

XProtect™ Corporate Performance on IBM® Equipment

A guide to optimizing XProtect Corporate performance based on tests with IBM equipment to demonstrate the impact of changes to video surveillance configuration

**Milestone White Paper:
XProtect Corporate Performance on IBM Equipment**

- A guide to XProtect Corporate performance on IBM equipment and the impact of changes to the video surveillance configuration

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Introduction

To gain the best performance from your video surveillance system requires more than choosing best-of-breed components to run on an open architecture software platform. You should know how to configure the system for optimal use of all the components involved.

Milestone XProtect video management software is a powerful surveillance platform that's easy to manage. One reason for this is due to its design with just such configuration capabilities that let you customize your solution to fit your exact needs.

Milestone system engineers thoroughly test these system parameters. This technical white paper shares test results with you that describe the performance of the Milestone XProtect Corporate Recording Server running on high performance IBM servers and SAN. It illustrates the hardware impact (on the CPU, storage and network) when changing the individual parameters of the video surveillance system, and recommendations are given on how to configure the surveillance system for optimal performance.

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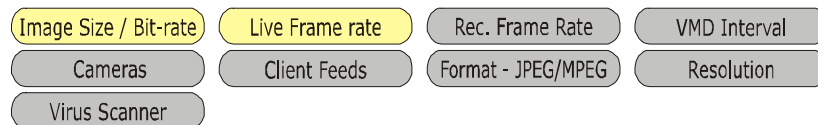
Video System Parameters

When configuring the Milestone XProtect Corporate (XPCO) Recording Server, there are a number of parameters to consider that influence the performance and load of the server, storage and network.

The parameters are the following:

- Number of cameras running
- Image format
- Image resolution
- Image file size or Bitrate (JPEG/MPEG)
- Live frame rate
- Recording frame rate
- Video Motion Detection interval (VMD)
- Client feeds
- Virus scanner

Parameters that are changed for the individual illustrations will be highlighted as shown in the example below.



When parameters are changed there is an impact on the system load; this will also be indicated for each illustration as shown below.

Green implies no change and Red implies load change.



This white paper focuses on the performance in a setup with JPEG images running at 4CIF (640x480) since this is still the most used configuration. Performance of MPEG4 and megapixel cameras will be covered in another white paper.

The equipment used for the tests were two powerful servers with Dual Dual-Core Intel Xeon CPUs (4 CPUs) and fast 10K RPM SAS disks in a SAN. All equipment was made available by IBM.

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System Overview

The performance tests in this white paper were conducted on the following IBM equipment:

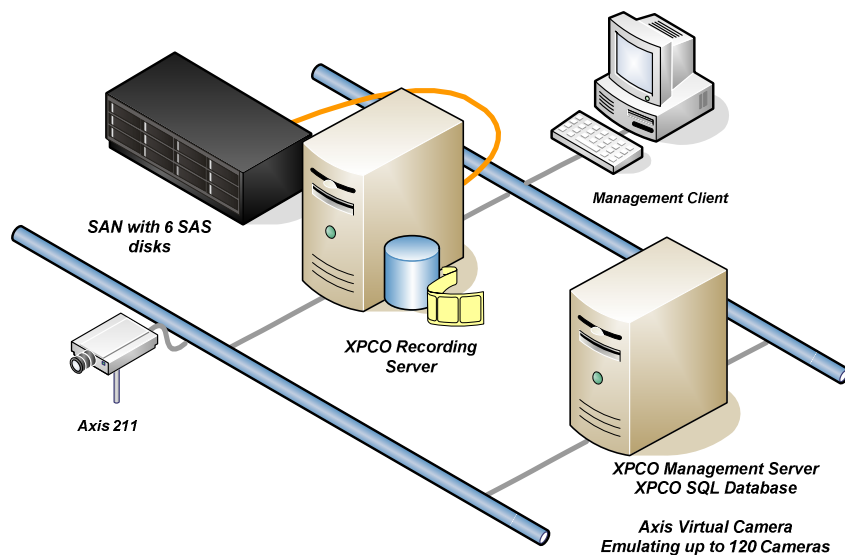
Servers (x2):

