



Milestone and Pivot3

Reference Architecture

Version 1.0



✓ Milestone Certified

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Section 1 Executive Summary

This reference architecture document provides guidance for those who are designing Milestone XProtect video management software deployments with Pivot3. It includes technical information for technology leaders and security professionals to take full advantage of the combined value of Pivot3 hyperconverged infrastructure (HCI) along with Milestone XProtect. Pivot3 is the leading provider of smart infrastructure for mission-critical video. When combined with Milestone's open video surveillance platform, you can achieve new levels of resilience, efficiency, and manageability at scale, and provide customers with solutions to address today's security challenges along with the flexibility to accommodate future requirements.

Section 2 Introduction

Audience

This reference architecture is intended for individuals responsible for architecting, designing, and deploying video surveillance solutions, including software and hardware infrastructure. Specifically, this reference architecture document will be helpful for individuals looking to architect, design, and deploy Milestone XProtect Video Management solutions with Pivot3 Surveillance Series hyperconverged infrastructure (HCI) for video surveillance.

Purpose

This reference architecture document describes the following information for technology leaders and security professionals:

- Provides an overview of Pivot3 Surveillance Series solutions
- Provides an overview of Milestone Systems' XProtect Video Management solutions
- Describes the combined solution reference architecture designs
- Describes best practices for solution sizing, configuration options and technical considerations

Pivot3 and Milestone Partnership

Pivot3 and Milestone are long standing Technology Alliance Partners and have been deployed together in the most demanding video surveillance installations of all sizes all over the world. Pivot3 qualifies, validates, and certifies its solutions regularly with Milestone XProtect video management software to ensure customers have proper sizing guidance and best practices for successful deployments. Pivot3 products and solutions for video surveillance are Milestone Certified Solutions under the Milestone Technology Partner (MTP) Certification Program.

Section 3 Pivot3 Surveillance Solutions

Pivot3 is the leading provider of intelligent infrastructure for mission-critical video. Designed specifically for video-based workloads, such as video recording, video analytics and visualization at the edge, core and cloud, Pivot3 helps organizations lower the Total cost of ownership (TCO), reduce risk, and simplify management at scale.

Pivot3 combines enterprise-class IT resilience and availability with network video recorder (NVR) simplicity with its Surveillance Series Hyperconverged Infrastructure (HCI) solutions. HCI combines server and storage resources into modular, scalable appliances that store video data without loss, protect it during failure events, and ensure it is always available when and where it is needed. A simple, single administrative console allows non-technical personnel to manage Pivot3 applications.

Pivot3's HCI provides the ideal platform for running the Milestone XProtect Video Management Platform by bringing all the benefits of an enterprise grade IT infrastructure, with the simplicity and ease of use that a security director desires. With unrivalled storage efficiency and resilience, Pivot3 provides a scalable, secure storage platform for critical video data, captured and managed by XProtect.

Resilience

Pivot3's infrastructure is built to handle the unique requirements of mission-critical video workloads and eliminates frame drops to prevent video loss and image degradation. Pivot3's patented erasure coding data protection and failover technology ensure that the video remains available and accessible, even in the event of disk(s) or HCI node failure.

Efficiency

Pivot3's erasure coding provides high levels of storage and compute efficiency for video workloads. Storage efficiency increases as total system storage capacity is scaled, achieving up to 94 percent storage efficiency at maximum scale. This efficiency, combined with the ability to consolidate multiple security workloads, including access control and identity management, onto a single infrastructure, helps to reduce datacenter footprint and management costs.

Simplified Management

You can minimize cost and overspending by deploying only the server and storage resources needed to meet today's needs. As camera counts increase, new camera technologies are used, and new security applications are deployed, Pivot3 solutions allow you to scale storage, compute, and bandwidth resources independently and linearly, without disruption. Since Pivot3 products are designed to be centrally managed by non-technical personnel, no specialized skills are needed.

