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# The Many Benefits of XProtect Dual-Recording with RMF

A WHITE PAPER

VEGA SYSTEMS INC.

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# Introduction

The central purpose of a surveillance system is to ensure *failure free* video capture, storage, and on-demand access to live and stored video.

In XProtect, the recording server is a heavyweight component of the system. Primarily, it fetches video from cameras, stores video, serves video to other XProtect components and third-party consumers. Unhandled failure of this critical component causes a serious security loophole.

XProtect offers mechanisms to mitigate failure in different parts of the surveillance system. For e.g., the effect of network failure is mitigated through support for Edge Storage. Recording server failure can be handled through failover. Management server failure is handled through Microsoft clustering.

We introduce RMF, a new method to enhance recording server redundancy. It makes recording server redundancy extremely flexible and significantly improves key high-availability metrics.

For e.g., a few redundant recording servers with RMF can tolerate concurrent failures of all primary recording servers. Live view recovery is within 100's of ms of the primary recording server failure. Un-interrupted access to archive footage even upon primary recording server failure is made possible.

# Dual Recording, RMF

Dual-Recording (DR) an Active-Active redundancy mechanism, is illustrated in Figure 1. The camera produces two video streams that are parallelly recorded on two separate recording servers always. The streams may or may not have identical resolution, frame rate, retention times.

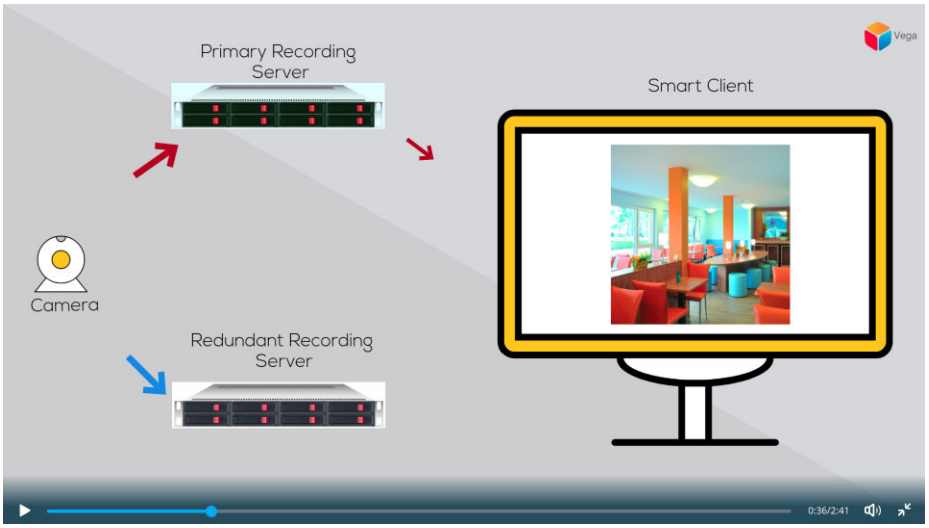


*Figure 1: Dual Recording Concept*



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The Redundancy Management Framework (RMF) is a plugin solution built on Milestone MIP that enables seamless, unified, DR management. *Video and functionality* are smart-combined across redundant recording servers. Being completely transparent to the end user, it adds *functional redundancy* to live, playback views, PTZ control, presets, bookmarks and alarms. Geographical redundancy across multiple XProtect sites is supported through Federation.

Next, we look at different types of installations and analyze how RMF provides benefits in these situations.

# Single Site Installations

'Single Site' refers to a XProtect installation with one Management Server.

In all scenarios considered below, Edge Storage is assumed to be enabled. This is the only mitigation for network failure.

## Sites with Primary Recording Servers + Edge Storage

At installations with Edge Storage configured, but with no failover recorder:

1. Live video is lost for the entire duration of primary recorder downtime.
2. New video produced during this downtime by a camera that was managed by the failed recorder, is not accessible by content consumers until the recorder comes back up and missing video is restored to it from the camera.
3. For the duration of downtime, no archive video is accessible.

This is illustrated in Figure 2.

A similar set up with RMF, mitigates all above issues.