- IBM 79783AG x3550 with 1GB Ram
- IBM 40K1238 2x Dual-Core Intel Xeon CPUs 5120 1.86 GHz
- IBM 39M5785 2GB Ram Additional RAM (3GB total in Servers)
- IBM 40K1052 3x 73.4GB Hot-Swap 2.5" 10K RPM SAS HD
- IBM 39R6525 2x QLogic 4Gb FC Single-Port PCIe HBA

SAN:

- IBM 172642x IBM System Storage DS3400
- IBM 40K1041 6x 300GB Hot-Swap 3.5" 10K RPM SAS HD
- IBM 39R6475 4x 4Gbps SW SFP Transceiver
- IBM 39M5697 4x 5m Fiber Optic Cable LC-LC

The Servers and SAN were connected as shown below.



Both servers were installed with *Microsoft® Windows® Server 2003 Enterprise Edition - service pack 2*.

Windows 2003 Server was chosen because Windows XP only supports up to 2 physical CPUs. The servers used contain 4 CPU kernels. Each server contains 3 internal SAS disks; these were only used for operating system and surveillance software installation.

The SAN was configured with six 10,000 RPM SAS disks in a RAID 0 configuration.

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Disk Performance Test

The below table shows the read, write and random seek + R/W speed to the SAN disk system tested with "Performance Test v6.1" from www.passmark.com

Configuration of SAN with 6 SAS disks	Write MB/s	Read MB/s	Random Seek + R/W MB/s
RAID 0 - Database	172.1	172.1	47.1
RAID 0 - File system	170.2	170.8	46.6
RAID 0 - Multimedia	153.5	154.7	46.5
RAID 3 - Database	100.8	101.9	14.3
RAID 3 - File system	104.2	105.7	13.9
RAID 3 - Multimedia	107.0	107.1	16.2
RAID 5 - Database	99.4	99.6	14.1
RAID 5 - File system	104.5	104.7	14.1
RAID 5 - Multimedia	138.3	138.2	14.1

The table shows a significant decrease in performance when running in random R/W mode compared to just reading or writing a single file. The random performance is also significantly lower when running RAID 3 or 5. The main reason is an overhead on managing and writing the data to the disk due to the fault tolerant nature of RAID 3 and 5.

When running the XPCO Recording Server with many cameras recording to the same disk, the disk will perform as when testing the performance in random seek +R/W mode since there are many open databases that are being written to at the same time.

All subsequent tests in this document were done with the SAN set to one *RAID 0 - Database* partition containing all 6 SAS drives in the SAN.

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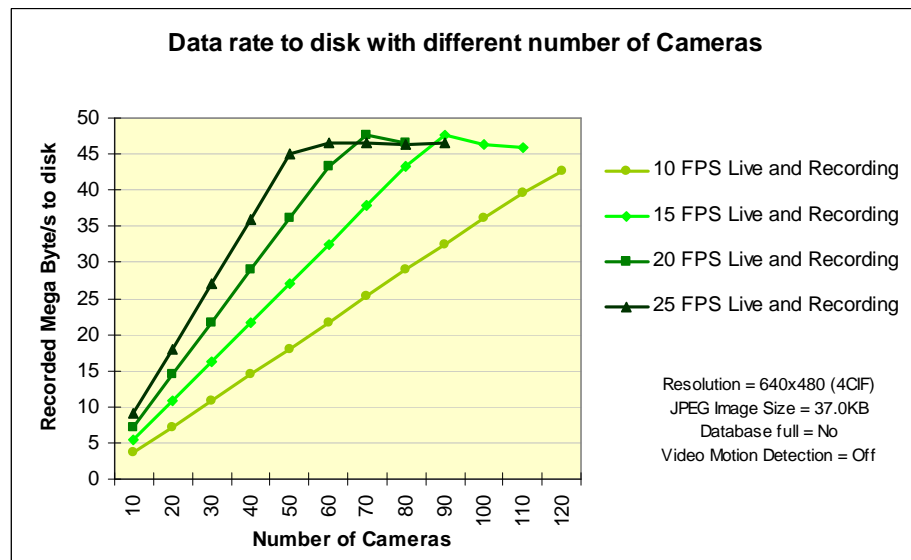
Data rate to disk

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate Rec. Frame Rate VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows the data rate in Mega Byte/s to the disk when recording all images at different frame rates.

