswell and Broadwell CPUs, reference the "Intel Xeon Ivy Bridge CPU" table. The stream count tests conducted for XAVC and AVC-ULTRA resolutions below used servers equipped with Haswell and Broadwell CPUs. See the table below for details.

Intel Skylake CPU

The following performance results were collected using MediaCentral Cloud UX v2018.11 with a 10Gb network connection to Avid NEXIS shared storage.

Server Type	XDCAM HD50	XDCAM HD35	XDCAM EX35	DVC Pro	DNX 45	DNX 145	DNX 220x
HPE DL360 Gen10, 2x Gold 6130 @ 2.10GHz, 32 cores, 128GB RAM	36	40	40	21	36	18	13
Dell R640 2x Silver 4114 @ 2.20GHz, 20 cores, 128GB RAM	30	34	35	21	31	18	12

Additional resolutions:

Server Type	HDV 1080	AVCI 50	AVCI 100	DNX HD100	AVC LongG 720p G12	XDCAM HD50 with 64 audio tracks
HPE DL360 Gen10, 2x Gold 6130 @ 2.10GHz, 32 cores, 128GB RAM	45	18	13	25	36	31
Dell R640 2x Silver 4114 @ 2.20GHz, 20 cores, 128GB RAM	42	13	11	22	33	27

Sony XAVC and Panasonic AVC-ULTRA LongG Support

The following tables detail XAVC and AVC-ULTRA playback support for MCCUX users. Each row lists the server, processor type, and network connection speed used to complete the testing.

Sony XAVC

Server Type	25 1080i 59.94	35 1080i 59.94	50 1080i 59.94	25 1080i 50	35 1080i 50	50 1080i 50	50 720p 50	50 720p 59.94
HPE DL360 Gen9, v4 E5-2683 (Broadwell) / 2.1ghz / 16 core, 10GbE	4*	2*	1*	5*	2*	1*	29*	27*

* Frame rate not guaranteed. Frame rate might temporarily be reduced during playback.

Panasonic AVC Ultra

Server Type	12 1080i / 59.94	25 1080i / 59.94	50 1080i / 59.94	12 1080i / 50	25 1080i / 50	50 1080i / 50	12 1080p / 29.97	25 1080p / 29.97	50 1080p / 29.97
HPE DL360 Gen9, v3 E5-2650L (Haswell) / 1.8ghz / 12 core, 10GbE	3	3	1	11	8	3	6	5	1
HPE DL360 Gen9, v4 E5-2683 (Broadwell) / 2.1ghz / 16 core, 10GbE	10	7	4	24	17	8	NA	NA	NA

Additional resolutions:

Server Type	12 1080p / 25	25 1080p / 25	50 1080p / 25	12 720p / 50	25 720p / 50	50 720p / 50	12 720p / 59.94	25 720p / 59.94	50 720p / 59.94
HPE DL360 Gen9, v3 E5-2650L (Haswell) / 1.8ghz / 12 core, 10GbE	12	9	2	16	7	3	19	8	3
HPE DL360 Gen9, v4 E5-2683 (Broadwell) / 2.1ghz / 16 core, 10GbE	NA	NA	NA	27	14	9	30	18	9

DNxHR Support

The following table lists the number of playback streams for a single server using DNxHR resolutions. The following numbers were collected using a single server with a 2.5ghz V2 processor connected to Avid NEXIS through a 10 Gb connection.

As these resolutions are system intensive, Avid recommends using proxy versions of each of the following formats instead of the full high-resolution media to optimize the user experience.