Product Offering

Pivot3's Surveillance Series HCI products are delivered as appliances comprised of the Pivot3 Acuity software platform and VMware ESXi hypervisor running on an industry standard server. Applications, such as Milestone XProtect along with Pivot3's software platform run as virtual machines (VMs) on the appliances. Each appliance is sized to meet the exact specifications required by each customer and are scalable to meet any future requirements.



Pivot3 V5-2000 Surveillance Series appliance:

- Node Type: Hyperconverged (HCI) or Storage-only
- Form Factor: 2U standard server
- Capacity/node: 12 – 384TB
- Max Scalability: Unlimited
- HCI Software Platform: Pivot3 Acuity Surveillance Edition
- Hypervisor: VMware ESXi
- Management: Stand-alone Acuity UI or vCenter Plug-in
- CPU: 2nd Gen Intel® Xeon® Scalable Processors
- RAM: 32 – 192GB
- Networking: 10 GbE BaseT, 10 GbE SFP+
- Optional GPU Support: Yes (on selected models)

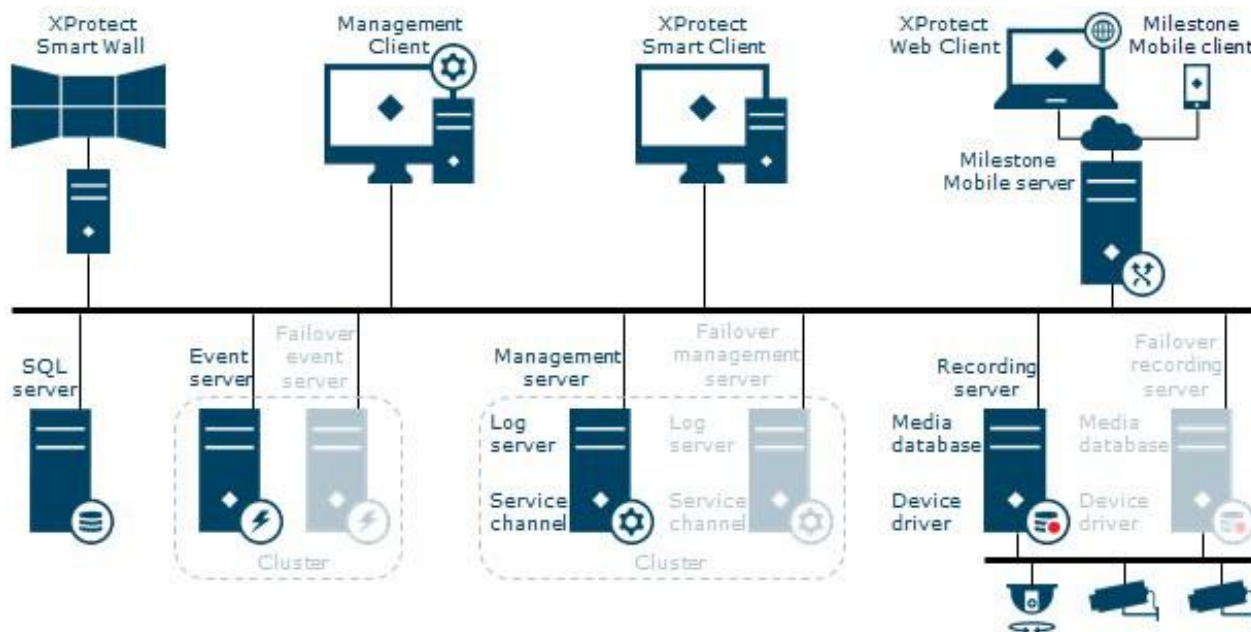
Section 4 Milestone Video Management Solutions

Milestone designs, develops, and produces world-leading, IP-based video management solutions for organizations of all shapes and sizes. The Milestone XProtect Video Management Platform is the industry-leading open platform for video management solutions to keep people and property safe in a wide range of industries.