The above chart shows that the data rate to the disk system increases linearly until either the CPU (not shown in graph) or disk performance limit is reached. The random seek plus read/write disk access limit was measured to around 46 Mbyte/s for the SAN. XProtect Corporate Recording Server with 50 to 120 cameras and 37KB images peaks out at around 46 Mbyte/s corresponding to the measured disk performance.

Conclusion: The Recording Server can record images to the disk as fast as the SAN disk system allows - regardless of the number of cameras. The tool used to test the disk performance gives a good indication of the disk performance that can be expected with many cameras recording to it.

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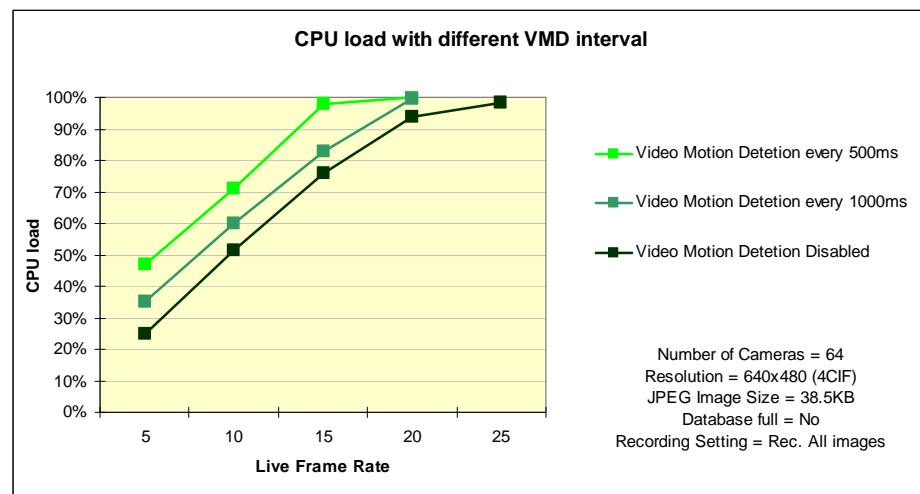
Video Motion Detection (VMD)

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate Rec. Frame Rate VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows the CPU load with different VMD intervals.

The CPU load on this system, with 64 cameras running in 4CIF MJPEG mode, increases by approximately 10% each time VMD is performed one time per second. The load increase when doing VMD is fairly constant regardless of the live frame rate.

When designing the system, it is important to consider what the VMD interval should be or if it should do it at all. Most cameras can do VMD inside the camera and alert the system with an event when motion is detected in the image. Using VMD in the camera will move the load from the Recording Server to the Camera allowing the system to run with more cameras or at a lower CPU load.

By using the pre-buffer function, video recordings preceding the event can be included in the event recording. This ensures that if there is a small delay in receiving the event from the camera, the system will still be able to record video at the time of the event.

Another option is to decrease the VMD interval on non-critical cameras and only run at a higher VMD interval on a few critical cameras.

In the above case, the server would be able to record at 10FPS instead of 5FPS with the same CPU load if VMD were performed in the camera.

Conclusion: To either lower the CPU load or run more cameras on the server, decrease the VMD interval or disable it altogether where possible, and use the VMD from the camera.

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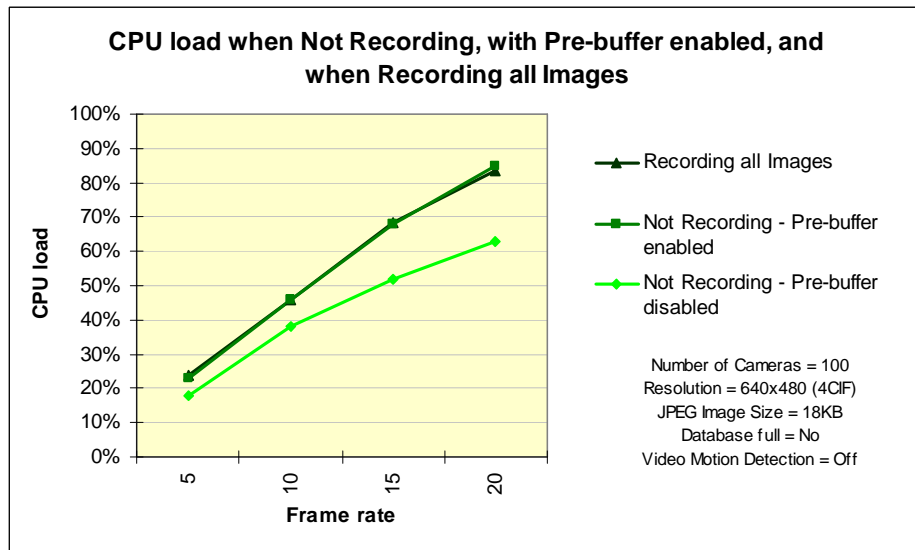
Recording – not Recording & Pre-buffer