DNXHR LB UHD 25fps	DNXHR SQ UHD 25fp	DNXHR HQ UHD 25fps	DNXHR HQx UHD 25fp	DNXHR LB UHD 29.97fps	DNXHR SQ UHD 29.97fp	DNXHR HQ UHD 29.97fps
16	5	3	2	15	5	2

DNXHR HQx UHD 29.97fp	DNXHR LB UHD 50fp	DNNHR SQ UHD 50fps	DNNHR HQ UHD 50fp	DNNHR HQx UHD 50fp	DNXHR LB UHD 59.94fps	DNXHR SQ UHD 59.94fps
2	8	1	1	1	7	1

DNXHR HQ UHD 59.94fps	DNXHR HQx UHD 59.94fp	DNXHR LB UHD 60fp	DNXHR SQ UHD 60fp	DNXHR HQ UHD 60fp	DNXHR HQx UHD 60fps
1*	1*	8	1	1*	1*

* Frame rate not guaranteed. Frame rate might temporarily be reduced during playback.

Sample Server Calculation

This section provides an example of how you might determine the number of required MediaCentral Cloud UX servers for your organization.

Peak Usage Assessment

To determine the number of servers you need to support your deployment of MediaCentral Cloud UX, you need to know how many users (at peak) are expected to be working with each media format in use. For example:

- 30 Mobile users of XDCAM 50
- 20 MediaCentral Cloud UX users of DNxHD 145 (no proxy)
- 40 MediaCentral Cloud UX users of XDCAM 50 (no proxy)
- 75 MediaCentral Cloud UX users of H.264 800 Kbps proxy

Overhead Assessment

To determine the number of servers you need, some overhead must be accounted for:

- There is a constant overhead of 0.25 servers to run non-playback services, followed by the servers needed to run the total number of users for each format.
- If high-availability is required, you must have a minimum of three servers.

Final Assessment

You make the final assessment by bringing in all previous assessments together. For example, given the following data:

- 10 Gb network connection to Avid NEXIS
- Constant 25% server overhead (.25)
- 30 Mobile users of XDCAM 50 @ 24 streams/server (30/24)

- 20 MediaCentral Cloud UX users of DNxHD 145 (no proxy) @ 16 streams/server (20/16)
- 40 MediaCentral Cloud UX users of XDCAM 50 (no proxy) @ 24 streams/server (40/24)
- 75 MediaCentral Cloud UX users of H.264 800 Kbps proxy @ 100 streams/server (75/100)

You make the following calculation:

$$.25 + \frac{30}{24} + \frac{20}{16} + \frac{40}{24} + \frac{75}{100} = x$$

which means:

or

$$.25 + 1.25 + 1.25 + 1.67 + .75 = x$$

$$x = 5.17 \text{ servers}$$

Avid recommends rounding up to ensure capacity. This method also provides some additional overhead in case of over-subscription or if a minimal number of additional users are added.

If your workflow includes Media Composer Cloud Remote clients, you must add those clients to your calculations.

Determining Scale: Media Composer Cloud Remote

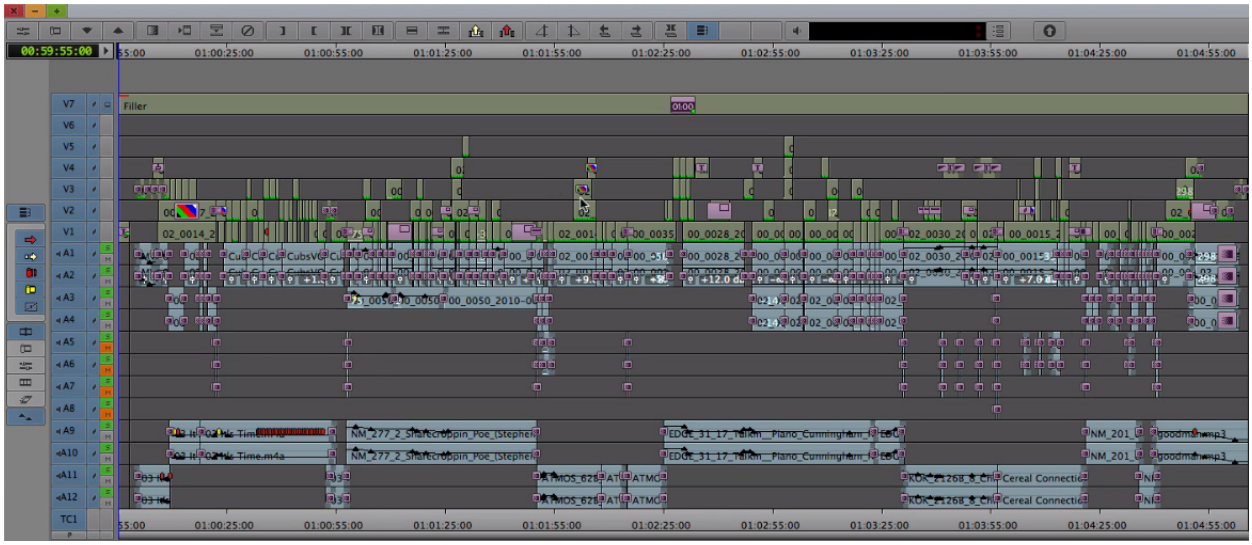
The Media Composer Cloud Remote option allows editors using Media Composer to remotely playback media from and upload media to a facility, enabling Media Composer users the freedom to work from everywhere. If the editor wishes to combine assets located in the remote Production Management database (stored on Avid shared storage), the MediaCentral Cloud UX server is used to stream the assets to the remote Media Composer client. Media Central Cloud UX is a required component for any Media Composer Cloud Remote workflow.