1. RMF provides very low live view breakage time (100's of ms).
2. New video produced during this downtime by a camera that was managed by the failed recorder, is accessible through the redundant recording server.
3. DR ensures availability of archive video always.
4. In addition, with the DR architecture managed by RMF, a *few redundant recording servers can support concurrent failure of all primary recording servers*.

This is illustrated in Figure 3. Key High-Availability metrics are improved.

Note that redundant recorders are free to record each stream at different frame rate/resolution and can have a different retention policy viz a viz the primary stream. Streaming and storage parameters can be chosen to meet bandwidth and cost budget constraints.



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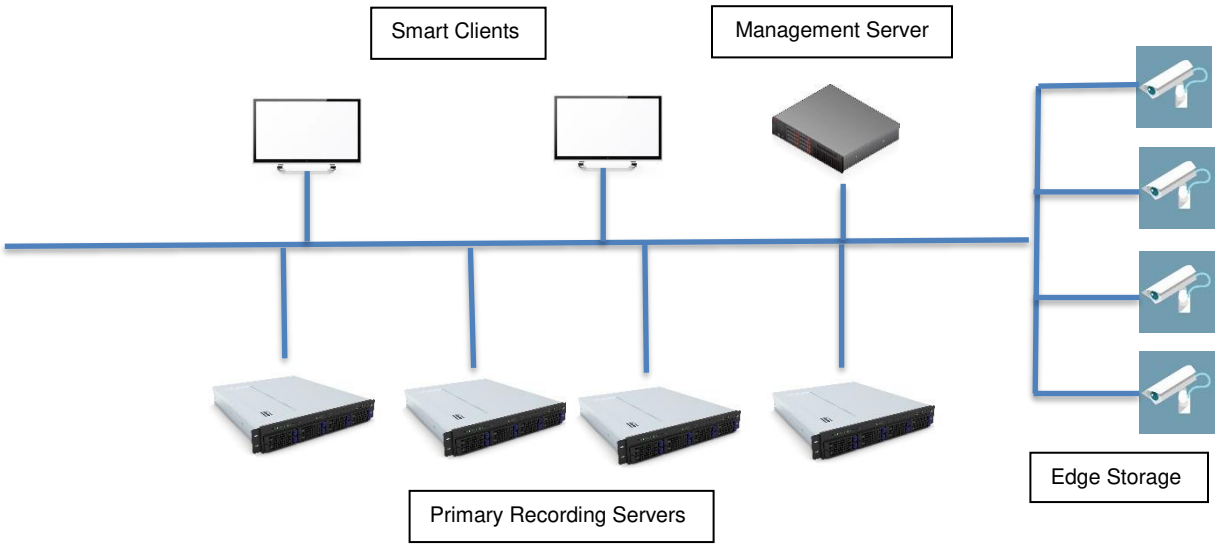
Missing footage on Redundant Servers during downtimes is restored directly from the camera through in-built XProtect Edge Storage features.

