



# VideoXpert<sup>®</sup>

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## Understanding the VideoXpert® Enterprise System

VideoXpert is a video management solution designed to fit surveillance operations of any size. Whether your operation has 100 cameras or 10,000, VideoXpert presents a solution to display, record, and manage your video resources. But VideoXpert Enterprise is more than a VMS. It is an enterprise-level video and data management solution designed to combine input from multiple systems, for a cohesive, real-time understanding of events taking place in your environment.



**Action:** Prior to obtaining a quote for or purchasing a system, contact a Pelco Technical Sales Engineer to validate your system configuration.

## Scoping System Licenses

VideoXpert is licensed for the system, for upgrades, and by channel—the video streams you view and record. It comes with one (1) license to start. The demo license provides unlimited channels that are active for a period of 60 days. These are active only the first time you install the software, or if the software was pre-installed, the first time you start up the system. In order for the system to function beyond the evaluation period, add the appropriate quantity of licenses to the system.



**Action:** Ensure that you have enough licenses. See the current version of the VideoXpert Enterprise Product Specification for available SKUs. Contact a Pelco Sales Representative for more information.

## Planning for Device Discovery

When adding devices to VideoXpert, the system issues a discovery message and then listens for devices for up to five minutes. Using the discovery process, VideoXpert adds your VideoXpert devices, including Pelco cameras and many third-party cameras. You must then manually commission the devices.



**Action:** Ensure that there are enough licenses for all of the devices on the system, and ensure that there will be enough bandwidth available to perform Device Discovery without interfering with system operation.

## Planning for FISMA/NIST Compliance

VideoXpert is compatible with current FISMA/NIST requirements. If your organization must comply with these requirements, establish a Risk Management Framework which includes:

- Categorizing the system
- Selecting security controls
- Implementing security controls
- Assessing the system
- Authorizing the system
- Performing continuous monitoring

The current version of the *VideoXpert Configuration Guide for FISMA/NIST Environments* includes configuration guidance and information needed to build a system documentation package for security control assessments. Specifically, the guide will help organizations documenting the system through the RMF process with information about how to categorize the system, which NIST-based security controls are applicable, and how VideoXpert Enterprise implements NIST-based security controls. Testing of these controls has also been performed by Pelco with VideoXpert Enterprise installed on a FISMA representative system to ensure functionality under a secure configuration with DISA STIG rules applied.



**Note:** NIST security control baseline has many allowances for organization-defined settings. While the *VideoXpert Configuration Guide for FISMA/NIST Environments* describes an RMF-friendly implementation for Pelco VideoXpert including NIST security controls and DISA STIG rules, it might not precisely match your organizationally-defined settings.



**Action:** To configure your system for FISMA/NIST compliance, contact Pelco Professional Services to obtain the *VideoXpert Configuration Guide for FISMA/NIST Environments*.

## Selecting Servers

VideoXpert requires both Core and Media Gateway servers. Although you can leverage separate Core and Media Gateway servers for systems of sufficient scale, most systems can easily support servers running both the Core and Media Gateway (CMG) services. A single CMG server provides the complete range of VideoXpert functionality that you would expect for systems with fewer than 2000 cameras and 100 simultaneous users.

However, for environments that are especially large, require exceptional redundancy, or incorporate a high number of low bandwidth and aggregated users, you might install individual Core and Media Gateway servers.



**Action:** Determine whether to use a CMG or separate VideoXpert Core server(s) and Media Gateway server(s) based on the number of cameras and users on your system. See the following sections for details.

### Choosing to Use One or More VideoXpert Core(s)

VideoXpert Core is the heart of the VideoXpert System, it maintains the database of cameras, recording devices, users, and permissions. Core works with VxToolbox, from which you can configure and manage the system. Through VxToolbox, you can administer user accounts and permissions, determining the system functions and devices users can access. You can create and assign “tags” to quickly organize cameras and devices within the system. You can also configure and respond to events within the system.

### Choosing to Use One or More VideoXpert Media Gateway(s)

The VideoXpert Media Gateway routes video traffic to appropriate users as requested. The Media Gateway:

- Routes the video to the workstation in a multicast environment
- Accesses the video in a unicast environment
- Transcodes the video for low-bandwidth connected VxOpsCenter clients

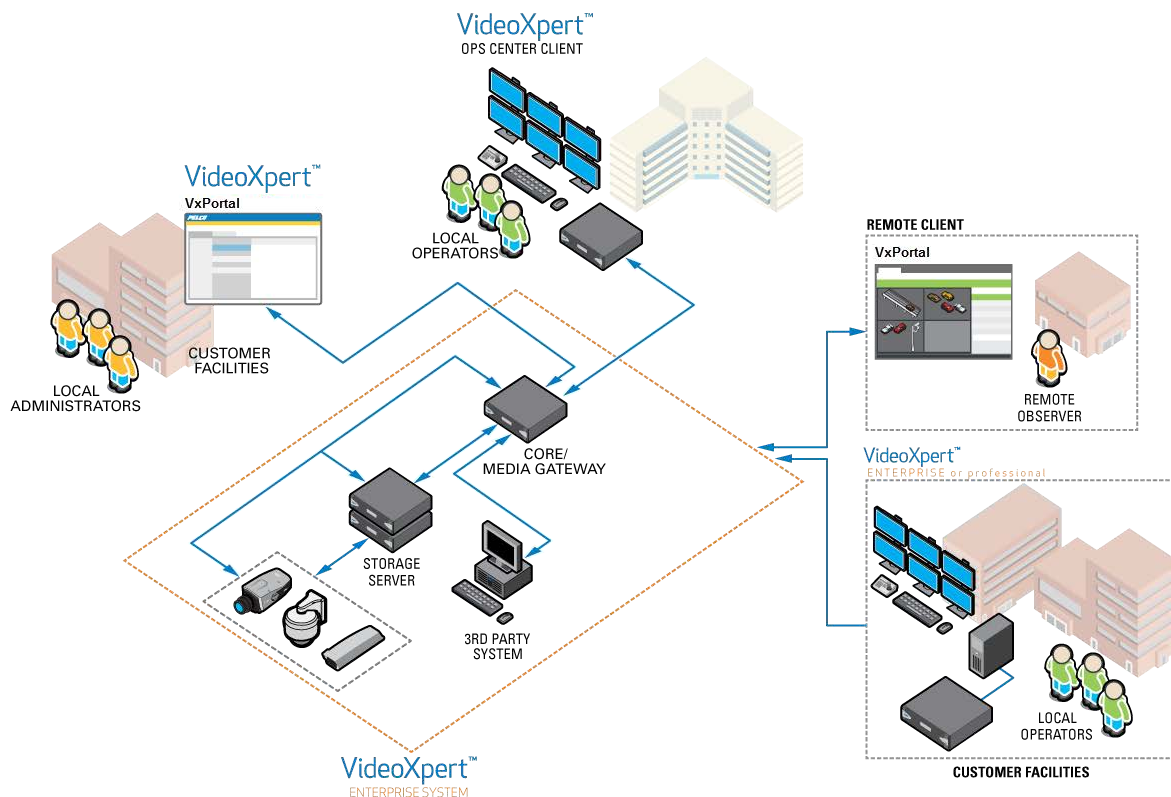
You can set the communication method, unicast or multicast, from the Video Source to the Media Gateway, and from the Media Gateway to the client. The media gateway is capable of transcoding multicast from the source to unicast for the client, and from unicast to multicast.

Like Core servers, Media Gateways can be added to VideoXpert modularly. You can add Media Gateways to the system as the media delivery needs increase.



## Planning to Use VideoXpert Aggregation

VideoXpert Enterprise with Aggregation allows for expansion at any level of your security environment. Your system begins with a single server running Core and Media Gateway software. Your system can use dedicated VxOpsCenter Clients to view live and recorded video, or it can use VxPortal, which fully utilizes HTML5 browser technology to deliver a similarly rich experience with no client software required. As your surveillance needs grow, you can add servers to expand modularly within a single environment, or you can aggregate multiple VideoXpert Enterprise systems to provide a single point of access for distributed video management networks.



**Caution:** Although VideoXpert Professional and VideoXpert Enterprise systems can be aggregated into the same Enterprise system, it is not recommended that you have cross-aggregation between multiple systems simultaneously.

## Growing the VideoXpert System

If your system grows to support additional users, cameras, or sites, or you just want to provide redundancy within your VideoXpert system, you can separate your VideoXpert Core and Media Gateway servers, and increase system capacity by clustering servers. If you are using aggregation, you can also aggregate other VideoXpert systems.

Consider using separate Core and Media Gateway servers when:

- There is a high number of simultaneous users.
- The system must scale to a high number of cameras and users.
- You have high expectations for availability and redundancy.

The table below lists typical deployment scenarios, with the maximum number of cameras and concurrent system users for each deployment; these numbers represent the limits at which the system becomes unusable (high latency in control requests).

Deployment	Cameras	Users	Availability	Additional Requirements
Single CMG	2500	100	Not fault tolerant	N/A
Dual CMG	2500	100	Active-Active single failover	N/A
Dual CMG (NSVR)	7500	400	Hot-standby failover	N/A
Triple CMG	10000	500	Active-Active single failover	N/A
Single Core/ Gateway	3000	200	Not Fault Tolerant	N/A
Multi-Core / Gateway	>10000	>500	High Availability	Independent load balancer

The table presents absolute maximums for VideoXpert deployment scenarios. Your experience might differ based on your network configuration, network equipment, average video bitrates, and other criteria.



**Action:** Build the system with at least 10% additional capacity (in terms of cameras, users, or preferably both), to ensure that the system is responsive and has additional capacity to take on new users or cameras. When planning a VideoXpert deployment, contact Pelco to ensure that the system has the capacity to support your environment and needs.

### Using Active-Active Failover (Single CMG vs Multi-CMG Environments)

A single CMG can host nearly 2500 cameras and 100 concurrent users, but the system is not fault tolerant; anything that could bring down the server will interrupt access to VideoXpert.



**Action:** Pelco recommends that if video is mission critical to the business, build a system with at least two CMG servers.

### Clustering Core Servers

In your VideoXpert environment, Core or CMG servers host the database. Clustering your Core or CMG servers provides redundancy and enables VideoXpert to scale.

In a clustered environment, each Core or CMG server in the cluster hosts a complete copy of the VideoXpert database.

In addition, you can install a copy of just the database on a server.



**Note:** VideoXpert itself performs all of the cluster configuration automatically during the setup process. If configuring a system containing more than three servers, contact a Pelco Sales Representatives or a Pelco Technical Sales Engineer.

Within each Core/CMG cluster, one server acts as the primary and the other servers operate as secondaries. The primary server processes all write operations and pushes data to the secondaries. Secondary servers replicate the primary server's database asynchronously.

- If you have two servers and one is unavailable, there is no loss of functionality.
- If you have three servers and one is unavailable, there is no loss of functionality.
- If you have three servers and two are unavailable, the available server is put into a read-only state.

In a read-only state, users can still call up video, but would be unable to apply bookmarks, export investigations, apply tags, and perform other similar operations within the system.

### Working with Clusters

A clustered environment requires at least two VideoXpert Core, Media Gateway, or CMG servers.

- Cores and Media Gateways must be on the same VLAN. They must also have static IP addresses, and these IP addresses must be different from each other.
- Traffic will be managed by a single Core; if that Core fails, another Core will perform the management tasks. Other tasks, such as export processing, are shared among all Cores.
- A single Media Gateway will receive streaming requests, but will redirect streaming to other Media Gateways to balance the load.
- The Media Gateway trans-casts to suit the network topology and needs. While the system is configured to get multicast streams from sources and to issue multicast streams to clients, you can select the appropriate communication method both from sources to the Media Gateway and from the Media Gateway to clients. The network topology and need for users to access sources simultaneously will inform your choice.