Media Composer Cloud Remote clients are often added to existing MediaCentral Cloud UX environments, making them a single component of a larger equation. Once you have determined the number of servers needed to support your Media Composer Cloud Remote clients, make sure to add this number to your “Sample Server Calculation” on page 16.

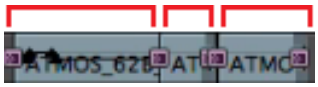
Sequence Complexity

Similar to the scale assessment for MediaCentral Cloud UX, the number of streams and users has a direct effect on the number of servers required to support the workflow. Additionally, as sequences created in Media Composer are often more complex than those created in MediaCentral Cloud UX, you must also account for this added complexity when determining scale for Media Composer Cloud Remote workflows.

Consider the following Media Composer sequence as an example:



This sequence consists of approximately 980 edit segments. A *segment* is defined as a portion of a sequence between two clip transitions. For example, the following illustration shows a portion of the sequence containing three individual segments:



Using the sequence shown above, Avid determined that a single Avid MediaCentral Cloud UX server was capable of servicing 8 simultaneous users playing back approximately 200 segments per minute of a high resolution 1080 raster HD format (ex. AVC-Intra 100 1080i 59.94).

The server used in these tests included the following components:

- Intel(R) Xeon(R) CPU E5-2683 v4 @ 2.10GHz
- 128GB of RAM
- 10 Gb connection to Avid NEXIS shared storage

These performance numbers listed above assume that at the time of playback, no media was cached on the Media Composer client. If media has already been cached, additional users, streams, or segments might be possible.

As detailed in the “Media Format and Stream Count Assessment” on page 12, different resolutions affect the capabilities of the system. Higher bandwidth formats such as AVC-Intra 100 might be limited by the network while lower bandwidth formats such as Proxy H.264 might be limited by the capabilities of the CPU.

Avid Qualified Servers

Avid performs specific and extensive testing on HPE and Dell servers during the qualification process of each new version of MediaCentral Cloud UX. The server models that are listed in this section continue to be used in this software qualification process.

The specifications below reflect the hardware options that were available at the time of purchase. In some cases, these exact specifications are no longer available for purchase from the hardware vendor. As noted in "Over-Specifying and Under-Specifying the Hardware" on page 7, Avid supports exceeding these specifications. As such, you are not required to purchase an "exact match" for the following system components. Instead, consider the information below as a guideline for making new purchases.

In some cases Avid has increased the minimum hardware requirements since the original qualification of the following servers. For instance the HPE ProLiant DL360 Gen9 specifications below call for only 64GB of RAM and spinning-disk HDDs. As you know from reading this document that unless approved by Avid Product Management, the current minimum specifications call for 128GB of RAM and solid-state storage for the OS volume. As another example, the Myricom adapter originally purchased for the HPE ProLiant DL360 Gen10 is no longer available.