The following parameters were changed for this test.

Image Size / Bit-rate	Live Frame rate	Rec. Frame Rate	VMD Interval
Cameras	Client Feeds	Format - JPEG/MPEG	Resolution
Virus Scanner			

Load impact on the server and network.

CPU	Storage	Network
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The above graph shows the CPU load when not recording with the pre-buffer disabled and enabled, and when recording all images.

Using the pre-buffer is not more CPU intensive than recording all the images, which could have been the case since images are recorded in the database for the pre-buffer time then deleted again if not used by a rule. However, the graph also shows that the system load using the pre-buffer feature equals the system load when all cameras were recording always, even with only a minor percentage of the total amount of cameras actually recording at any given time, e.g. when motion is detected on some of the cameras.

Conclusion: CPU load in a system with pre-buffering enabled will be the same as if the system were always recording all cameras. Deleting images from the database/pre-buffer does not add any noticeable CPU load to the system. In order to lower the CPU load on the system, enable only pre-buffering on the cameras where this feature is necessary.

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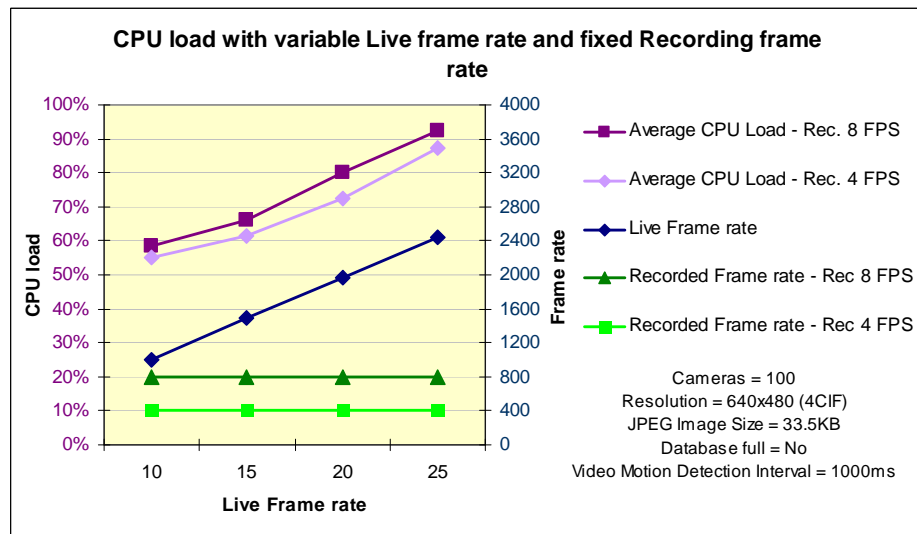
Variable Live frame rate

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate Rec. Frame Rate VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows the CPU load with a variable live frame rate and a fixed Recording Frame rate at 4 and 8 FPS

The CPU load increases with a higher Live frame rate, even when the Recording frame rate and the VMD interval remain the same. This is because drivers and the system in total have more data to handle. The CPU load also increases when the Recording frame rate increases, due to the database handling more data going to it.

Conclusion: Running the cameras at a higher live frame rate increases the CPU load. This needs to be taken into account when designing the system. In the setup shown, the CPU load would go from around 87% with 100 cameras live at 25 FPS to around 62% if the live FPS were lowered to 15 FPS (still recording at 4 FPS).

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Image size

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate Rec. Frame Rate VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows the CPU load with different image sizes at different frame rates.