Use VxToolbox to configure clusters. See the current version of the *VideoXpert® Toolbox Operations Manual* section titled *Adding Systems*.

### Aggregating Systems

VideoXpert Enterprise with aggregation includes an aggregation server, through which you can provide centralized access to a series of VideoXpert member—VideoXpert Professional and/or VideoXpert Enterprise—systems. Through the VideoXpert Enterprise server acting as the aggregation system, you can access and control settings and video for distributed VideoXpert systems.

When adding a member to the aggregation server, you will select your connection speed to the aggregation server. Your connection speed determines both the performance of video within the VideoXpert environment hosting the aggregation server and the number of video streams you can reasonably expect to get simultaneously from the aggregated site.

At present, you cannot change settings for aggregated systems from the VideoXpert instance hosting the aggregation server. You must change settings for member systems from the member itself.

The aggregation server does not inherit permissions, roles, or users from aggregated members. If aggregating a VideoXpert Enterprise environment containing roles with restricted permissions, you must re-create these roles and permissions with resource restrictions with the VideoXpert System acting as the aggregation server.

### Using LDAP Authentication

You can configure VideoXpert to validate user credentials from an LDAP server. While the system can validate credentials over LDAP, you must create corresponding user IDs and roles within the VideoXpert database against which to validate the credentials. These IDs and roles must match the IDs and Groups in the LDAP directory exactly (including capitalization) in order for the authentication to pass through. Using the LDAP interface DOES NOT alter the schema of the LDAP directory, so all permissions to the VideoXpert system(s) must be defined in the VideoXpert system

You can select the authentication method and parameters used.

- VideoXpert Authentication  
When using VideoXpert Authentication, you can set passwords to expire at specific intervals, or to never expire.
- LDAP authentication using simple bind authentication  
When using LDAP authentication with simple bind, you can set passwords to expire at specific intervals, or to never expire.
- LDAP authentication using two-stage binding  
When using LDAP authentication with two-stage binding, you can set passwords to expire at specific intervals, or to never expire.
- (Optional) If you select LDAP authentication, you can also retrieve users and roles from LDAP
- LDAP authentication using single sign-on (SSO)
  - SSO allows users to log in to multiple systems using a single set of login credentials.
  - SSO can be used with either Single-Stage or Two-Stage binding, and can be used with the Synchronize Users and Roles From LDAP option.
  - SSO requires valid certificates; each user must have a valid certificate that the system can access.
  - When using LDAP authentication with SSO, you cannot set passwords to expire. Password expiration is controlled by the LDAP database policies.



**Note:** If VxOpsCenter is running on the same server as the VxPro or Core system, SSO will not be available. This is due to MS Windows limitations.

### Planning for Multi-System Access

You can design the VideoXpert system to run using Single Server Access mode or Multi-Server Access (MSA) mode. MSA mode enables access to multiple stand-alone VideoXpert systems simultaneously.

When the system is in MSA mode, and *Multi-System Access opens without initial credentials* is selected in VxToolbox, users can sign-in to VxOpsCenter without signing-in to a specific system. Credentials will be required when you select a VX System.



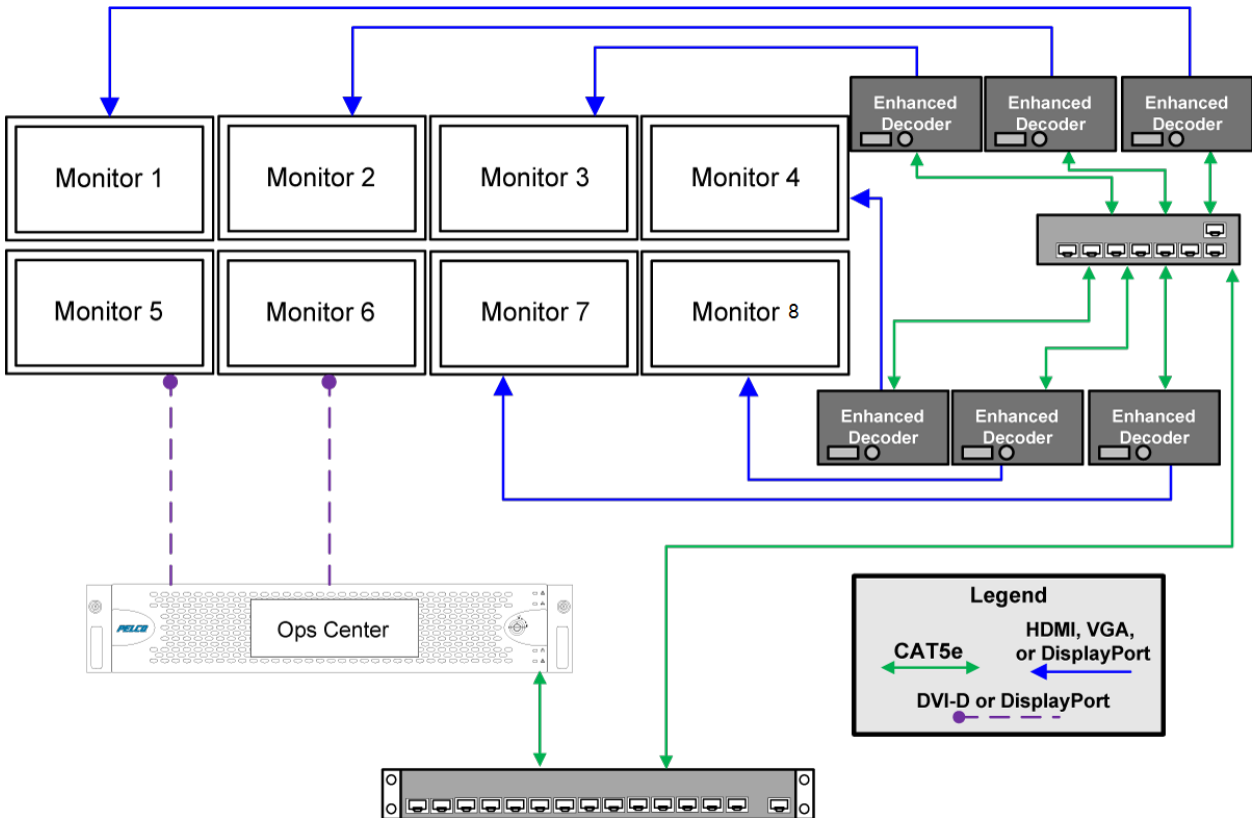
**Action:** When defining the system connections in the VxOpsCenter client software, you can fine-tune the maximum network bandwidth to allow from the system. This will ensure that the video streams to the workstation have the best resolution and image rate possible without over-saturating the network link(s) between the system and the user workstation.



**Action:** When planning to use MSA mode, ensure that the same user ID and passwords exist and exactly match on all of the different systems. When using MSA mode, Pelco recommends that you use LDAP to synchronize users and roles to each VX system. This will ensure that the username and passwords match.

### Understanding Operator Workspace Topology

The VxOpsCenter, running on an 8-monitor rackmount Workstation, supports up to eight monitors: two connected directly to the Workstation, and the other six driven independently by Enhanced Decoders. The Enhanced Decoders enable each monitor connected through a workstation to display up to 25 video streams while maintaining a seamless user experience.



Enhanced Decoder-driven monitors operate just like native monitors; users can move windows across monitors seamlessly. But, when the user requests a video stream or plugin, the Enhanced Decoder communicates directly with VideoXpert servers to get and decode video. This enables operators to maximize the display-capabilities of the VxOpsCenter without complicating the user experience.

Because the Enhanced Decoders do not run the VxOpsCenter application themselves, you might experience better performance in quantity and responsiveness of HD streams on decoder-driven monitors, instead of directly-connected monitors.

VxOpsCenter also supports Shared Display mode which provides monitor-wall functionality for a VX Workstation or a Shared Display Decoder. Monitor walls are specific groups of monitors that are frequently viewed or used together. A monitor wall does not require an 8-monitor workstation, and it can be scaled as large as needed using configured monitor numbers. (Monitor numbers are configured in VxOpsCenter.) Users can send tabs and video to the shared display and control the shared display remotely. In order to connect to the VX System from VxOpsCenter, the user must have permissions that allows the user to add monitors to the system.

If you require additional monitors on a monitor wall, Shared Display Decoders can be used in combination with Enhanced Decoders to create a complete monitor wall experience.

## Selecting Recorders

VideoXpert supports multiple recording platforms. In general, traffic and video delivery operates much the same using any of the available recording platforms. If building a new system, you would typically use VxStorage E-Series, VxStorage T-Series, and VXS5300 recorders; if migrating from an existing Endura system, you can use NSM5200 and NSM5300 servers as recorders.



**Action:** Determine the recorders you will need for your system.

## Using VideoXpert Storage (VxStorage) for Recording

VxStorage is a RAID 6, dual power supply, high-availability recording software platform that captures recorded video for your VideoXpert system. The VxStorage E-Series, VxStorage T-Series, and VXS5300 have the following features:

- Through the user of camera drivers, the VxStorage can support most camera models from most camera vendors.
- VxStorage supports hot-standby failover configurations so that it can be configured for high-availability.
- VxStorage has a flexible scheduling engine which allows you to extend the retention of data on the system without sacrificing video quality.
- On the VxStorage E-Series and VxStorage T-Series, the operating system is contained on an dual SSD RAID 1 array; hard drives belonging to the RAID array are hot-swappable.
- The VxStorage E-Series, VxStorage T-Series, and VXS5300 servers come with redundant power supplies.
- Server management uses the embedded iDRAC port which provides out-of-band diagnostics and remote access to the server OS in the event of a failure.
- VxStorage natively supports IP cameras via ONVIF S, G, Q, and T, and via native driver packages.

You can configure storage through VxToolbox, making it easy to set recording schedules and assign cameras to your storage servers. Storage supports motion, alarm, and bump-on-alarm style recording, so you can always capture events relevant to your environment at high quality. You can set different retention times per camera or camera group. Storage also supports redundant recording by assigning cameras to multiple recorders, ensuring that VideoXpert continues recording video even if a single storage server falls offline.

## Using VSM, NSM5200, and NSM5300 Servers as VideoXpert Recorders

VideoXpert supports VSM, NSM5200, and NSM5300 servers as VideoXpert Recorders. NSM5200 and NSM5300 servers provide migration paths to VideoXpert; both can operate as recorders within VideoXpert while continuing to support their respective Endura environments.

The VSM, NSM5200, and NSM5300 recorders can be configured as a pool, where one unit acts as the pool manager and the other units will take the camera assignments from the pool manager. This also allows for automatic camera redistribution across the remaining pool members, in the event that one of the pool members fails. The manager role is handled as an election process within the pool and will be reassigned to another pool member if the pool manager fails.

## Planning for Recording

Recorder types and the settings for recordings can vary widely as VideoXpert systems expand and change. Devices assigned to recorders will record based on the schedule and recording triggers you configure through VxToolbox.

Factors to consider when planning for recording include:

- The number and type of data sources (video, audio, PTZ vs. fixed, etc.) that will be added to a recorder
- The recording behaviors (triggers)
- The data source recording schedules
- The global maximum retention period of recordings (The retention period for individual devices must be shorter than the global retention period.)
- The transmission method (multicast or unicast)
- The stream(s) to record (primary, secondary, and/or tertiary)
- Whether the system uses motion recording
- Whether the system uses bump-on-alarm recording
- Whether and how many data sources are using auto-backfill of recording gaps
- The maximum bitrate of recordings
- How many bookmarks are expected to be stored, the standard retention limit of unlocked bookmarks, and the expected retention of locked bookmarks



**Action:** Ensure that you have enough recorders (standard and failover), recording space (per recorder and system-wide), and appropriate network capacity to support the likely storage requirements and network traffic.