This document provides HPE and Dell part numbers for each item as a reference. Part numbers and individual components such as specific processors, drives, or other might change without notification. Consult the manufacturer directly for updated information.

As a reminder, hardware-based deployments of MediaCentral Cloud UX are supported on HPE and Dell servers only. Product descriptions and part numbers have been added (where available). Refer to the following sections for details on specific servers:

- HPE ProLiant DL360 Gen10
- HPE ProLiant DL360 Gen9
- Dell PowerEdge R640
- Dell PowerEdge R630

HPE ProLiant DL360 Gen10

Avid has qualified the HPE DL360 Gen10 server for use with MediaCentral Cloud UX. This 1U form factor server provides enough expansion for NICs and drives to suit all MCCUX deployments.

For more information on this server, see the following link: https://www.hpe.com/us/en/product-catalog/servers/proliant-servers/pip.hpe-proliant-dl360-gen10-server.1010007891.html

DL360 Gen10 Hardware Requirements

The following table presents the minimum server specifications:

Item	Qty	Part Number	Component	Description
1	1	867959-B21	Product	DL360 Gen10 8SFF Configure-to-order (CTO) Server
2	1	860687-L21	Processors	DL360 Gen10 Xeon-G 6130 FIO Kit
3	1	860687-B21		DL360 Gen10 Xeon-G 6130 Kit

Item	Qty	Part Number	Component	Description
4	4	815100-B21	Memory	32GB 2Rx4 PC4-2666V-R Smart Kit
5	2	765453-B21	1st and 2nd hard drive (OS + applications)	1TB SATA 7.2K SFF SC 512e DS HDD
6	8	872477-B21	Drives (media cache)	600GB SAS 10K SFF SC DS HDD
7	1	869083-B21	RAID controller	Smart Array P816i-a SR G10 LH Ctrlr
8	1	875241-B21	Smart Storage Battery	96W Smart Storage Battery 145mm Cbl
9	2	AF556A	Power Cord	1.83m 10A C13-UL US Pwr Cord
10	1	665240-B21	Flexible LOM options	Ethernet 1Gb 4-port 366FLR Adapter
11	1	867966-B21	Backplane (motherboard)	DL360 Gen10 2SFF SAS/SATA Bkpln
12	2	865414-B21	Power Supply	800W FS Plat Ht Plg LH Pwr Sply Kit
13	1	874543-B21	Rail Kit	1U Gen10 SFF Easy Install Rail Kit

Additional Notes:

- Not listed: 10GB Myricom network adapter when connecting to Avid shared storage.
- **Item 4**: The server must be configured with 4x32GB RAM DIMMs or better. Using smaller DIMM sizes could adversely affect system performance.
- **Items 5 and 6**: The first two drives are configured in RAID 1 and host the operating system and MCS software installation. All remaining drives are configured in a RAID 5 as a media file cache. For more information, see “Drive and Caching Requirements” on page 4.
- **Item 10**: The HP Ethernet 1 Gb 4-port 331FLR adapter (network interface card) cannot be used with Avid shared storage! If you are purchasing servers to configure MCS for use with MediaCentral connected to one or more Avid shared storage systems, substitute the HP Ethernet 1 Gb 4-port 366FLR FIO adapter instead.
- **Item 12**: The power cord indicated is standard for North America, Central America, parts of South America, and other countries. Please ensure you specify the correct power cord for your particular geographical region.

HPE ProLiant DL360 Gen9

Avid has qualified the HPE DL360 Gen9 server for use with MediaCentral Cloud UX. This 1U form factor server provides enough expansion for NICs and drives to suit all MCCUX deployments.

This server is no longer available for purchase.