*Figure 2: Single XProtect Site with Edge Storage*



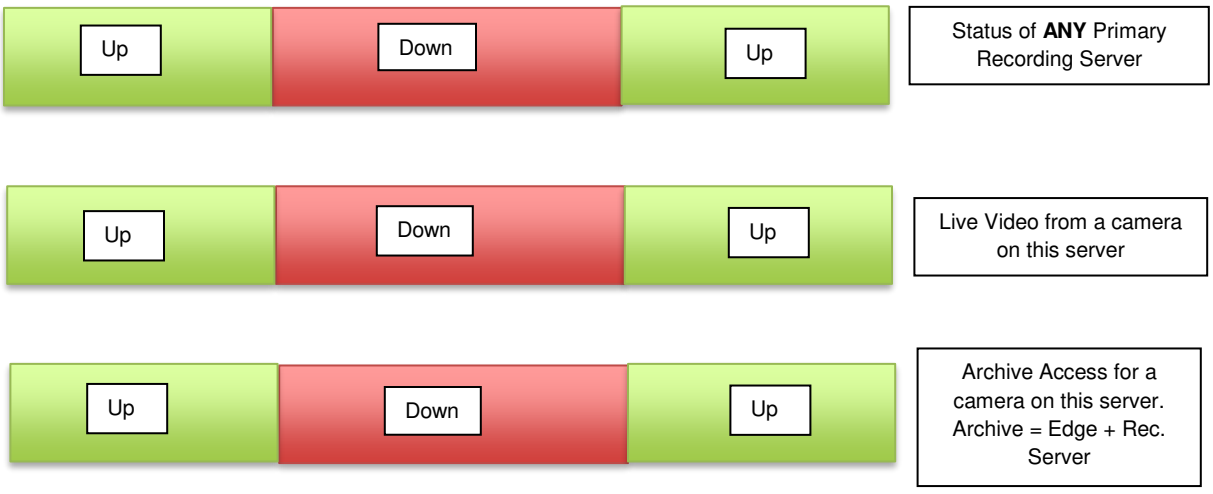






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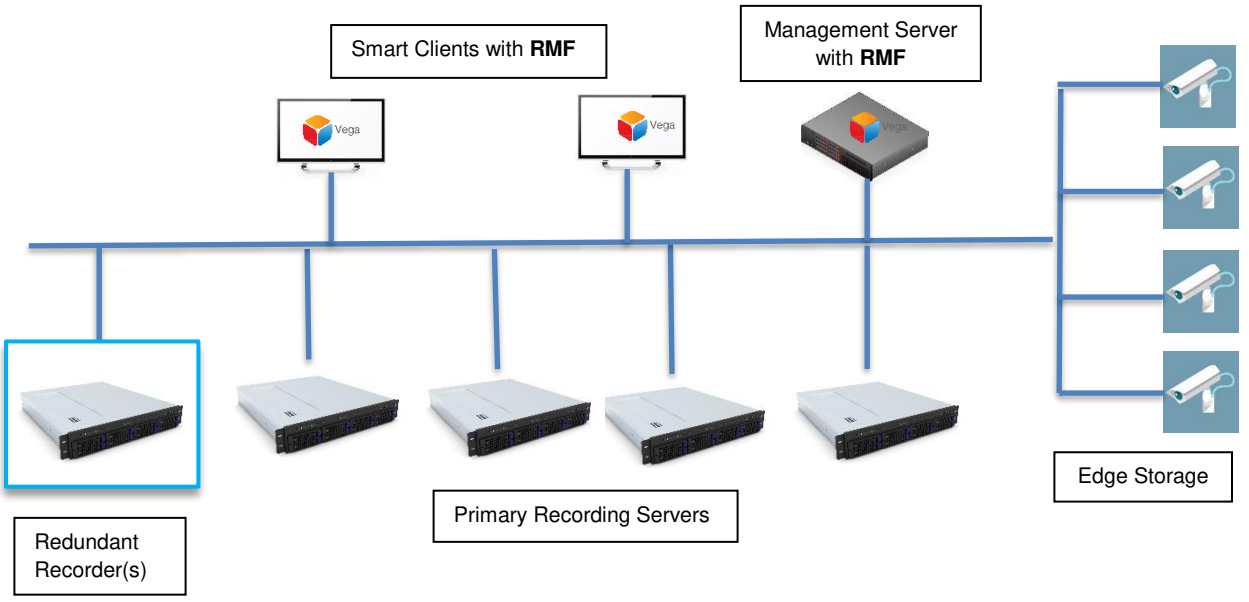
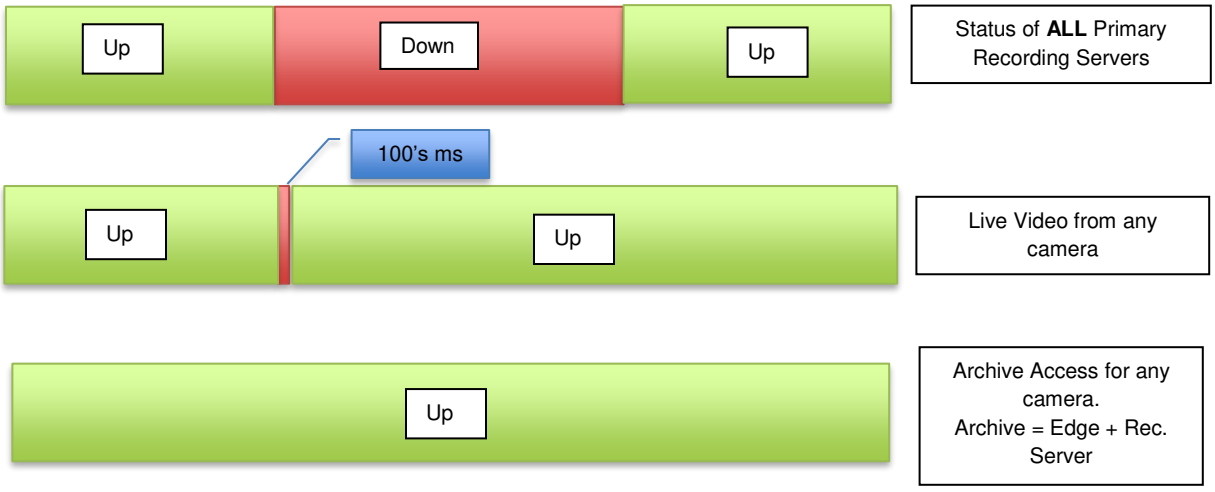
*Figure 3: Single XProtect site with RMF + Edge Storage*