## Correlating Recording Storage Platforms and Their Requirements

VideoXpert supports the recording platforms identified in [Table 1: Recording platforms](#).

*Table 1: Recording platforms*

Parameter	VxStorage T-Series	VxStorage E-Series	VXS5300	VSM	NSM5300 (2.4.3 or later)
Maximum capacity	144 TB	288 TB	48 TB	48 TB	48 TB
RAID level	RAID 6	RAID 6	RAID 6	RAID 6	RAID 6
Configure using	VxPortal	VxPortal	VxPortal	VxPortal / Pelco Utilities	VxPortal / Pelco Utilities
Bandwidth	1 Gb: 700 Mbps in; 175 Mbps out 10 Gb: 1000 Mbps; 175 Mbps out	1 Gb: 700 Mbps in; 175 Mbps out 10 Gb: 2500 Mbps; 175 Mbps out	450 Mbps in; 175 Mbps out	250 Mbps in; 32 streams out (per pool)	250 Mbps in; 32 streams out (per pool)





**Note:** Optera cameras or cameras supporting high framerates and resolutions require an increased amount of storage. This is mostly due to increased bitrates; in some cases, increased processing load might also become a factor.

## Understanding Camera Support

Different VideoXpert systems support different cameras, as shown in [Cameras supported per VideoXpert System](#).

Table 2: *Cameras supported per VideoXpert System*

Camera	VideoXpert Storage	VSM/NSM
Optera	Yes	Yes <sup>1</sup>
EVO, GFC-Multi, Esprit Ti, Sarix Value	Yes	No
Other Pelco	Yes	Yes
ONVIF-compliant	Profile S	No
Native API support	Axis, Hikvision, Panasonic, Vivotek, etc.	No

<sup>1</sup>Optera is supported on the VSM/NSM however the camera is limited to Tile mode. The Panomersive modes are not available.

## Planning for Camera SD Card Data Retrieval

Some cameras have SD card data retrieval capabilities to populate the recorded video. Using this capability can cause extra network traffic due to the SD card polling and the recorder replenishment from the SD card to the recorder(s).



**Action:** Consider this capability when devising the recording schedule(s), and accommodate for the potential extra network bandwidth needed.

## Planning for Auto-Backfill

For cameras that have local recordings, you can enable *Auto-backfill recording gaps using on-camera storage*. When selected, if there is a gap in recording of a camera (an edge device), the recorder will query the camera for recordings, and automatically download video and audio (if present) to fill the gap.

You can also adjust the following settings:

- The number of cameras from which data is downloaded at one time  
Downloading from more cameras uses more bandwidth, which will slow the data transmission rate.
- A time-interval to apply if edge devices (cameras) and the recorder lose communication  
The VX System will attempt to connect to the edge device again at the time-interval specified in this field.
- The number of attempts to reconnect if edge devices and the recorder lost communication.
- If available, the maximum bitrate at which to download data.





**Action:** Determine the number of cameras that will use Auto-Backfill, the time-intervals to apply when reconnection is necessary, the number of attempts to reconnect, and the maximum bitrate for each download. Use this information to ensure you have enough network bandwidth to accommodate the reconnection attempts and downloads.

## Planning for Recording Schedule Capabilities

The primary recording schemes used by VideoXpert are:

- Continuous recording can be performed at full or reduced frame rates.
- Event-triggered recording (including alarm, analytics, and motion detection events) is performed at full frame rate.
- Bump-on-alarm is a type of continuous recording during which the system records reduced frame rate (I-Frame only) video during normal situations, and records full frame rate video during an alarm or event.
- In VxToolbox, administrators reduce the frame rate of previously recorded video after a specified number of days, resulting in increased retention time and storage cost savings. To use this feature, see instructions in the current version of the *VxToolbox Operations Manual*.



**Action:** Full frame-rate recordings will consume more storage than reduced frame rate recordings. Ensure that your system has enough storage to accommodate the expected recording types.

## Using Volumes and Volume Groups

You can organize your device video storage by creating and managing Volumes and Volume Groups.

- A volume is a logical directory in which you want to store video.
- A volume group is a group of volumes to which cameras are assigned and distributed. You can use volume groups to:
  - Separate types of storage (like internal vs. external).
  - Set different retention parameters for different sets of drives.
  - Write video to more than one volume. When all volumes are full, the system will overwrite volume containing the oldest stored video.
- The system ships with a volume group called *Default Volume Group*. You can rename or delete this volume group.
- An archive volume group is a volume group to which the recorder will move the oldest video from the other volume groups, instead of deleting the oldest video. See [Using External NAS Storage \(Archive Volume Groups\)](#) for more information about the archive volume group.





**Action:** To use volumes and volume groups, determine which cameras will be assigned to each, on which recorder the volumes and volume groups will reside, and where the archive volume group will reside. Ensure there is adequate storage and network bandwidth to support their use.

## Using External NAS Storage (Archive Volume Groups)

By connecting an external volume (network storage/NAS) to your system, you can extend your retention time for VideoXpert Storage recorders. When your VideoXpert Storage recorder achieves its maximum capacity and would normally begin to delete the oldest video, it will send video over to the NAS instead. Video will still adhere to retention parameters, even when moved over to external storage. The experience in accessing video is the same, whether a recording is served from a the VxStorage recorder or an external server.

To use external storage, the external storage server reside on the VideoXpert network, and should not have login credentials. If the server requires login credentials, VxStorage will not be able to transfer video to the external server.

 **Action:** As video transfers from a VxStorage recorder to an external storage server, bandwidth of your incoming cameras is equal to the bandwidth out to external storage. When using external storage, plan storage distribution to ensure bandwidth availability for incoming cameras, storage overflow, and user impact in viewing recorded video.

 **Action:** While each VxStorage recorder can only have a single archive group, multiple VxStorage recorders can use the same NAS server. In this case each VxStorage recorder must point to a different path/folder on the NAS server; pointing multiple VxStorage recorders to the same archive group network path will cause video to expire earlier than expected and without warning.

### Using VSM and NSM5300 Models as VideoXpert Recorders

Through VxToolbox, you can set camera associations and recording schedules; however, you must configure other aspects of your recording devices through other interfaces. Configure storage pools through the VSM/NSM5300 Web interface. Configure recording schedules through Pelco Utilities.

### Planning for Redundant Recording

Redundant recording can be configured to perform in the following ways:

- Two recorders recording the primary stream
- Two recorders recording the same camera with one recording the primary stream and the other recording an alternate, lower-quality stream

Recordings do not have to be the same size/retention unless those are part of the end-user's standards.

Plan for the following network considerations when configuring redundant recording:

- Multicast recording of the streams will allow for only a single stream coming out of the camera, no matter how many recorders are recording the stream.
- Unicast recording of the cameras will have implications in that most cameras can only push out 2-4 copies of the stream; if two streams are in use by recorders, then there might not be another stream available for live viewing.
- Double the number of network ports you would otherwise need for recorder connection.
- In Unicast-recorded networks, the bandwidth handled by the uplinks between the switches and the switch backplanes will be doubled; this could result in resource over-allocation or recording/viewing failures.
- Unicast recording could result in the need to create LACP teamed network trunk uplinks, or necessitate replacement of the switches/switchports with 10Gig inter-switch network ports.

When planning HVAC and UPS for redundant recording:

- Double the number of power plugs you would otherwise need.
- Plan for additional BTU mitigation.
- Double the number of network ports you would otherwise need for recorders.
- Include enough UPS battery capacity to maintain the desired power-outage run time for the system including the additional recorder(s) power load.

## Configuring VideoXpert Storage Failover Recording

By putting VxStorage units in failover mode, you can assign VxStorage models to act as hot-standbys for live recorders and ensure uninterrupted recording when active recorders fail. Pelco recommends that you use this feature to implement a failover strategy that ensures full time recording and video availability in your environment in the event of possible network, power, or hardware failures.

A single designated failover recorder can monitor up to eight active recorders. When a recorder is in failover mode, if there is a failure in any of the recorders that the failover unit is assigned to monitor, the failover unit will take over and continue recording the camera groups and schedules previously belonging to the failed recorder.

Failover recording does not ensure access to historical data from failed recorders; it only ensures continued recording. If you want to maintain uninterrupted access to recorded video, even when a recorder fails, then record cameras redundantly across multiple recorders.

One or more failover recorders can be added to a Failover Group to monitor one or more other recorders. If a unit fails, one of the recorders in the failover group will take over recording of the cameras and schedules belonging to the failed unit(s). The failover recorder(s) will record cameras from multiple failed recorders simultaneously, up to the maximum capability of the failover recorder(s).

The failover recorder(s) do not need to be of the same capacity as the production units, but they must be sized to accommodate the video retention that would be needed until the production recorder can be brought back online.



**Action:** Ensure that you have enough standby VxStorage units to support your failover requirements.

## Planning a Backup Strategy for Recorder Database Entries

A system backup contains the system database. Backups do not capture exported video or any settings that you changed outside of VxToolbox (for example: changes made directly to configuration scripts). The speed of each backup depends on the size of the VideoXpert database, network bandwidth, and other variables.

VideoXpert Storage takes database recovery points daily, and stores these points for ten days. You can also initiate a manual backup.

## Understanding VideoXpert Storage Failover and Redundant Recording

Recorders are not part of the standard Core/CMG cluster. However, typical deployments should arrange for some measure of redundancy to ensure that required streams and video never go unrecorded. VideoXpert Storage (VxStorage) supports two methods for redundancy:

- Redundant recording—assigning the same camera to multiple recorders, or setting the camera primary stream to record on one recorder and the secondary or tertiary stream on another recorder
- Failover monitoring—assigning a recorder to act as a hot-standby for one or more recorders

Redundant recording is a quick way to ensure video uptime and redundancy, but requires an equal amount of storage across each recorder set to record a stream.

Putting recorders in Failover mode allows you to assign them to monitor and act as a hot-standbys for active recorders; if any of the active recorders fail, the failovers will record the camera groups and schedules in place of the failed recorders ensuring nearly uninterrupted recording.



**Note:** During a failover, you might experience a recording gap of up to 30 seconds.

## Selecting Independent Backup Storage

For any system with more than one VideoXpert Core, you must backup to a network location. The network location must be accessible via a UNC path (for example: \\backupserver\backups). Local and mapped network drives (S:\backups) are not supported for the backup process. Pelco recommends that you store backups to a server independent of other VideoXpert hardware, preferably containing its own RAID array, ensuring that your backups are safe from catastrophic failures.



**Action:** If your VideoXpert system has more than one Core, select one or more independent servers for backup storage. Plan to accommodate network traffic for these servers.

## Evaluating Additional System Components

Depending on the shape and scale of your system, you might need one or more of the following components.

### Selecting a Load Balancer

For load balancing, you can use VideoXpert Internal Load Balancing or an external load balancer.

#### Using VideoXpert Internal Load Balancing

If VideoXpert internal load balancing is used, then the CMGs must be on the same VLAN. This is because the high availability VIP is owned by the CMGs .

#### Using an External Load Balancer

For systems with more than three CMGs or multiple independent Core and Media Gateway servers, you might need an external load balancer. The load balancer provides the virtual IP address used to target clustered servers.

Your load balancer must meet the following requirements.