The CPU load increases when the image size increases: drivers and internal image handling have to manage more data through the system. When designing a system to run with a number of cameras at a specific frame rate, it is important to take into consideration the JPEG image size or in MPEG mode, the bit-rate. The higher the bandwidth into the Recording Server, the higher the CPU load is on the Server. If the image quality is increased in a running system, the CPU load will also increase.

Conclusion: It is important to know the JPG image size or MPEG bit rate when designing the system. Increasing the JPEG image size at 12 FPS live will increase the CPU load from around 48% with 20 KB images to around 85% with 50 KB images.

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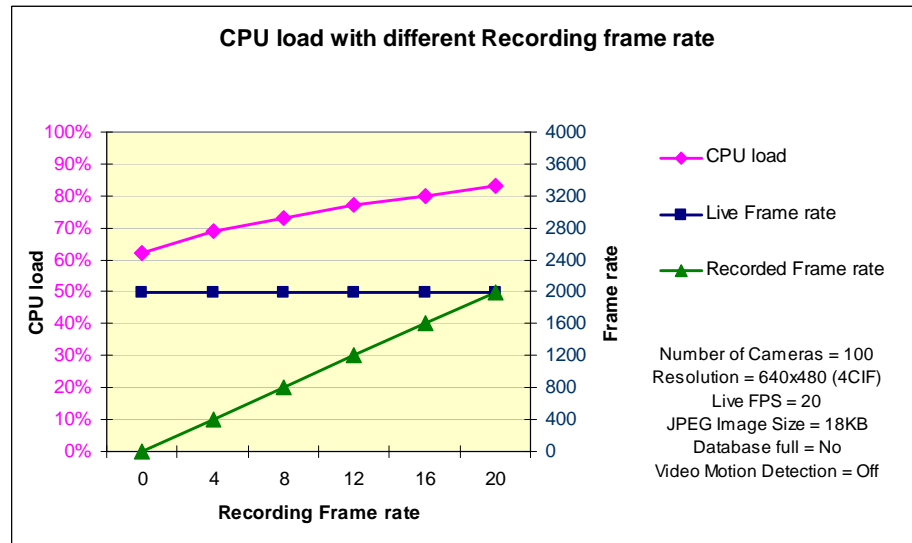
Variable Recording frame rate

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate **Rec. Frame Rate** VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows the CPU load with increased Recording FPS while retrieving images at 20FPS.

The CPU load increases when the recording frame rate increases since the database needs to handle more data going into it. Recording to the database is relatively inexpensive compared to just retrieving the images to the Recording Server.

Retrieve at 20 FPS and record at 0 FPS = 62% CPU load.

Retrieve at 20 FPS and record at 20 FPS = additional 20% CPU load.

Conclusion: Running the cameras at a higher live frame rate will increase the CPU load relatively more than merely increasing the recording frame rate.

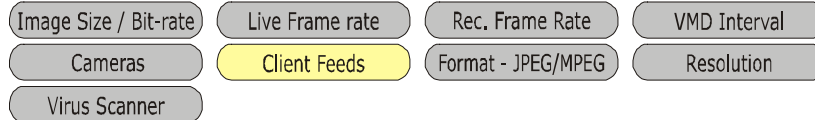
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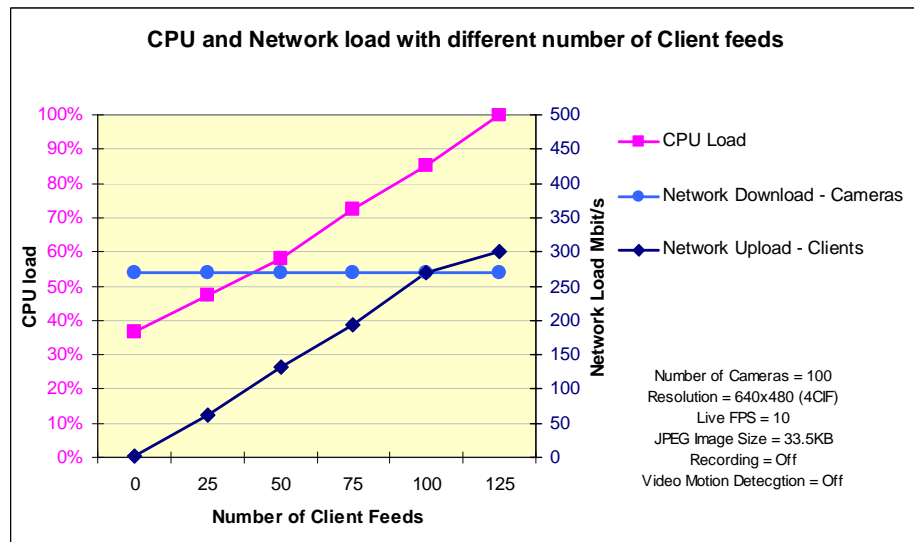
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Client feeds