Milestone XProtect Video Management Platform

Milestone XProtect delivers powerful, reliable, and easy-to-manage surveillance solutions for all size of customers. With technology partners, you can customize XProtect systems to fit your business requirements.

The Milestone XProtect system architecture, the primary system components, and their functions are described in the following diagram.



The following table describes the key components of the Milestone video management system relevant to the combined Pivot3, Milestone reference architecture. All of these components can be run on Pivot3 appliances.

| Milestone Component | Description |
|--------------------------------|---|
| Management Server | <p>Management Server – The central component of the VMS and is responsible for handling the system configuration, distributing configuration information to other system components (such as recording servers) and for facilitating user authentication.</p> <p>Log Server – Responsible for storing all log messages for the entire system.</p> <p>Service Channel – Responsible for communicating various service and configuration messages to the XProtect Smart Client, mobile server, and third-party components listening to the service channel.</p> |
| Management and Viewing Clients | <p>XProtect Management Client – The administration interface for all parts of the VMS.</p> <p>XProtect Smart Client – The main client for the VMS offering a full set of advanced features.</p> |
| Recording Servers | <p>Recording Server(s) – Responsible for all devices (cameras, video and audio encoders, input/output (I/O) modules, metadata sources, and so on), communication, recording and event handling.</p> <p>Failover Recording Server(s) – Responsible for taking over video recording should a recording server(s) fail.</p> |
| SQL Server | <p>SQL Server - Configuration database stored in a standard Microsoft SQL server on the management server or on a separate server. SQL Server can be installed on the Management Server.</p> |
| Event Server | <p>Event Server - Handles various tasks related to events, alarms, maps and third-party integrations via the Milestone Integration Platform Software Development Kit (MIP SDK). Event Server can be installed on the Management Server.</p> |

Section 5 Solution Architecture

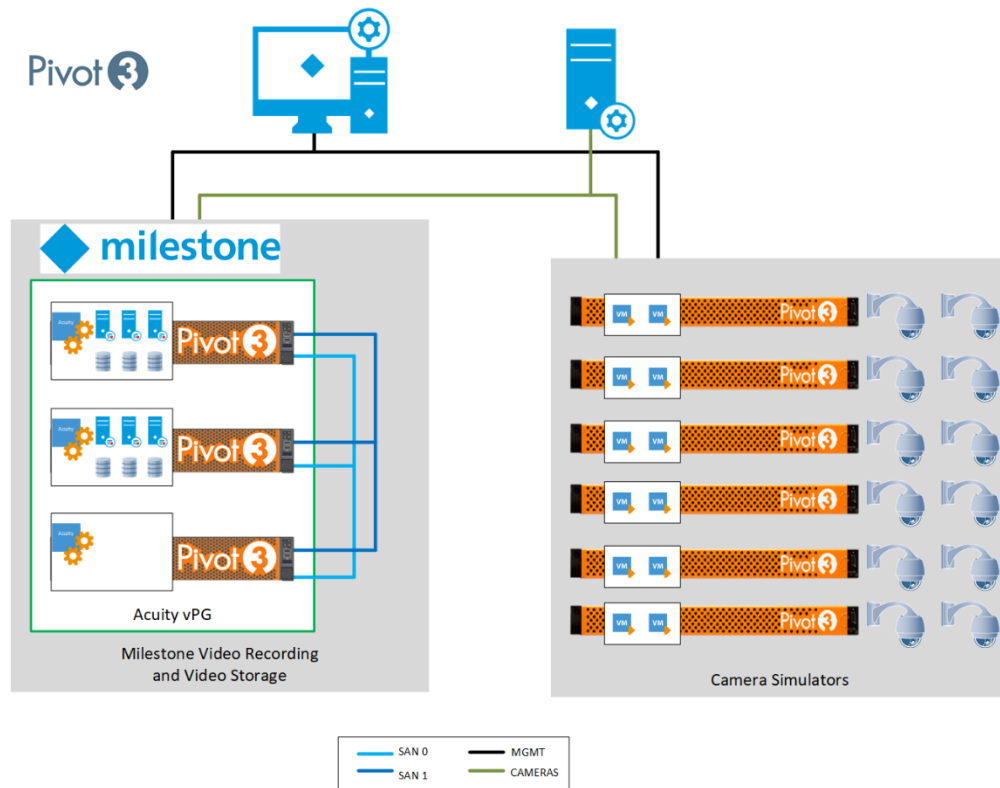
Milestone XProtect on Pivot3 Surveillance Series Design Considerations