- High-level requirements:
  - HTTP
  - HTTPS
  - websocket support
  - RTSP support; alternatively, support for raw TCP/IP connections
  - Support for multiple sets of backend servers; necessary if using separate Core and Media Gateway servers
  - Support for application-level HTTP healthchecks
  - Support for application-level RTSP or TCP/IP health-checks
- High availability requirement—Must be able to configure load balancer appliances such that if an appliance becomes unavailable (for example: through power loss), the other appliance(s) can assume functionality of the unavailable appliance.
- Recommended Features:
  - Allow administrators to gracefully disable servers during upgrades
  - SSL offloading



**Action:** Select a load balancer that is appropriate for the size of your system. Contact Pelco Professional Services for assistance.

### Using a Network Time Protocol (NTP) Server

All servers in your VideoXpert system must reference a time server to ensure that all devices belonging to the system use the same time. Time disparities may result in errors when recording and recalling video.

- Pelco recommends that you use an official NTP server or purchase and use a network clock to keep your system synchronized.

- You can choose to use the VideoXpert Core cluster on your VideoXpert system as the NTP server, but doing so will allow the time of your system to drift significantly from the actual time if there is no time source.



**Action:** Pelco strongly recommends that you have a dedicated NTP server for VideoXpert. Other options include: network routers configured as NTP servers, an application like Nettime for internet connected systems, and a GPS or cellular network time server device.

### Selecting a DHCP Server

Pelco recommends that you use a DHCP server to assign and manage addresses for the devices within your VideoXpert network, using one of the following:

- Microsoft Windows with DHCP Server
- DHCP services on a network switch
- A separate, dedicated DHCP server (for advanced installations with multiple ranges and a need to edit address reservations.)



**Action:** Select an appropriate DHCP server to accommodate the number of ranges on the VideoXpert System and whether you will edit address reservations.

### Supporting DNS

On systems that are connected to networks with DNS servers, the devices can resolve the hostnames of the source devices, rather than just relying on the IP addresses. This is key for multiple NTP server connectivity. Using DNS also provides the administrator the ability to:

- Leverage the DNS system to create DHCP IP address reservations.
- Resolve the name of the device using the IP addresses.

### Designing Export Archive Storage

You can store exports in a network location on or off of the VideoXpert Core server. Storing exports off of the Core ensures greater availability to exported video, especially in clustered environments. When storing exports on the Cores in a clustered environment, exports are not shared among Cores; each export is only stored on the Core server on which it was created. If the server storing an export fails, users lose access to the exported video; if the server fails and you have to restore from a backup, you will lose your exports on that Core server. Storing exports in a separate location ensures availability independent of any individual Core server, and allows you to easily backup video exports at whatever interval is most convenient for you.

You can either save exports to the default location or to another location. Any other location must be defined in URI format; it cannot use the local drive letter format. If export encryption is enabled, a password is required for saving to the default location.



**Action:** Design an appropriate storage strategy that will ensure the availability of exports. Plan for the amount of storage and the network traffic necessary to support the strategy.

## Understanding Network Operation Modes

### Using Rendezvous Points (RP)

PIM-SM builds a shared multicast distribution tree within each domain, and the RP router is at the root of this shared tree. Although you can physically locate the RP anywhere on the network, it must be as close to the source as possible. Only one active RP router exists for a multicast group.

At the RP router, receivers meet new sources. Sources use the RP to identify themselves to other routers on the network; receivers use the RP to learn about new sources.

The RP performs the following tasks:

- Registers a source that wants to announce itself and send data to group members
- Joins a receiver that wants to receive data for the group
- Forwards data to group

Sample RP router configuration is as follows:

```
ip multicast-routing
ip pim send-rp-announce loopback0 scope 16
ip pim send-rp-discovery scope 16
interface loopback0
ip address <address> <mask>
ip pim sparse-dense-mode
interface ethernet0
ip address <address> <mask>
ip pim sparse-dense-mode
interface serial0
ip address <address> <mask>
ip pim sparse-dense-mode
```

### Using PIM Modes for Multicast Routing

Protocol Independent Multicast (PIM) routing operates in either Sparse Mode (SM), Dense Mode (DM), or Sparse Dense Mode (SDM).



**Action:** Before selecting a PIM operating mode, consider the impact that protocol selection will have on the network.

The following sections provide an overview of PIM modes and use considerations.

#### Using PIM Dense Mode (PIM-DM)

PIM-DM is easier to install than PIM-SM. The network engineer will enable PIM-DM on each network router that is required to route multicast traffic. PIM-DM operates in what is referred to as a push model. Traffic is initially flooded to all neighbors that have formed a PIM neighbor relationship. Downstream routers will then determine if the traffic is necessary and either forward the traffic appropriately or send a prune message to an upstream router to suppress the flow of multicast traffic. Keep in mind that although the traffic has been suppressed, the (S,G) state is still maintained in the multicast routing table. One of the major drawbacks to PIM-DM is that multicast routing switches that are not actively transmitting a



multicast flow might still be required to maintain that state. Maintaining this state can lead to the consumption of additional resources on the switch even though no active client on that router has requested the multicast traffic. During the flood and prune cycle (S,G), states are flooded to every multicast router on the network and every multicast router will maintain the (S,G) state as long as the multicast source is actively transmitting. The resulting traffic flow for multicast will follow the shortest path tree (SPT) from source to receiver.

- **Determine if the Layer 3 routing devices support state refresh.** Because PIM-DM will flood traffic throughout the network to build (S,G) states in each downstream multicast router, careful consideration must be given to the support of state refresh. Multicast routing devices that support state refresh will prevent periodic flooding. PIM-DM operates in a flood and prune cycle. The multicast routing tree is flooded every three minutes and relies on pruning mechanisms to determine whether or not downstream routers require the multicast traffic. Periodic flooding of the network can be a major concern for networks for which bandwidth is limited. Layer 3 devices that support state refresh prevent the countdown timer on the (S,G) entry from expiring. If the countdown timer never expires, the multicast source will no longer flood the network periodically after the initial flood cycle.
- **Determine the multicast table routing table entry limitations of each switch on the network.** There is a finite limit for each switch concerning the number of multicast routing table entries the switch can handle. If the available multicast routing table entries are exhausted, further entries might fail to be allocated to the table resulting in a multicast group that can no longer be routed. As a network engineer, you must ensure that the switch that is being used is not exceeding its capacity for the multicast routing tables. It is the responsibility of integrators or network engineers to contact the switch manufacturer to assess the capabilities of the switch and any limitations with respect to multicast routing table entries.
- **Select recommended network switches or test non-recommended switches.** In addition to the multicast routing table, a selected switch must be able to handle an adequate number of IGMP entries. Switch manufacturers specify the number of IGMP entries a switch can handle. When switches exceed these limits, they typically will either flood or block multicast traffic. Pelco maintains a list of recommended switches that have been tested for their maximum recommended IGMP entries. If an integrator or network engineer selects a switch that is not from the recommended switch list, it is the responsibility of the integrator or network engineer to contact the vendor to determine the IGMP limitations of the switch selected.
- **Verify network limitations associated with wireless connections.** Due to the limited bandwidth associated with wireless connections, PIM-DM might not be an appropriate selection. The flood and prune cycle might result in a wireless network link that becomes saturated.

### Using PIM Sparse Mode (PIM-SM)

While PIM Sparse Mode requires careful consideration during the design process, there are major benefits associated with using PIM-SM as opposed to PIM-DM. Unlike PIM-DM, PIM-SM has a dedicated RP to send messages to build both the shared (\*,G) and source (S,G) sides of the tree. The end result is that PIM-SM will not perform flood and prune cycles to build trees for forwarding multicast traffic. When the multicast traffic is not flooded to all PIM-enabled devices, devices not in the path of transmission will not maintain entries in the multicast routing table. This will result in lower utilization of switch resources that are not in the SPT.

Due to the operation of PIM-SM, placement of the RP can be a critical decision in network design. If a centralized RP is selected for all traffic in the network, that switch must be able to handle the appropriate number of multicast routing table entries for all traffic traversing the network. As an alternative, you can use multiple RPs that serve as candidates for multicast routing. Filtering can be implemented to distribute the multicast routing load across multiple RPs. This type of application allows you to distribute the



multicast routing load across multiple PIM-SM routers and, if designed properly, isolates multicast traffic to intended segments of a network. For example, if a multicast recording network storage pool is implemented and the RP also serves as the local designated router, multicast recorded traffic would use its local designated router as the RP and isolate the majority of the multicast flows to the local router. Since the SPT is local to the switch, multicast recording traffic would be contained within a segment of the network.

In an implementation using PIM-SM, only the initial video packets are sent to the RP. If a single RP is used in a network, after the encapsulated video in the register message is sent, all remaining video packets use the SPT from source to destination.

An SPT threshold can be configured to force a multicast flow to bypass the SPT. Care should be taken if SPT thresholds are to be modified.

If a single RP is used in PIM-SM, it is critical that the multicast routing switch have enough resources to handle all (\*,G) and (S,G) entries that will be created in the multicast routing table. Even though the traffic is traversing the SPT, resources must be allocated to handle all existing multicast routing table entries, and any processing of joins and prunes throughout the network. Packet replication, RPF recalculation, state maintenance, and register processing all create memory and CPU loads on the RP. Depending on the size of the network and scalability requirements, different Layer 3 devices might be selected as RP based on their resources.

The default response of PIM on some switches is to fall back to PIM-DM in the event that a RP cannot be found. Based upon the network topology this might or might not be a desired effect. Always take into account the effect that reverting to PIM-DM might have on the network. This response is present on Cisco systems.

### Using Sparse-Dense Mode (PIM-SDM)

Some implementations of PIM simultaneously support Dense Mode for some multipoint groups and Sparse Mode for others. This provides the regularity of flood/prune broadcasts in Dense mode and the bandwidth savings of Sparse mode.

### Using DVMRP for Multicast Routing

DVMRP is a routing protocol supporting multicast transmission. Stemming from Routing Information Protocol (RIP) and used in the Internet multicast backbone (Mbone), DVMRP allows for tunneling multicast messages within unicast packets. It also supports rate limiting and distribution control based on destination address, and it is responsible for the following tasks:

- Routes multicast datagrams
- Periodically floods multicast traffic (similar to PIM-DM)
- Allows use of non-multicast aware edge devices