The following parameters were changed for this test.



Load impact on the server and network.



The above graph shows the CPU load with different numbers of Client feeds connected – one feed is one camera shown in one Client.

Note: The Client load was tested with a Milestone Smart Client that does not decode the images but only retrieves them from the server. The reason was to make sure that the CPU was not overloaded on the workstation running the Client and to make sure that the Client was able to retrieve all the images from the server for each measurement.

The CPU load increases with the number of Client feeds the Recording Server has to stream to the Clients. Hence, when designing a surveillance system one has to take into account how many Client feed connections there are going to be, either to live streams or to recorded images. It should also be taken into account that the CPU load per Client feed increases when the image size increases, just as when changing the size of the images retrieved from the cameras.

Conclusion: It is important to consider how many Clients will be connected to the system and calculate the additional load each Client feed will add to the CPU. As a rough estimate, the CPU load ratio is around 1:1 for load from camera feed to load to Client feeds.

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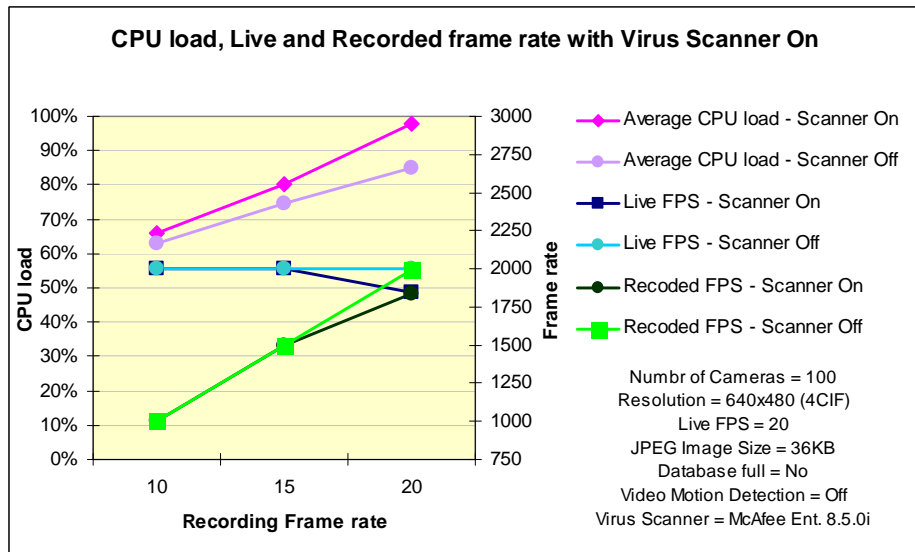
Virus Scanner

The following parameters were changed for this test.

Image Size / Bit-rate Live Frame rate **Rec. Frame Rate** VMD Interval
Cameras Client Feeds Format - JPEG/MPEG Resolution
Virus Scanner

Load impact on the server and network.

CPU Storage Network



The above graph shows that the CPU load increases when the virus scanner scans the folder where the media database is located.

Note: The measurements with the virus scanner switched off were done with the virus scanner installed, but set not to scan files in the folder where the database was placed. The virus scanner used was McAfee® Enterprise 8.5.0i. Other virus scanners may use more or less CPU when scanning the media database folder. When installing a virus scanner on the system, it is important to consider the performance impact on both the CPU load and the disk access performance.

General recommendation: For a stand-alone surveillance system with a closed surveillance network with no other network access (internet/corporate cameras or remote clients), it is recommended not to install a virus scanner. System security is not compromised, since the system is separated from other IP networks. In a system with other network access (internet or corporate LAN), it is recommended to install a virus scanner and configure it not to scan the folder containing the video databases as it will cause a higher CPU load and a lower disk performance.