When designing and architecting a Milestone XProtect system on Pivot3, the following are key design considerations:

| Design Consideration | Sizing, Architecture, and Design Items to Consider |
|------------------------------------|---|
| Sites | Single or multiple sites |
| Camera Count | Quantity of cameras that will be recorded |
| Camera Sizing | Camera Stream Resolution Image Complexity Scene Motion Days of Retention |
| Resilience and Availability | Pivot3 scale-out storage and erasure coding handles multiple drive and node failures. If using Pivot3 VM failover feature, an additional Pivot3 node must be part of the vPG (N+1) and be void of application VMs, including any Milestone servers. |
| Networking | Networks <i>must</i> be set up correctly to avoid significant performance and resiliency issues. |
| Storage Capacity Considerations | Camera Count and Sizing information (see above) Continuous Recording or Record on Motion Days of Retention |
| Storage Performance Considerations | Camera Count and Sizing information (see above) Continuous Recording or Recording on Motion Live and/or Archive Database |
| Compute Performance Sizing | Use Milestone CPU calculator to ensure enough compute resources for video recording. |

| Design Consideration | Sizing, Architecture, and Design Items to Consider |
|----------------------------------|---|
| Recording Server Considerations | <p>Run one XProtect Recording Server per VM (multiple XProtect Recording Server VMs can be installed on a single Pivot3 appliance).</p> <p>Keep database to no more than 20,000 cameras.</p> <p>Set RecorderConfig.xml parameters as follows:</p> <ul style="list-style-type: none">• <i>Maxframesinqueue = 1024</i>• <i>Maxbytesinqueue = 104857600</i> <p>If server-side motion, set motion detection to keyframes only.</p> <p>If 1fps, use Record keyframes only.</p> <p>If multiple video volumes, camera must be assigned to volumes.</p> <p>Format Windows volumes with NTFS @ 64K 'allocation unit size'.</p> <p>Set motion detection to done 'in memory'.</p> |
| Management Server Considerations | <p>The Management Server is typically not resource intensive.</p> <p>For large deployments, place the SQL Server and Event Server on different VMs.</p> <p>At 5,000 cameras, add a second Management Server.</p> <p>Use Windows Server clusters for failover protection of the Management Server.</p> |
| Failover Server Considerations | <p>Determine how many XProtect Failover Recorders to run and where to run them. Running XProtect Failover Recorders on a separate node requires additional Pivot3 nodes but reduces count(s) of XProtect Failover Recorders and Windows licenses.</p> <p>Failover groups can prioritize server order.</p> <p>Camera groups can be failed over.</p> |
| Archiving Considerations | <p>Separate storage for long term archive (typically Pivot3 archive storage); minimizes the Live database size and associated rebuild times.</p> <p>For highest performance, deploy Live database on separate system from archiving storage.</p> <p>Use the same Pivot3 system (storage and compute) for Live database and archiving to reduce complexity; requires additional storage capacity and performance to accommodate both workloads (recording and archiving).</p> |

Base Test Configuration



The tested surveillance system topology included the following:

- One (1) Milestone XProtect Corporate Management Server
- One (1) Milestone XProtect Corporate Management Client
- Three (3) Pivot3 Surveillance Series nodes
- Six (6) virtual machines running Milestone Corporate Recording Server

Using camera simulator VMs on servers outside the test surveillance system enables accurate performance results, removes any potential network bottleneck and enables repeatable test iterations.