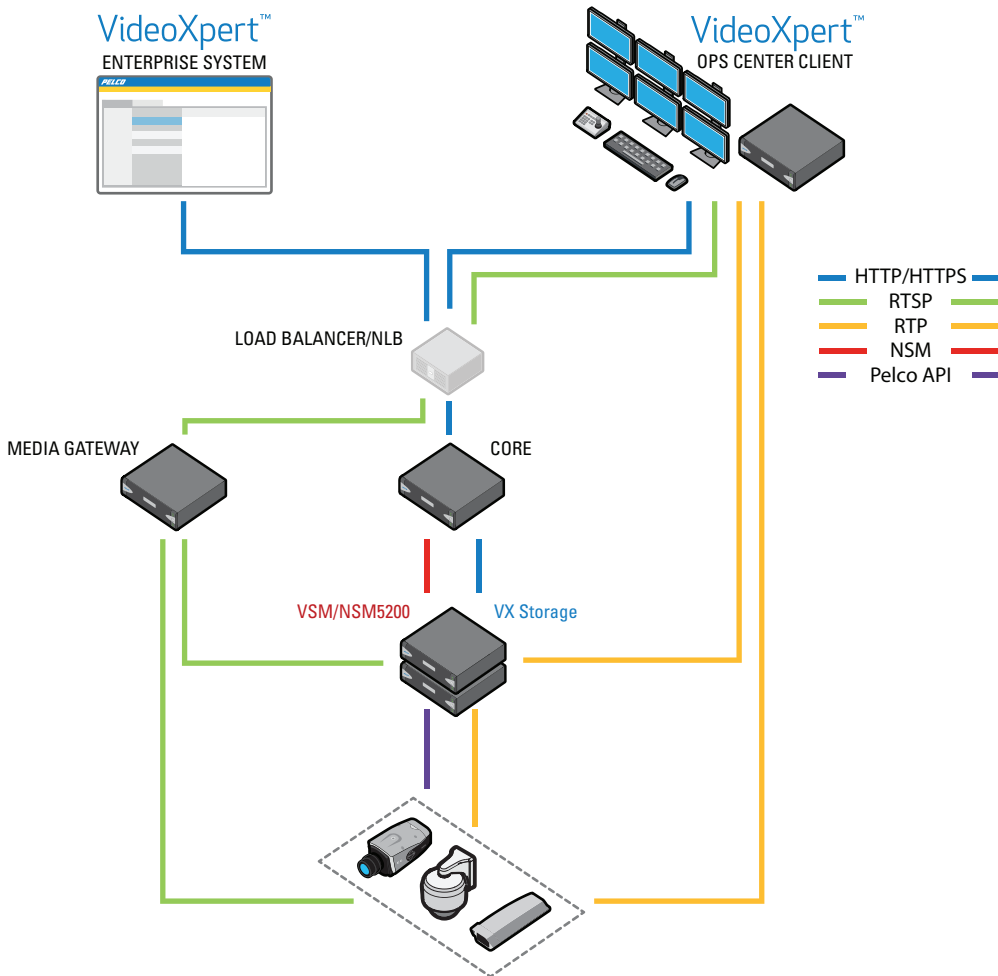


**Note:** When choosing PIM-DM or DVMRP as a multicast routing protocol on systems that include wireless devices or that require remote access to the system, understand that these protocols have bandwidth limitations that are negatively affected by periodic flooding of data streams.

## Planning Network Traffic Flow

Command and control traffic (user actions within the system), occur over HTTP or HTTPS depending on your system. You can configure workstations to operate over HTTP or HTTPS, and you can select the port for communications with VideoXpert Servers. (For information on ports, see the section titled [Appendix B: Network Protocols and Ports Reference](#).)

Video is delivered to clients either via RTSP or RTP, depending on the Media Gateway Communication method for which your system is configured. When configured for unicast delivery to clients, the Media Gateway re-streams video to the client. When configured for multicast delivery to clients, video streams directly from the camera, encoder, or RTSP source from which the stream is requested.



## Addressing Traffic and System Limitations

VideoXpert systems are tested to determine how many users and cameras a system supports before performance degrades significantly. The systems tested represented environments with strong network connections using VSM models for storage. For purposes of performance tests, “users” are simultaneous operators performing continuous, expected duties, including streaming video, receiving events, controlling (PTZ) cameras, and exporting video.

Refer to the current version of the *VideoXpert Enterprise Product Specification* for details.

For help determining the best system size and configuration to meet your needs, contact a Pelco Sales Representative.

### Addressing Client-Side Display Limitations

As a VxOpsCenter workstation uses an increasing amount of memory, users might experience “jittery” mouse controls on decoder-driven monitors. This problem is most likely to occur if users are running applications in tandem with the VxOpsCenter client, or is viewing a large number of Optera or HD streams on locally-connected monitors.

### Understanding Secondary and Tertiary Stream and Camera Settings

VxOpsCenter uses step-down behaviors when under heavy load. Optimal camera configuration ensures that you always view the highest possible quality video and prevents the system from entering I-Frame-only or disconnection step-down scenarios.

- Set secondary streams to 640 x 352 (or the corresponding 4:3 equivalent, depending on available aspect ratios) at 5 images per second or lower to ensure secondary stream performance in a 4x4 layout.
- For Optera cameras, set the I-Frame interval to 6 and use Smart Compression on the camera to reduce the bandwidth being used. Optera cameras consume more system resources than other cameras.
- Set tertiary streams to the lowest resolution and frame rate that is acceptable to ensure tertiary stream performance in high-density layouts and for use with low-bandwidth connections.

See the section titled [Determining Streaming Delivery](#).

### Understanding VxOpsCenter 6 x 6 and 8 x 8 Layout Requirements


Support for 6 x 6 (36 streams) and 8 x 8 (64 streams) layouts consumes a substantial amount of resources on VxOpsCenter clients and enhanced decoders. To ensure that you do not overtax your client system and enhanced decoders, Pelco recommends that you provide a secondary stream with a maximum resolution of 640 x 480 and maximum framerate of 30 fps on the following Pelco-supplied hardware:

- For local viewing, a VxOpsCenter Desktop Workstation or a PC with comparable specifications is required. See the current version of the *VideoXpert Desktop Workstation Product Specification*.
- For viewing from a connected decoder, a VideoXpert Enhanced Decoder is required. See the current version of the *VideoXpert Shared Display Product Specification*.
- For viewing from a Shared Display (SDD), a VideoXpert Shared Display is required. See the current version of the *VideoXpert Shared Display Product Specification*.

Streaming behavior can be unstable if the recommended stream configurations are not provided for each viewable stream in a 6 x 6 or 8 x 8 layout. Typically, VxOpsCenter client will become very slow, possibly unresponsive; in worst cases, the client might terminate due to lack of available resources.

Additional support information is as follows:

- In setups with multiple monitors connected to the VxOpsCenter client PC, the maximum supported number of concurrent streams is 64. This is only true if the secondary streams are configured with the recommended maximum stream configuration of 640 x 480 at 30 fps.
- No more than 128 streams are allowed on a single decoder instance. A decoder instance is an enhanced decoder, shared display, or a local decoder on the VxOpsCenter client PC.

 **Caution:** Although the hard limit for the number of streams per decoder instance is 128, Pelco recommends that you do not exceed 64 streams. Doing so might have undesirable behavior. The 128-stream limit is used as a buffer to allow functionality, such as stream sequencing, to behave properly when streams are created and destroyed.


- When dragging streams into cells, no more than 64 streams can be dragged at the same time.
- VideoXpert Professional deployments on which VxOpsCenter clients are run from the same box as the VxPro Server are not supported with 6 x 6 and 8 x 8 layouts; decoding and viewing 36-64 streams is resource-intensive and competes with VxPro Server for resources.
- Due to the high resource demands of Optera and Evo cameras, Pelco recommends that you do not stream Optera and Evo cameras above 5 x 5 layouts; the behavior is undefined if these cameras are streamed in 6 x 6 or 8 x 8 layouts.

### Determining Streaming Delivery

When the system is in Multicast mode, the stream comes directly from the camera. When the system is in Unicast mode, stream delivery is largely the responsibility of the Media Gateway, and is dependent on the communication method you select, your connection to the system, and the connection of aggregated devices to the system. In general, you can receive streams identified in the table below.

Stream quality	Factors
Primary	Bandwidth > 100 Mbps; Cell size ≥ 25% of layout
Secondary	Cell size < 25% of layout; quality step-down when VxOpsCenter is under heavy load
Tertiary	Quality step down (from secondary stream) when VxOpsCenter is under heavy load
I-Frame Only	Quality step down (from tertiary stream) when VxOpsCenter is under heavy load
MJPEG/H.264/H.265	<p>VxOpsCenter:</p> <ul style="list-style-type: none"> <li>- Client bandwidth &gt; 5 mbs will support the full range of options, lower connections will be forced to MJPEG.</li> <li>- Aggregation connections with bandwidth ≥ 10 mbs will support the full range of options, lower connections will be forced to MJPEG.</li> <li>- PTZ Camera, when in MJPEG mode, will only support click-to-center. A warning is given.</li> </ul> <p>VxPortal: Same as VxOpsCenter, but without any warnings provided regarding MJPEG limitation.</p>

See [Appendix A: Video Streaming Diagrams](#) for examples of streaming configurations and parameters.

 **Action:** Because the system delivers secondary streams as a step-down adjustment, configure secondary streams with reduced resolution and frame rate compared to the primary. Similarly, because the system delivers tertiary streams as a step-down adjustment, configure tertiary streams with reduced resolution and frame rate compared to the secondary.

### Making VxOpsCenter Streams Adjustments

By default, VxOpsCenter displays streams based on the size of the cells in a tab. Typically, cells that represent 25% of a layout or more display full resolution, primary streams; cells smaller than 25% of a layout deliver secondary streams. The 2x3 layout is also designed to show primary, full resolution streams in all cells.

When the CPU load on the decoding device (Workstation, Shared Display Decoder, or Enhanced Decoder) that displays the streams crosses the 75% threshold, VxOpsCenter will request lower-quality streams in an attempt to reduce CPU load below 50% utilization. Stream quality is reduced from primary to secondary, and secondary to I-Frame-only mode until the CPU load drops below 50%. If the reduction in stream quality does not reduce the CPU load below the 50% threshold, VxOpsCenter will begin disconnecting streams, citing limited CPU resources.

### Planning for MJPEG Video Streaming

The system streams MJPEG video as described in [Determining Streaming Delivery](#). MJPEG Video includes the following limitations:

- PTZ controls for MJPEG streams are limited to click-to-center controls.
- MJPEG streams might not synchronize perfectly when in sync playback mode. This is due to the nature of the MJPEG pull mechanism. You can still use the sync playback controls to manipulate video, but synchronization might be noticeably affected.
- When Media Gateway CPU utilization reaches its threshold, it will reject requests to transcode new MJPEG streams.



**Action:** If cameras will be expected to return MJPEG video at greater than two I-Frames per second, ensure that there is enough bandwidth on the system and that the Media Gateway(s) can accommodate the MJPEG streams.

### Planning for 4K Support for Videos, Cameras, and Monitors

The VideoXpert system supports 4K monitors, 4K live and playback modes for cameras that support streaming through ONVIF, and the ability to export recorded 4K segments.

Enhanced Decoders do not support 4K video output to monitors. You can connect 4K monitors to Enhanced Decoders, but the monitors will step down to show 1080p only.



**Action:** To support 4K video, cameras, and monitors, ensure that the VideoXpert system has enough storage and network bandwidth to support the greater amount of data that will be stored and streamed.

### Planning for H.264 and H.265 Streaming

The system streams H.264 and H.265 video for users with connections greater than 10 Mbps, or cameras belonging to aggregated sites with connection speeds greater than 5 Mbps.



**Note:** VxPortal cannot consume H.265 streams directly, so uses MJPEG.

Cameras configured to use H.264 and H.265 streaming will consume more network and WAN bandwidth than MJPEG and other streaming methods.



**Action:** Determine how many devices will be using H.264 or H.265 streaming and ensure adequate network and WAN bandwidth.

## Planning to Use Additional Features

### Planning for SNMP Monitoring

If you use an SNMP manager to monitor the VideoXpert environment (native hardware or your own hardware), you must monitor the same events as the VideoXpert Front Panel Service. VideoXpert Front Panel Service is a software utility that runs on Pelco hardware (native) that monitors the VideoXpert services.

Pelco has other management information bases (MIBs) that can be used in SNMP monitoring on the VideoXpert system.