DL360 Gen9 Hardware Requirements

The following table presents the minimum server specifications:

Item	Qty	Part Number	Component	Description
1	1	755258-B21	Product	HP ProLiant DL360 Gen9 8-SFF Configure-to-order (CTO) Server

Item	Qty	Part Number	Component	Description
2	1	764101-L21	Processors	HP DL360p Gen9 E5-2650Lv3 (1.8GHz/12-core/ 30MB/65W) FIO (Factory Installation Option) Processor Kit
3	1	764101-B21		HP DL360p Gen9 E5-2650Lv3 (1.8GHz/12-core/ 30MB/65W) Processor Kit
4	16	726718-B21	Memory	HP 8 GB (1x8 GB) Single Rank x4 DDR4-2133 CAS-15-15-15 Registered Memory Kit
5		766205-B21	Storage controller[a]	HP DL360 Gen9 Smart Array P840 SAS Card with Cable Kit
6		-- --	Drive cage	HP 8-Bay Small Form Factor Drive Cage
7		764630-B21	Additional drive cage (recommended)	HP DL360 Gen9 2SFF SAS/SATA Universal Media Bay Kit
8	2	652745-B21	1st and 2nd hard drive	HP 500 GB 6G SAS 7.2K rpm SFF (2.5in) SC Midline 1 yr Warranty Hard Drive
9	6 or 8	652572-B21	Drives (cache)[b]	HP 450 GB 6G SAS 10K SFF (2.5-inch) SC Enterprise 3 yr Warranty HDD
10		-- --	RAID setting	None. Do not specify a RAID setting when ordering. RAID is configured during software installation.
11		665240-B21	Flexible LOM options / upgrades[c]	HP Ethernet 1 Gb 4-port 366FLR (Flexible LOM form factor) FIO (Factory Installed Option) adapter
12	2	720479-B21	Power Supply	HP 800W Flex Slot Platinum Hot Plug Power Supply Kit
13	2	AF556A	Power Cord	HP C13 - Nema 5-15P US/CA 110V 10Amp 1.83m Power Cord
14	1	663201-B21	Rail Kit	HP 1U Small Form Factor Ball Bearing Rail Kit

a. Includes the P840 Smart Array controller with 4 GB integrated cache, HP Smart Storage Battery, and associated cabling to attach it to a 10 SFF configuration

b. The procurement of additional HDDs for caching depends on deployment and media formats. See "Drive and Caching Requirements" on page 4.

c. For non-Avid shared storage connections, you can substitute the following adapter instead: HP Ethernet 1 Gb 4-port 331FLR (Flexible LOM form factor) FIO (Factory Installation Option) Adapter (part # 684208-B21)

Additional Notes:

- **Item 4**: If you plan to enable settings in MediaCentral Cloud UX permitting playback at higher image quality you might need to configure more memory than indicated in the body of the table.
- **Items 6 and 7**: The DL360 supports up to 10 internal drives. The included drive cage provides space for up to eight internal HDDs. The additional drive cage (764630-B21) replaces the optical drive bay to accommodate two more HDDs.



Avid highly recommends ordering the additional drive cage and two additional HDDs for increased storage capacity.

- **Items 8 and 9**: The first two drives are configured in RAID 1 and host the operating system and MCCUX software installation. All remaining drives are configured in a RAID 5 as a media file cache. For more information, see “Drive and Caching Requirements” on page 4.
- **Item 11**: The HP Ethernet 1 Gb 4-port 331FLR adapter (network interface card) cannot be used with Avid shared storage! If you are purchasing servers to configure MCCUX for use with MediaCentral connected to one or more Avid shared storage systems, substitute the HP Ethernet 1 Gb 4-port 366FLR FIO adapter instead.
- **Item 13**: The power cord indicated is standard for North America, Central America, parts of South America, and other countries. Please ensure you specify the correct power cord for your particular geographical region.

Dell PowerEdge R640

Avid has qualified the Dell PowerEdge R640 server for use with MediaCentral Cloud UX. This 1U form factor server provides enough expansion for NICs and drives to suit all MCCUX deployments.