The camera simulator topology included:

- Six (6) infrastructure servers
- Twelve (12) VMs running camera simulator software provide looped, motion video feeds
- Each VM generated 80 video streams. Total 960 camera streams

Product Configuration

| Component | Technical Details |
|---|--|
| Pivot3 V5-2000 Surveillance Series hyperconverged nodes | <p>Each V5-2000 node equipped as follows:</p> <ul style="list-style-type: none"> (2) Intel® Xeon® Scalable CPUs (12-core, 2.20GHz) per node 96GB RAM (16) 8TB 3.5" HDDs (2) 480TB 2.5" SSDs (caching) (6) 10GbE NIC ports VMware ESXi 6.5 (build 6921384) |
| Pivot3 Acuity Hyperconverged Software Platform | Acuity Surveillance Edition 10.7.1 |
| Storage Configuration Information | <p>One Acuity volume per Milestone Recording Server VM, Size: 1TB, Erasure Code Level 3 (EC3)</p> <p>Volumes connected via iSCSI using Pivot3 DSM for Windows MPIO</p> <p>Volumes formatted with NTFS filesystem at 64K allocation unit</p> |
| Pivot3 Acuity Management Software | Acuity Management Application |
| Virtual Machine Resource Allocations | <p>Milestone Recording Server VM settings:</p> <ul style="list-style-type: none"> • CPU Allocation: 10 vCPU (not reserved) • Memory Allocation: 14GB RAM (not reserved) <p>Pivot3 Acuity VM settings:</p> <ul style="list-style-type: none"> • CPU Allocation: 10 vCPU (reserved) • Memory Allocation: 16GB RAM (reserved) |
| Milestone Video Management Software | <p>The following Milestone XProtect video management and recording software was tested as part of the reference architecture:</p> <ul style="list-style-type: none"> • Milestone XProtect Video Recording server • Milestone XProtect Management server • Milestone XProtect Viewing and Management clients |

| Component | Technical Details |
|-----------------------------------|--|
| Network Infrastructure – Physical | <p>All server NIC ports are 10GbE. The following network infrastructure was used:</p> <ul style="list-style-type: none"> • (2) 10GbE switches: ThinkSystem NE1032 RackSwitch <ul style="list-style-type: none"> ◦ Configured for Management, SAN and Application VLANs |
| Network Infrastructure – Logical | <p>Per best practices, the Acuity system requires three high-speed, highly available (HA) logical networks to provide best performance and resiliency. The following summarizes the three logical networks, typically implemented as VLANs:</p> <ul style="list-style-type: none"> • Management – Acuity management traffic, Milestone management traffic, VMware management traffic, IPMI traffic and vMotion traffic should be on this network. • Storage Area Network (SAN) – All storage traffic (iSCSI) should be on this network. Acuity utilizes two SAN ports per node (SAN0 and SAN1) to provide storage performance and availability. • Application – camera traffic and Milestone recording and archiving traffic should be on this network. |
| Node Count | <p>Max Nodes per Pivot3 Domain: no limit</p> <p>Max nodes per Pivot3 group (vPG): 12</p> <p>Tested configuration: 3 nodes</p> |

Base Test Results

Testing was configured to illustrate Pivot3's performance under the most rigorous conditions.

Performance Test

The data load used in the test included the following parameters:

- 6 recording server VMs
- 930 total cameras
- 155 cameras recorded per recording server (155 cameras x 6 recording servers = 930 total)
- 1920x1080 resolution
- H.264 video codec
- 15 fps
- 100% recording
- 20% Motion Detection
- Erasure Code Level 3
- Test Duration 4 hours

Performance Test Results

| Item | Result |
|--|--------------------------------------|
| Average Recorder Throughput (I/O) | 350 Mbps (44 MB/s) |
| Average Pivot3 Per Node Storage Throughput (I/O) | 1320 Mbps (306 MB/s) per node |
| Total System Throughput | 2640 Mbps (612 MB/s) |
| Average Camera Stream | 2.3 Mbps (287 MB/s) |
| Average Recorder Server CPU Utilization | 37.4 % |
| % Frames Lost | 0.0% |
| Average Disk Latency | 5.01ms Disk Read / 8.41ms Disk Write |

There were no problems noted with frame loss, video latency or CPU utilization caused by the hardware or software integration.