At a minimum, monitor and send traps for the following software services:

- VideoXpert Core
- VideoXpert Exports
- VideoXpert Media Gateway
- VideoXpert OpsCenter Communications
- VideoXpert Storage
- VideoXpert Storage Database

Pelco recommends that you monitor and send traps for the following hardware events:

- Running software (executable name, path, and status)
- Processor load
- Storage/memory statistics
- Hard disk failures
- Power failures
- System uptime



**Action:** Ensure that you have enough network bandwidth to support communication of SNMP traps you plan to send.

### Planning to Use Maps

Maps imports and uses AutoCAD 2013 DWG files, raster maps (jpeg or png), and ESRI Street) maps, allowing customers to use their pre-existing building maps with Maps in VideoXpert.



**Action:** If the system will use ESRI Street files, ensure that each station that uses them has internet access.

### Planning to Use Integrations and Plugins

VideoXpert supports integrations both through VxOpsCenter and directly to VideoXpert Core. Integrations through VxOpsCenter function as plugins—applications that a user can add to VxOpsCenter—either operating in conjunction with or overlaying video. Integrations through Core typically inject events into VideoXpert, extending the functionality of the system and issuing events to VxOpsCenter users when the third-party system records them. Through integration, you can add incident reporting, analytics, license plate recognition, and other features to VideoXpert. You can download VideoXpert integrations and plugins from <https://www.pelco.com/partners/technical-partners/>.

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Pelco offers integration tools and software development kits (SDKs) to help you extend the functionality of your VideoXpert system through the Pelco Developer Network at <https://www.pelco.com/training-support/developer-support/>. Pelco's Partner First site provides information about and access to a number of ready-made integrations and plug-ins for VideoXpert.



**Action:** Find out storage and network requirements from the manufacturer of each plugin that you will use. Ensure that the VideoXpert System has enough storage space and network bandwidth to support all aspects of each plugin.



**Action:** Obtain the appropriate license(s) from Pelco or the third-party for each plugin that you use.

## Planning for Event Reporting, Logs, and Notifications

You can pull reports (in CSV format) containing events and configuration information to audit your system and VideoXpert users. Reports requiring a start date and time include an event history; reports that do not require a start date and time provide current configuration information only. System Administrators can schedule automatic report generation in VxToolbox.

In addition, each VideoXpert product produces and stores its own logs, which roll over every 30 days. You can use the logs to troubleshoot issues, or to help Pelco troubleshoot issues you might encounter in the field.

In addition to the on-screen notifications, the VideoXpert system can be configured to send notifications using SMS messaging or via email. (SMS and email are not available on isolated network VideoXpert systems.) This will increase network traffic based on the number and frequency of notifications that are expected.

The following sections provide more information about events, reports, logs, and notifications.



**Action:** Ensure that you have enough storage and network bandwidth to support storing and retrieving/accessing the reports and logs, and enough bandwidth to manage the network traffic associated with notifications. For SMS notifications, ensure network connections outside the system through the Firewall. For email notification, ensure access to an internet-connected mail server.

## Understanding Event Types

Event types typically refer to who or what is the cause of an event, and do not necessarily determine the report in which an event will appear:

- Admin events typically occur at the administrative level.
- Analytic events are the result of software analytics.
- Client events are reported by the client.
- External events are injected into the system by a third party.
- Hardware events are the result of physical hardware issues and sensor readings.
- System events are the result of normal operator actions.
- Custom event types are configured through the Rules Engine in VxToolbox.

By default, events expire every 30 days. However, you can choose to keep events for up to 90 days, and you can set different expiration periods for both events local to the system and events from aggregated sites.

You can also set a maximum number of events; the default maximum is 10,000 events.

## Using Reports

You can create and generate reports, and export them from the system. Reports are exported in CSV format.

Report Types available in VxToolbox include:

- Camera Report
- Camera Role Access Report
- Device Report
- Event History



- Counting Lines Report
- Recording Gap Report
- Role Report
- Storage Report
- System Status Report
- User Report
- User Action Report

Create a new report template and edit the template details to include only the information needed. This will affect the storage space necessary to accommodate the reports.

### Locating Logs

Each VideoXpert product produces and stores logs to assist in troubleshooting. Logs are available in the following locations:

- Core—C:\ProgramData\Pelco\Core\logs
- Media Gateway—C:\ProgramData\Pelco\Gateway\logs
- VxStorage—C:\ProgramData\Pelco\Storage\logs
- VxOpsCenter—C:\ProgramData\Pelco\OpsCenter\Logs; logs are available within the application by navigating to **About VxOpsCenter** and clicking **Get Logs**.

Each of these location requires storage for the anticipated number and size of the logs.

### Planning for Notifications

System notifications are delivered via a pop-up window on your VxOpsCenter Client. The System Administrator can configure settings including: whether there is a pop-up banner associated with the notification, whether the notifications require acknowledgment, and whether it will play a sound. The configuration must define the individual groups that will be notified on each specific event type.

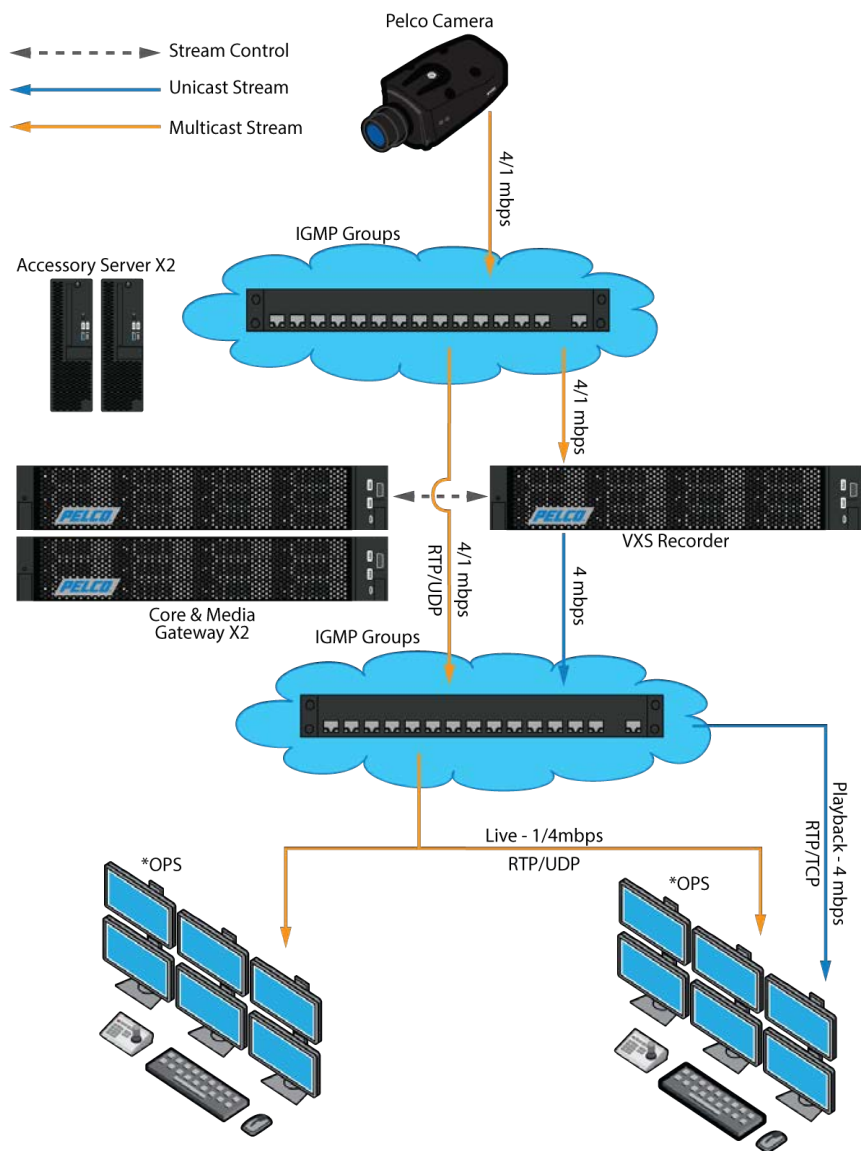
Notifications can also be sent using SMS messaging or via email.

- SMS messaging requires bandwidth and network traffic connectivity outside the system through firewalls. To send SMS notifications, you must create a Twilio account for the system and then the system Administrator must configure the notification in VxToolbox.
- E-mail notification can only be used if there is a connection to an e-mail server via SMTP which requires a connection to an internet-connected mail server. E-mail notifications are not available for isolated network VX systems.

Configure event details and notifications to ensure that the right users are notified when the system records a particular action or alarm. The way in which rules are configured determine how many notifications are likely to be sent and how often.

## Appendix A: Video Streaming Diagrams

### Multicast Recording, Multicast Viewing of a Pelco Camera

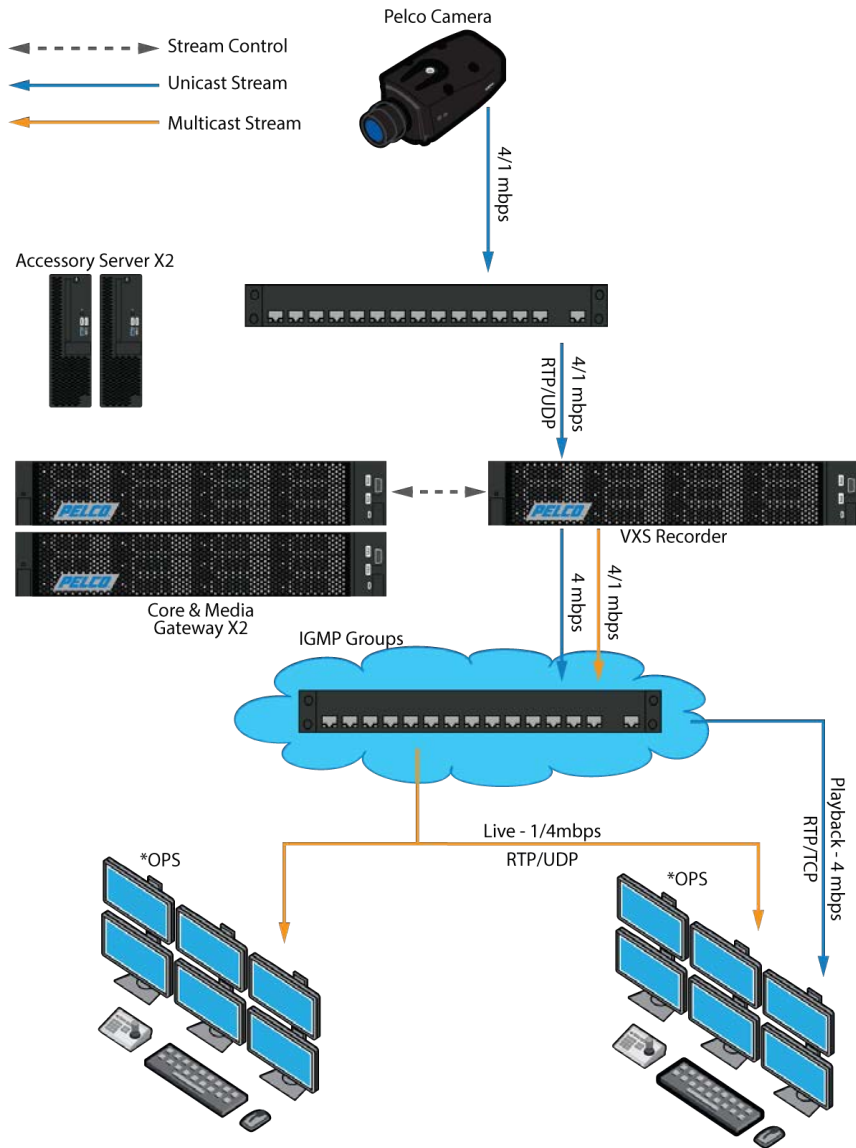


Live—Live video is authenticated by the CMG and streamed from the camera/network to the viewing client and the VXS.