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Appendix:

Software version used during performance tests:

All tests were performed on **Milestone XProtect Corporate 1.5c**

Tools and software used during the tests:

- **Axis® Virtual Camera** version 2.02.001 with an **Axis 211A** emulate up to 120 cameras
- **Performance Test v6.1** from Passmark™ Software
www.passmark.com
- **Microsoft Performance Monitor (Perfmon)** to monitor live and recorded frame rate
- **Microsoft Task Manager** to monitor CPU load on the server
- **XProtect Corporate Database-analyzer** - Milestone internal development tool to analyze the XProtect Corporate Database
- **Net Traffic Meter** Version 6.1716.36851 to monitor the network load

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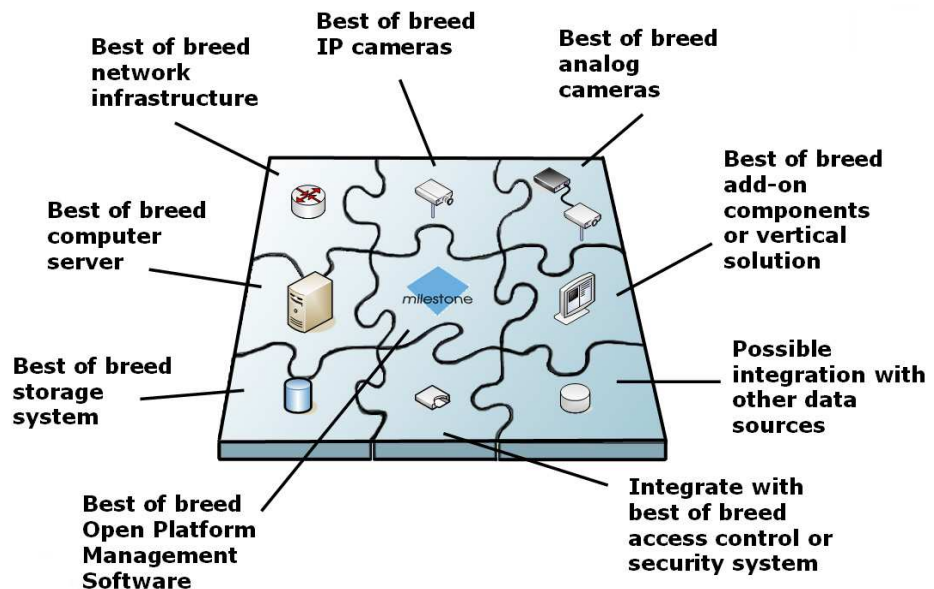
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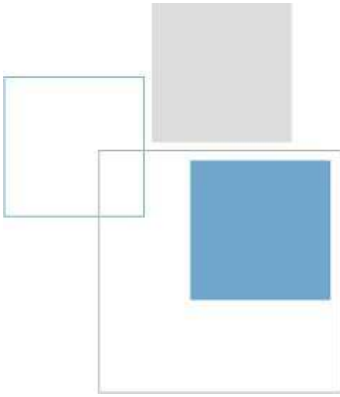
Innovative. Milestone Systems is internationally recognized as an innovator and thought leader in open platform IP video management software. Milestone's XProtect products operate as the core of surveillance systems: connecting, sharing and managing all devices through a single interface that is easy to learn and operate.

Easy to use. The XProtect platform is easy to use, proven in operation, and scales to support unlimited devices. XProtect products support the widest choice of network video hardware and are designed with an Application Programming Interface (API) that integrates seamlessly with other manufacturers' systems.

"Best of breed." Using XProtect, you can build scalable, "best of breed" solutions to video-enable your business, reduce costs, optimize processes, protect assets and ultimately increase value in your organization's products and services.



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Milestone Systems is a global developer of open platform IP video management software. Milestone XProtect™ gives users a powerful surveillance solution that is easy to manage, reliable and proven in more than 35,000 customer installations. With support for the industry's widest choice in network hardware and integration with other systems, XProtect provides best-of-breed solutions to "video enable" organizations - reducing costs, optimizing processes, and protecting assets. Milestone solutions are sold exclusively through authorized partners in 90 countries.

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