Functional Test (Not Max Performance)

The data load used in the test included the following parameters:

- 1 recording server VM
- 240 cameras per recording server
- 192 cameras recorded continuously, 48 cameras continuous recording with motion detection
- 1920x1080 resolution
- H.264 video codec
- 15 fps
- 100% recording
- 20% Motion Detection
- Erasure Code Level 3
- Test Duration 4 hours

Functional Test Results

| Item | Result |
|--|------------------------------------|
| Average Recorder Throughput (I/O) | 650 Mbps (81 MB/s) |
| Average Pivot3 Per Node Storage Throughput (I/O) | 648 Mbps (81 MB/s) per node |
| Average Camera Stream | 2.3 Mbps (287 MB/s) |
| Average Recorder Server CPU Utilization | 38.6 % |
| % Frames Lost | 0.0% |
| Average Disk Latency | 1.0ms Disk Read / 3.9ms Disk Write |

There were no problems noted with frame loss, video latency or CPU utilization caused by the hardware or software integration.

Section 6 Sizing and Scalability

Sizing Calculation Steps

Properly sizing the Milestone and Pivot3 system is key to ensuring a successful customer deployment. It is important to size both the compute and storage required for video recording. Pivot3 recommends that you work with Pivot3 solution architects and/or Pivot3 certified partners when designing, sizing and configuring the Pivot3 and Milestone system.

The following are the steps a solution architect uses when sizing a system:

1. Use Milestone Server calculator to calculate CPU requirements.
2. Translate the Milestone recommended CPU requirements to Pivot3 CPU options.
3. Use Pivot3 sizer tool to calculate Pivot3 node count requirements for compute and storage

Work with Pivot3 solution architects and/or Pivot3 certified partners to correctly size and configure the Pivot3 system or upgrades to existing systems for use with Milestone.

In the sections that follow, common small, medium, and large-scale deployment options are described in detail to provide examples of how Pivot3 systems are sized and scaled with Milestone to meet different customer requirements.

Small-Scale Deployment Options

For small or edge recording deployments, one can stand-up a 3-node Pivot3 and Milestone system to deliver the performance and resilience described here:

| Item | Description |
|-------------------------------|---|
| Pivot3 Node Count | 3 nodes: A minimum supported node count is a single node, without high availability / failover. |
| Milestone Recording VMs | 4 VMs |
| Camera Count | 930 total cameras: 155 cameras per Milestone Recording VM |
| Resolution | 1920x1080 |
| Video Codec | H.264 |
| Frames per Second | 15 fps |
| Recording / Archiving Profile | 100% Recording / 0% Archiving |
| Motion Detection Profile | 20% Motion Detection |
| Video Retention Duration | 30 Days @ record on motion (50% motion) |
| Pivot3 Data Protection | Erase Code Level-3 |
| Pivot3 Failover | Pivot3 Failover requires one node not hosting Milestone VMs |
| Milestone Recording Failover | Not Used |

| Item | Description |
|---------------------|--|
| Storage Capacity | 462 TB Usable (Erasure Code Level-3) 672 TB Raw (16 drives * 14TB * 3 nodes) |
| Performance Results | Total Throughput: 2,640 Mbps (330 MB/s) Per Node Throughput: 1,320 Mbps (165 MB/s) Per Milestone Recording VM Throughput: 660 Mbps (82.5 MB/s) |