For more information about this server, see the following link: https://www.dell.com/en-ca/work/shop/povw/poweredge-r640

Dell PowerEdge R640 Hardware Requirements

The following table presents the minimum server specifications:

Item	Qty	Part Number	Component	Description
1	1	R640	PowerEdge R640	PowerEdge R640 Server
2	- -	5098750	Motherboard	PowerEdge R640 Motherboard
3	- -	NTPM	Trusted Platform Module	No Trusted Platform Module
4	1	5101048	Chassis Configuration	2.5" Chassis with up to 8 Hard Drives and 2PCIe slots, 2CPU only
5	1	5103402	Processor	Intel® Xeon® Silver 4114 2.2G, 10C/20T, 9.6GT/s, 14M Cache, Turbo, HT (85W) DDR4-2400
6	1	5103403	Additional Processor	Intel® Xeon® Silver 4114 2.2G, 10C/20T, 9.6GT/s, 14M Cache, Turbo, HT (85W) DDR4-2400
7	- -	5099793	Processor Thermal Configuration	Standard Heatsink for 2 CPU
8	- -	5099278	Memory DIMM Type and Speed	2666MT/s RDIMMs
	- -	PEOPT	Memory Configuration Type	Performance Optimized
9	8	5098888	Memory Capacity	16GB RDIMM, 2666MT/s, Dual Rank
10	- -	5098873	RAID Configuration	C4, RAID 5 for 3 or more HDDs or SSDs (Matching Type/Speed/Capacity)
11	- -	5102586	RAID/Internal Storage Controllers	PERC H730P RAID Controller, 2GB NV Cache, Minicard

Item	Qty	Part Number	Component	Description
12	8	5103818	Hard Drives	600GB 10K RPM SAS 12Gbps 512n 2.5in Hot-plug Hard Drive
13	- -	NOOS	Operating System	No Operating System
14	- -	NOMED	OS Media Kits	No Media Required
15	- -	5099556	Embedded Systems Management	iDRAC9,Enterprise
16	- -	5100926	Group Manager	iDRAC Group Manager, Disabled
17	- -	5101344	Password	iDRAC,Legacy Password
18	- -	5099711	iDRAC Systems Management Options	Static IP
19	1	5098851	PCIe Riser	Riser Config 3,1x16 LP,1x16 FH
20	- -	5101077	Internal Optical Drive	No Internal Optical Drive
21	8	5101073	Fans	Standard Fans for R640
22	1	495R	Power Supply	Dual, Hot-plug, Redundant Power Supply (1+1), 495W
23	2	125V10	Power Cords	NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord, North America
24	1	5099012	Bezel	Standard Bezel for x4 and x8 chassis
25	- -	5101881	Quick Sync 2 (At-the-box mgmt)	No Quick Sync
26	- -	HPBIOS	BIOS and Advanced System Configuration Settings	Performance BIOS Setting
27	- -	UEFIB	Advanced System Configurations	UEFI BIOS Boot Mode with GPT Partition
28	1	RDYRL	Rack Rails	ReadyRails™ Sliding Rails Without Cable Management Arm

Additional Notes:

- Not listed: Avid added a 10GB network adapter to connect to Avid shared storage.
- **Item 23**: The power cord indicated is standard for North America, Central America, parts of South America, and other countries. Please ensure you specify the correct power cord for your particular geographical region.

Dell PowerEdge R630

Avid has qualified the Dell PowerEdge R630 server for use with MediaCentral Cloud UX. This 1U form factor server provides enough expansion for NICs and drives to suit all MCCUX deployments.

Although no longer available for purchase, this server continues to be supported.