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## Sites with Primary Recorders + Failover Recorders + Edge Storage

Here, during primary recording server downtime:

1. Live view disruption due to Failover server warmup, is of the order of 10's of seconds.
2. Archive footage cannot be retrieved either from the primary recording server or from edge storage.
3. In both cold and hot failover modes, there is a one-to-one correspondence between Primary and failover recording servers. For e.g., an installation with 20 primary recording servers and 2 failover recording servers can tolerate concurrent failures of two primary recording servers at most.

These are illustrated in Figure 4.

In a similar dual recording set up managed by RMF:

1. Live video loss is limited to 100's of ms.
2. Access to archive footage is provided due to DR. The amount of archive storage is a design parameter under SI control.
3. There is no limitation of a one-to-one correspondence between primary and redundant recording servers. Each redundant stream's parameters are set independently from the primary stream. These can be chosen to achieve an all-to-few recorder mapping. *A few redundant recording servers can tolerate concurrent failures of all primary recording servers*.

With RMF, Streaming and storage parameters can be chosen to meet bandwidth and cost budget constraints.

Illustrated in Figure 5.



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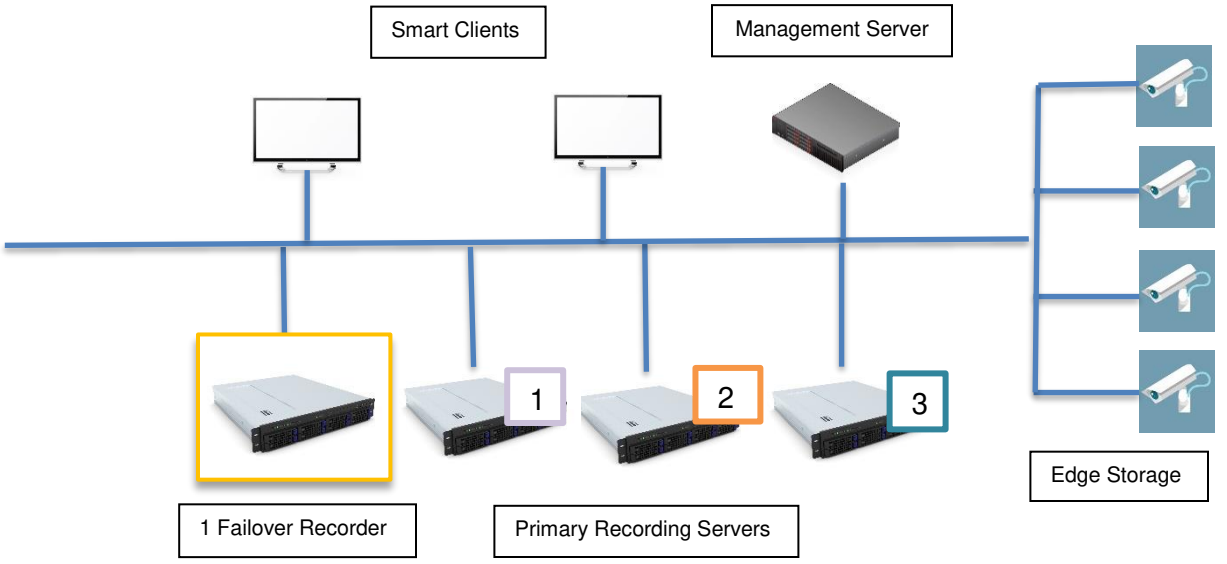
*Figure 4: Single XProtect Site with Failover and Edge Storage*