Playback—Playback is always unicast from the VXS.

\*Bandwidth calculated is for one camera being viewed in a single screen on one monitor. VideoXpert intelligently selects camera streams based on multi-screen configuration and client utilization. OPS Viewing clients subscribe to camera source IGMP groups to view video in multicast.

### Unicast Recording, Multicast Viewing (With a VXS Proxy) of a Pelco Camera

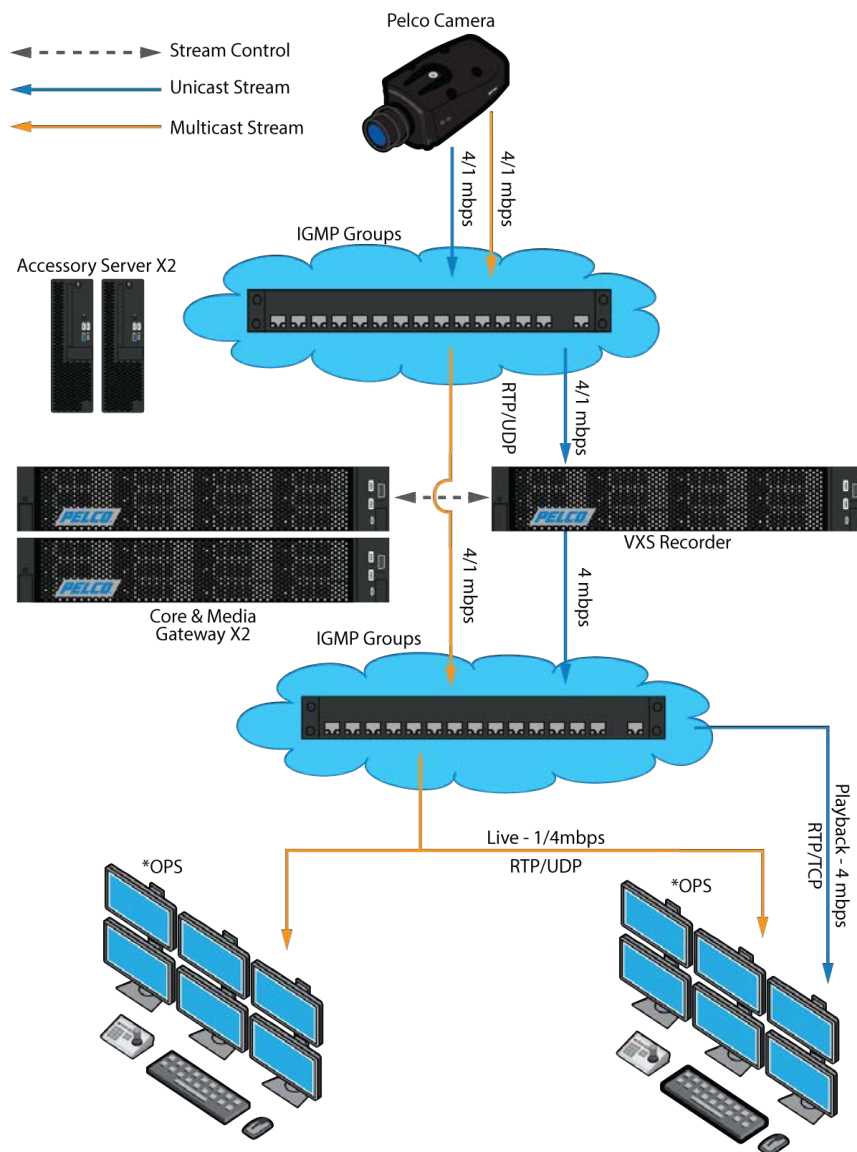


Live—Live video is authenticated by the CMG and streamed from the VXS to the viewing client. This is the default on VX v 2.5, but is configurable on VX v 3.0 and later.

Playback—Playback is always unicast from the VXS.

\*Bandwidth calculated is for one camera being viewed in a single screen on one monitor. VideoXpert intelligently selects camera streams based on multi-screen configuration and client utilization. OPS Viewing clients subscribe to camera source IGMP groups to view video in multicast.

## Unicast Recording, Multicast Viewing of a Pelco Camera

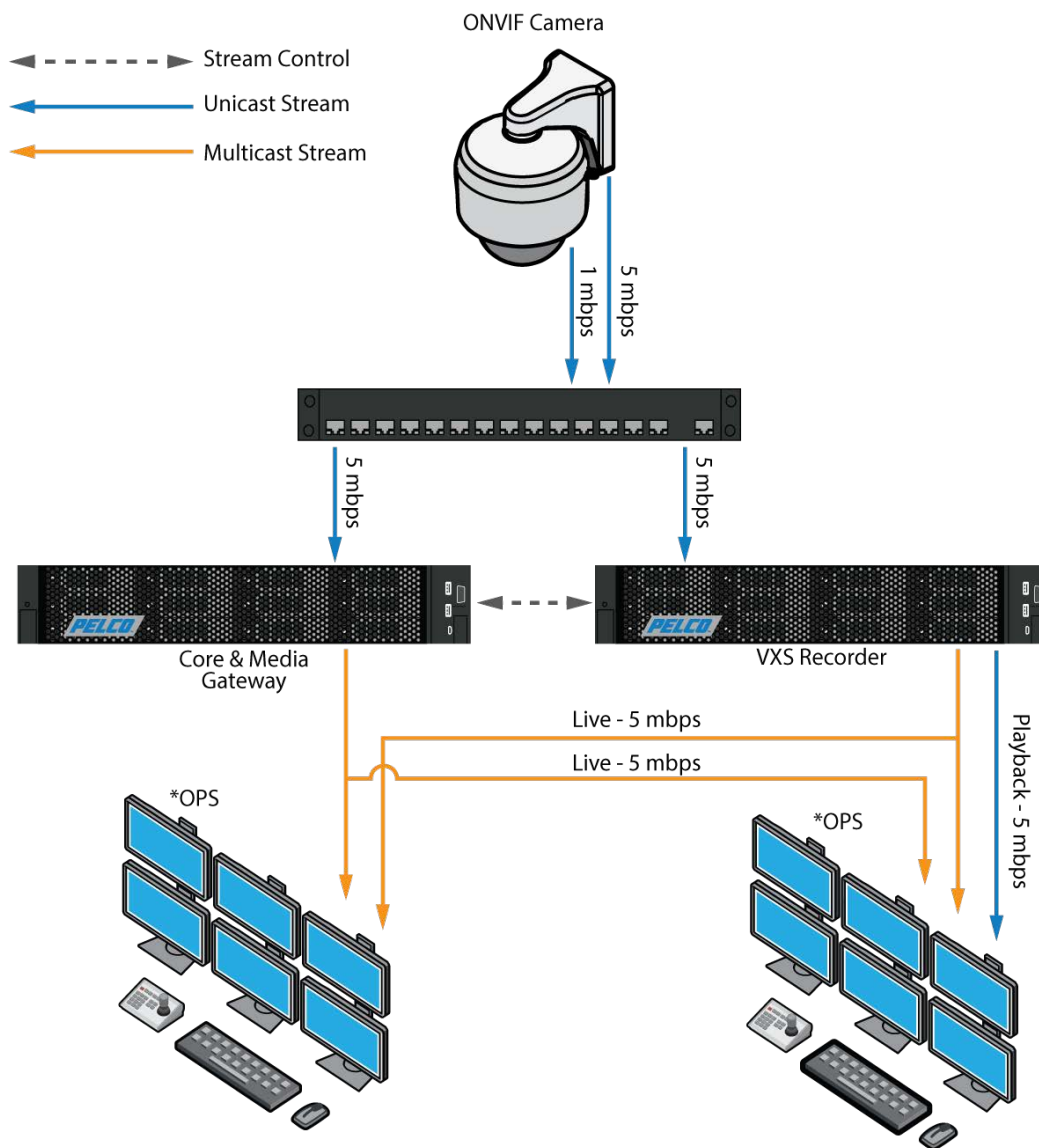


Live—Live video is authenticated by the CMG and streamed from the camera/network to the viewing client. This is the default on VX v 3.0 and later, and can be changed so that the VXS provides the multicast stream.

Playback—Playback is always unicast from the VXS.

\*Bandwidth calculated is for one camera being viewed in a single screen on one monitor. VideoXpert intelligently selects camera streams based on multi-screen configuration and client utilization. OPS Viewing clients subscribe to camera source IGMP groups to view video in multicast.

## Unicast Recording, Multicast Viewing of an ONVIF Camera

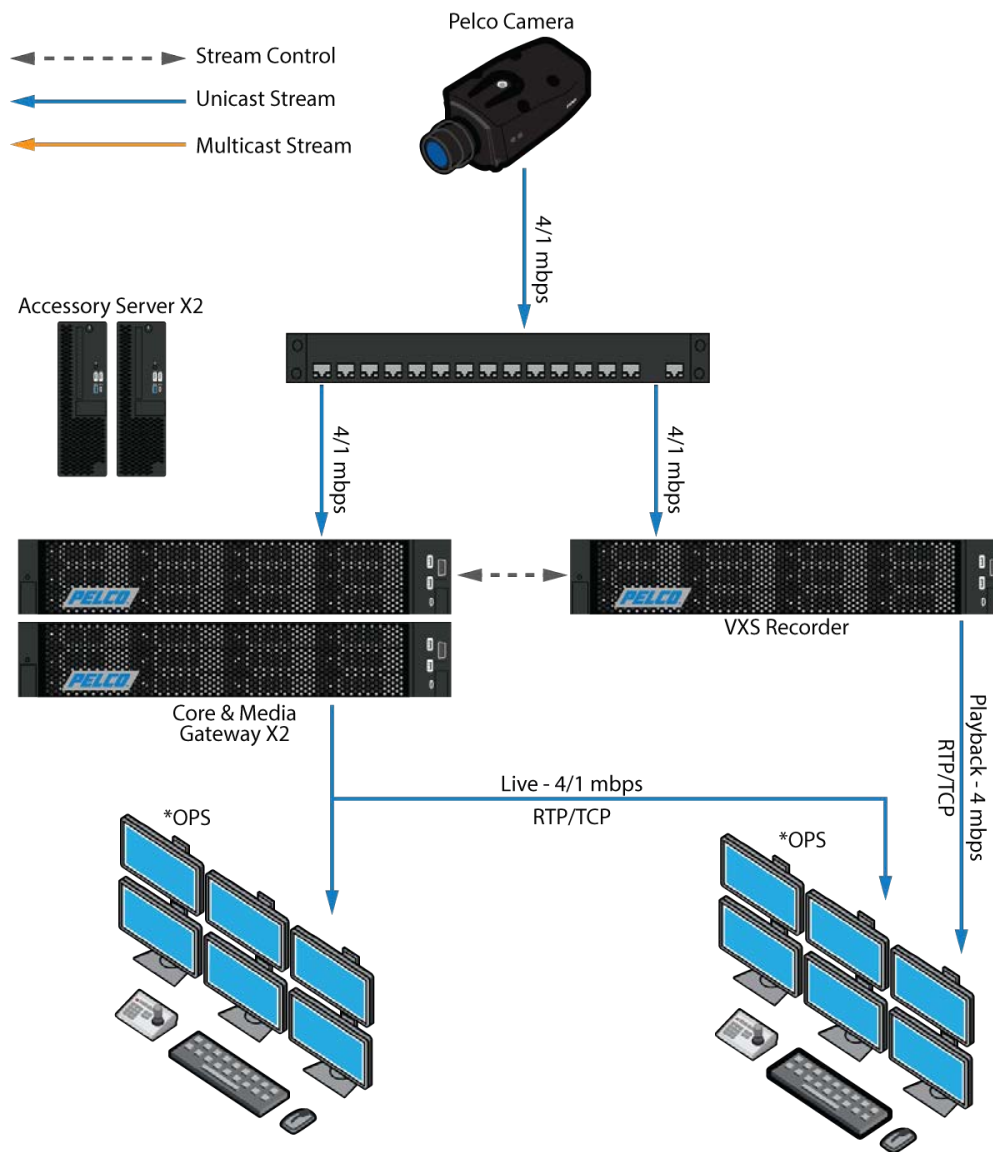


Live—Some ONVIF cameras are re-streamed by the VXS to the OPS Viewing client and authenticated by VideoXpert Core; some are re-streamed by the Media Gateway to the viewing client. Features are camera-dependent.