- Dell PowerEdge R630 product page:
  http://www.dell.com/ca/business/p/poweredge-r630/pd
- Dell Support Center:
  http://www.dell.com/support/home/us/en/04/Products/

Dell PowerEdge R630 Hardware Requirements

The following table presents the minimum server specifications:

Item	Qty	Part Number	Component	Description
1	1	R630	Product	PowerEdge R630 Server, No TPM
2	- -	103P	Chassis Configuration	Chassis with up to 10, 2.5" Hard Drives, 3 PCIe Slots
3	1	10523	Processors	Intel® Xeon® E5-2650 v3 2.3GHz,25M Cache,9.60GT/s QPI,Turbo,HT,10C/20T (105W)
4	1	A10523		Intel® Xeon® E5-2650 v3 2.3GHz,25M Cache,9.60GT/s QPI,Turbo,HT,10C/20T (105W)
5	1	HS1202	Processor Thermal Configuration	2 CPU up to 120W
6	- -	- -	PCIe Riser	None
7	- -	R2133	Memory DIMM Type and Speed	2133MT/s DIMMs
8	- -	AECC	Memory Configuration Type	Advanced ECC
	16	8G2R	Memory Capacity	8 GB RDIMM, 2133MT/s, Dual Rank, x8 Data Width
9	- -	URH	RAID Configuration	Unconfigured RAID for H330/H730/H730P (1-24 HDDs or SSDs)
10	1	H7301G	Storage Controller[a]	PERC H730 RAID Controller, 1 GB NV Cache
11	8	600S10	Hard Drives	600 GB 10K RPM SAS 6 Gbps 2.5in Hot-plug Hard Drive
12	1	I350	Network Daughter Card	Intel Ethernet i350 QP 1 Gb Network Daughter Card
13	- -	- -	Additional Network Cards	No additional NIC cards
14	- -	- -	Host Bus Adapter/ Converged Network Adapter	No host bus adapter
15	- -	- -	Additional PCIe cards	No additional PCIe cards
16	1	I8EXP	Embedded Systems Management	iDRAC8 Express, integrated Dell Remote Access Controller, Express
17	- -	- -	Internal SD module	None

Item	Qty	Part Number	Component	Description
18	- -	NODVD1	Internal Optical Drive	No internal optical drive
19	- -	NOBEZL	Bezel	No bezel
20		RRCMA	Rack Rails	ReadyRails™ Sliding Rails With Cable Management Arm
21	- -	HPBIOS	Performance BIOS Setting	Performance BIOS Setting
22	1	495R	Power Supply	Dual, Hot-plug, Redundant Power Supply (1+1), 495W
23	2	125V10	Power Cord	NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord, North America
24	- -	- -	Server Accessories	No server accessories
25	- -	NODOCS	Systems Documentation	No systems documentation, no OpenManage DVD Kit
26	- -	NOOS	Operating System	Operating System
27	- -	- -	Licenses	No licenses
28	- -	NOMED	OS Media Kits	No Media Required
29	- -	- -	OS Partitions	None
30	- -	- -	Secondary OS	No secondary OS
31	- -	- -	Virtualization Software	None
32	- -	- -	Virtualization Licenses and Subscription	None
33	- -	- -	Enable Virtualization	None
34	- -	- -	Database Software	None
35	- -	- -	Client Access Licenses	No client access licenses
36	- -	- -	Additional Software Offerings	None
37	- -	- -	Advanced System Configurations	No advanced system configurations
38	- -	- -	System Management Upgrades	No system management upgrades
39	- -	U3OS	Hardware Support Services	Avid does not have a specific recommendation. Select according to client needs.
40	- -	- -	Proactive Systems Management	None
41	- -	NOINSTL	Installation Services	No installation
42	- -	- -	Proactive Maintenance	Proactive maintenance declined

Item	Qty	Part Number	Component	Description
43	- -	NORCS	Remote Consulting Service	Declined Remote Consulting Service
44	- -	- -	Additional Installation Services	No additional installation services
45	- -	- -	Keep Your Hard Drive	None

a. PERC H730P RAID Controller, 2 GB NV Cache (optional)

Additional Notes:

- **Item 23**: The power cord indicated is standard for North America, Central America, parts of South America, and other countries. Please ensure you specify the correct power cord for your particular geographical region.

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