Medium-Scale Deployment Options

For mid-sized requirements, the following Pivot3 and Milestone configuration can be deployed to meet the performance, capacity, and resilience required:

| Item | Description |
|-------------------------------|---|
| Pivot3 Node Count | 9 nodes: Eight active nodes + 1 failover node. |
| Milestone Recording VMs | 16 VMs (two per Pivot node) |
| Camera Count | 2,496 total cameras: 156 cameras per Milestone Recording VM |
| Resolution | 1920x1080 |
| Video Codec | H.264 |
| Frames per Second | 15 fps |
| Recording / Archiving Profile | 100% Recording / 0% Archiving |
| Motion Detection Profile | 20% Motion Detection |
| Video Retention Duration | 30 Days @ continuous recording with motion OFF |
| Pivot3 Data Protection | Erasure Code Level-3 |
| Pivot3 Failover | Yes; 8+1 nodes (8 active nodes + 1 failover node) Pivot3 Failover requires one node not hosting Milestone VMs |
| Milestone Recording Failover | No |
| Storage Capacity | 1,581 TB Usable (Erasure Code Level-3) 2,016 TB Raw (16 drives * 14TB * 9 nodes) |
| Performance Results | Total Throughput: 5,750 Mbps (718 MB/s) (718 * 8node) Per Node Throughput: 718 Mbps (90 MB/s) Per Milestone Recording VM Throughput: 359 Mbps (45 MB/s) |

Large-Scale Deployment Options

For larger scale requirements, you can deploy the following Pivot3 and Milestone configuration to meet the required performance, capacity, and resilience:

| Item | Description |
|-------------------------------|---|
| Pivot3 Node Count | 36 nodes total; 12 per group (vPG): 30 Milestone Recording nodes + 3 Milestone Failover nodes + 3 Pivot3 failover nodes. |
| Milestone Recording VMs | 60 (two per Pivot3 node) |
| Camera Count | 9,360 total cameras: 156 cameras per Milestone Recording VM |
| Resolution | 1920x1080 |
| Video Codec | H.264 |
| Frames per Second | 15 fps |
| Recording / Archiving Profile | 100% Recording / 0% Archiving |
| Motion Detection Profile | 20% Motion Detection |
| Video Retention Duration | 30 Days |
| Pivot3 Data Protection | Erasure Code Level-3 |
| Pivot3 Failover | Yes; 33+3 nodes (33 active nodes + 3 failover node) Pivot3 Failover requires one node not hosting Milestone VMs |
| Milestone Recording Failover | Yes Three (3) Milestone Failover Recording VMs |
| Storage Capacity | 6,543 TB Usable (Erasure Code Level-3) 8,064 TB Raw (16 drives * 14TB * 36 nodes) |
| Performance Results | Total Throughput: 21,540 Mbps (2,692 MB/s) (718 * 30) Per Node Throughput: 718 Mbps (90 MB/s) Per Milestone Recording VM Throughput: 359 Mbps (45 MB/s) |

Section 7 Conclusion

As described in this reference architecture document, you can deploy a scalable range of video surveillance solutions based on Pivot3 and Milestone products with confidence, knowing that the joint solution is sized, qualified, and certified by Pivot3 solutions engineering. With Pivot3's video optimized hyperconverged infrastructure combined with Milestone's open video surveillance platform, customers can achieve new levels of resilience, scalability, and flexibility. Pivot3 products and solutions for video surveillance are Milestone Certified Solutions under the Milestone Technology Partner (MTP) Certification Program.

Section 8 References and Certifications

References

- Pivot3: <https://www.pivot3.com/>
- Pivot3 Acuity Surveillance datasheets: <https://resources.pivot3.com/datasheet/pivot3-surveillance-series/>
- Milestone Systems: <https://www.milestonesys.com/>
- Milestone XProtect Video Management Software: <https://www.milestonesys.com/solutions/platform/video-management-software/>

Certifications

Milestone certification: <https://www.milestonesys.com/globalassets/marketplace/uploaded-assets/0012000001vvzkraaj/pivot3-milestone-certification-report-august2018.pdf>

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