Playback—Playback is always unicast from the VXS.

\*Bandwidth calculated is for one camera being viewed in a single screen on one monitor. VideoXpert intelligently selects camera streams based on multi-screen configuration and client utilization. OPS Viewing clients subscribe to camera source IGMP groups to view video in multicast.

## Unicast Recording, Unicast Viewing of a Pelco Camera



**Live**—Live video is authenticated by the CMG and streamed from the Media Gateway to the viewing client. This is the default on VX v 3.0 and later, and can be changed so that the VXS provides the multicast stream.

**Playback**—Playback is always unicast from the VXS.

\*Bandwidth calculated is for one camera being viewed in a single screen on one monitor. VideoXpert intelligently selects camera streams based on multi-screen configuration and client utilization. OPS Viewing clients subscribe to camera source IGMP groups to view video in multicast.

## Appendix B: Network Protocols and Ports Reference

The tables below correspond to VideoXpert software components; in some cases, the same server can host multiple components. The ports listed must be open to ensure VideoXpert functions properly.

*Table 3: VideoXpert Core™ protocols and ports*

Protocol	Ports	Service
TCP/HTTP	80	HTTP, used for camera configuration as necessary
TCP/HTTPS	443	HTTPS
UDP/SSDP	1900	SSDP discovery target on 239.255.255.250
UDP/WSD	3702	WS discovery
TCP/Hazelcast	6001	Hazelcast communications, before cluster configuration
TCP/Hazelcast	6002	VxDatabase Hazelcast communications, before cluster configuration
TCP/Postgres	15432	Database
TCP/Hazelcast SSL	16011	Hazelcast SSL communications, after cluster configuration
TCP/Hazelcast	16012	VxDatabase Hazelcast TLS communications, after cluster configuration

*Table 4: VideoXpert Media Gateway™ protocols and ports*

Protocol	Ports	Service
UDP/RTP/RTSP	All	When streaming Unicast from cameras, the Media Gateway uses ports in the range 41950-65535 to receive the data, but the client may request data on any port. Multicast data will use the port configured on the camera, thus all UDP ports must be available.
TCP/RSTP	554	RTSP
TCP/HTTPS	5443	Internal API, HTTPS (MJPEG and other communication)
TCP/Hazelcast	6002	Hazelcast communications, before cluster configuration
TCP/HTTP	8090	Internal API, HTTPS (MJPEG) not used by the system
TCP/Hazelcast SSL	16002	Hazelcast SSL communications, after cluster configuration



Table 5: VxStorage™ protocols and ports

Protocol	Ports	Service
UDP/SSDP	1900	SSDP discovery
TCP/RTSP	5544	RTSP video and audio command and control
TCP/Hazelcast	6003	Hazelcast communications
TCP port/ HTTP	9091	HTTP, API calls
TCP/HTTPS	9443	HTTPS, API calls
UDP/RTP	41950-65535	Receiving streamed video and audio
UDP/RTCP	41950-65535	Receiving media streams metadata

If recording in multicast mode, the required UDP port range is determined by the cameras.

Table 6: VSM / NSM5200 / NSM5300 Storage protocols and ports

Protocol	Ports	Service
TCP/SSH	22	SSH, remote shell connectivity
UDP/DHCP	68	DHCP Client
TCP/HTTP	80	HTTP, web access
UDP/SNMP	161	SNMP
UDP/SNMPTRAP	162	SNMP-trap
TCP/SMUX	199	SNMP multiplexing service
TCP	1605	NSTERM Server
UDP	1781	NSTERM Search, recording services
UDP/UPnP	2900-2901	UPnP Discovery
TCP/HAL	4343	HAL
TCP	10000-10008	Private services for NSM5300/VSM
TCP	25556	DB Replication service for redundant recorders
UDP/UPnP	32768-61000	UPnP Communication
TCP/UPnP	49152	UPnP Communication



Table 7: Enhanced Decoder protocols and ports

Protocol	Ports	Service
TCP/FTP	21	Used for firmware updates, snapshot downloads, etc.
UDP	4500-4900	Unicast streaming via Windows host (not decoders)
TCP	43241	Proprietary control protocol

Enhanced decoders operate on Xubuntu 14.04 and communicate over the protocols identified in the table above.

Table 8: Shared Display Decoder / VideoXpert Workstation protocol and ports

Protocol	Ports	Service
TCP/VNC	5900-5906	Allows the decoders to operate in concert with the workstation as a single desktop/workspace

This is the normal port range for a workstation with 5 enhanced decoders. The actual range may vary. The range can be confirmed on the workstation using the installed TightVNC Service Control Interface. If no enhanced decoders are connected, these ports are not necessary.

Table 9: VxOpsCenter Client protocols and ports

Protocol	Ports	Service
TCP/FTP	21	Provides firmware updates to enhanced decoder, downloads snapshots and logs from the enhanced decoder
TCP/HTTPS	443	REST API
TCP/RTSP	554	Video and audio command and control
UDP	4502-4900 <sup>1</sup>	Unicast streaming
TCP/RTSP	5544	Video and audio command and control

<sup>1</sup>Unicast streaming previously used a port range of 4500-4600.

Table 10: Outgoing and general protocols and ports (for VxToolbox, VideoXpert Core, Media Gateway, VxStorage, VideoXpert Professional, and for viewing clients)

Protocol	Ports	Service
TCP/FTP	21	
TCP/HTTP	80	
TCP/NTP	123	Time synchronization
TCP/HTTPS	443	

Protocol	Ports	Service
TCP/RTSP	554	
UDP/SSDP	1900	SSDP discovery
UDP/WSD	3702	WS discovery
TCP/UDP/RDP	3389	Remote desktop
UDP	4500-4900	Unicast streaming via Enhanced Decoders
UDP	4502-4900 <sup>1</sup>	Unicast streaming via Windows host (not Enhanced Decoders)
TCP/HTTPS	9443	Discovery of VxStorage
UDP/UPnP	49152	UPnP communication
TCP/UDP—RTP/ RTCP/RTSP	N/A	Streaming and control

<sup>1</sup>The VxOpsCenter and Shared Display unicast streaming previously used a port range of 4500-4600.

## Appendix C: Live Video Streaming Performance

The tables below provide VideoXpert users with expected camera streaming count performance, when using various VideoXpert clients and decoders.

Testing was performed using these software versions:

- VxOpsCenter v 3.11.0.330
- VideoXpert Core v 3.11.0.106
- VideoXpert Media Gateway v 3.11.0.55

Table 11: Camera configurations tested

Stream Name	Resolution	Framerate	Bitrate	GOP	Encoding	Profile	Rate Control
Primary	1920 x 1080	30	5000	30	264	high	CBR
Secondary	640 x 360	15	1150	15	264	high	CBR
Optera	2048 x 11525	12	16000	12	264	high	CBR
Optera, secondary	800 x 2680	6	2000	6	264	high	CBR
4k	2560 x 1440	30	8000	30	264	high	CBR
4k, secondary	1920 x 1080	15	3850	15	264	high	CBR

Table 12: Products tested

Part Number	Description
VX-A4-SDD	Shared Display Decoder, Dell OptiPlex 7070 Micro 8 GB
VX-A5-SDD	Shared Display Decoder, Dell OptiPlex 7080 Micro 16 GB
VX-WKST & VX-WKS	Desktop Workstation, Dell OptiPlex XE3 SFF i7 16GB, NVIDIA T600
VX-RKWKS8T & VX-RKWKS8	Rackmount Workstation, Dell Precision 3930, i7 16GB, NVIDIA T600 (x2)

Table 13: Results for VX-A4-SDD—Shared Display Decoder, Dell Optiplex 7070 Micro 8 GB and for VX-A5-SDD—Shared Display Decoder, Dell Optiplex 7080 Micro 16 GB

Monitor Qty and Attachment	Monitor Resolution	Stream Quality	VX-A4-SDD Maximum Camera Count	VX-A5-SDD Maximum Camera Count
1, direct	1080p	Primary	6	6
		Secondary	64	64
		Optera, primary	2	2
		Optera, secondary	19	34
		4k, primary	6	6
		4k, primary - H265	6	6
		4k, secondary	23	34
2, direct	1080p	Primary	12	12
		Secondary	64	64
		Optera, primary	4	4
		Optera, secondary	19	64
		4k, primary	8	12
		4k, primary - H265	8	12
		4k, secondary	23	34
1, direct	4k	Primary	6	6
		Secondary	64	64
		Optera, primary	2	2
		Optera, secondary	24	64
		4k, primary	6	6
		4k, primary - H265	6	6
		4k, secondary	23	35

The Maximum Camera Count is the maximum number of cameras that can be displayed on a defined monitor configuration connected to the hardware tested, assuming that all cameras are set to the same stream quality. Cameras can be distributed in any combination among all connected monitors. Different display layouts will dynamically adjust to different stream qualities.

Table 14: Results for VX-WKST and VX-WKS—Desktop Workstation, Dell OptiPlex XE3 SFF i7 16 GB, NVIDIA T600

Monitor Qty and Attachment	Monitor Resolution	Stream Quality	Maximum Camera Count
1, direct	1080p	Primary	12
		Secondary	64
		Optera, primary	4
		Optera, secondary	45
		4k, primary	12
		4k, secondary	64
4, direct	1080p	Primary	16
		Secondary	64
		Optera, primary	4
		Optera, secondary	45
		4k, primary	10
		4k, secondary	64
2, direct	4k	Primary	12
		Secondary	64
		Optera, primary	4
		Optera, secondary	45
		4k, primary	12
		4k, secondary	64

The Maximum Camera Count is the maximum number of cameras that can be displayed on a defined monitor configuration connected to the hardware tested, assuming that all cameras are set to the same stream quality. Cameras can be distributed in any combination among all connected monitors. Different display layouts will dynamically adjust to different stream qualities.

Table 15: Results for VX-RKWKS8T and VX-RKWKS8—Rackmount Workstation, 8 monitor, Dell OptiPlex XE3 SFF i7 16 GB, NVIDIA T600 (x2)

Monitor Qty and Attachment	Monitor Resolution	Stream Quality	Maximum Camera Count
4 total—1 direct, 3 Enhanced Decoders	1080p	Primary	24
		Secondary	256
		Optera, primary	24
		Optera, secondary	256
		4k, primary	24
		4k, secondary	256
8 total—1 direct, 7 Enhanced Decoders	1080p	Primary	48
		Secondary	512
		Optera, primary	48
		Optera, secondary	512
		4k, primary	48
		4k, secondary	512

The Maximum Camera Count is the maximum number of cameras that can be displayed on a defined monitor configuration connected to the hardware tested, assuming that all cameras are set to the same stream quality. Cameras can be distributed in any combination among all connected monitors. Different display layouts will dynamically adjust to different stream qualities.



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