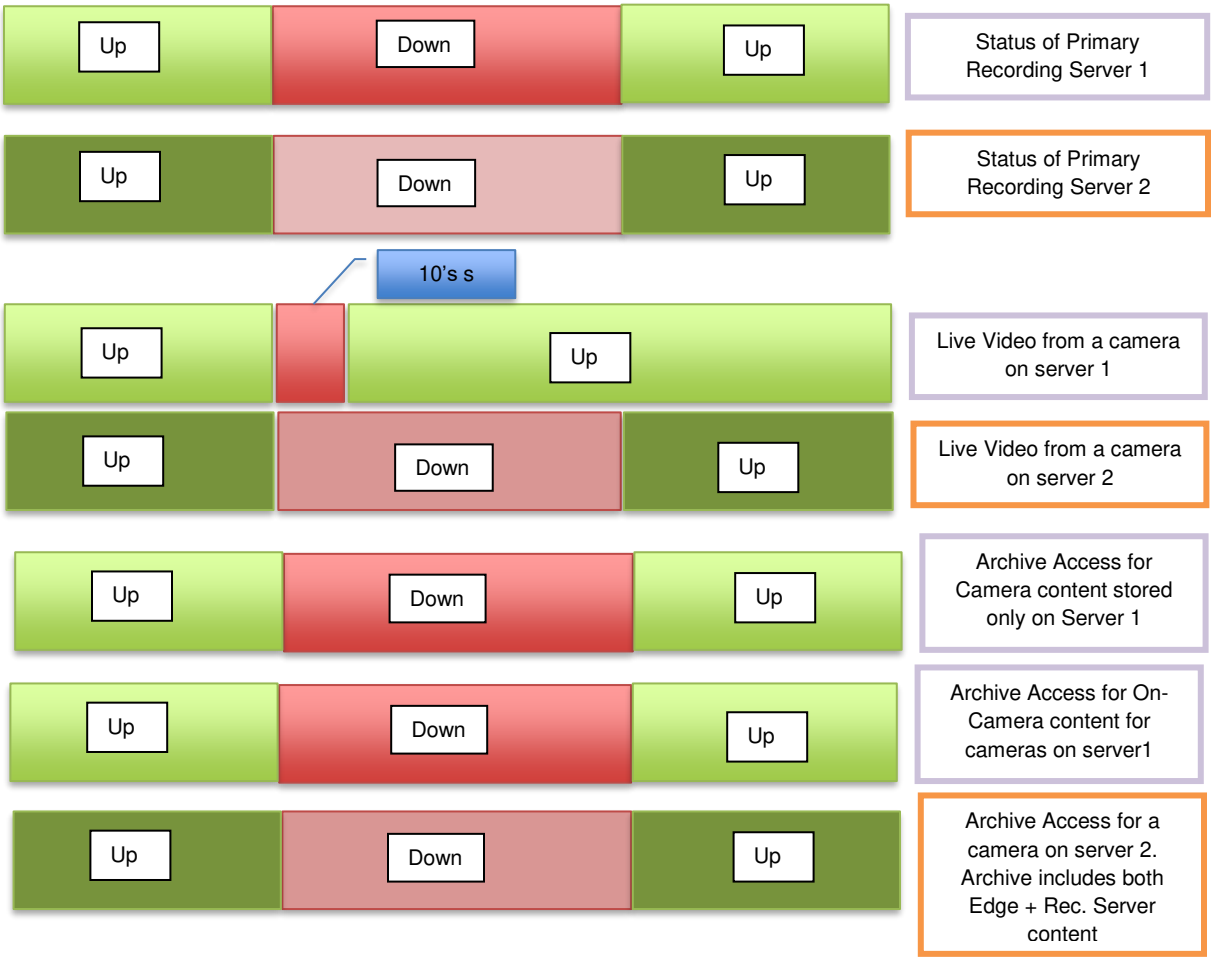
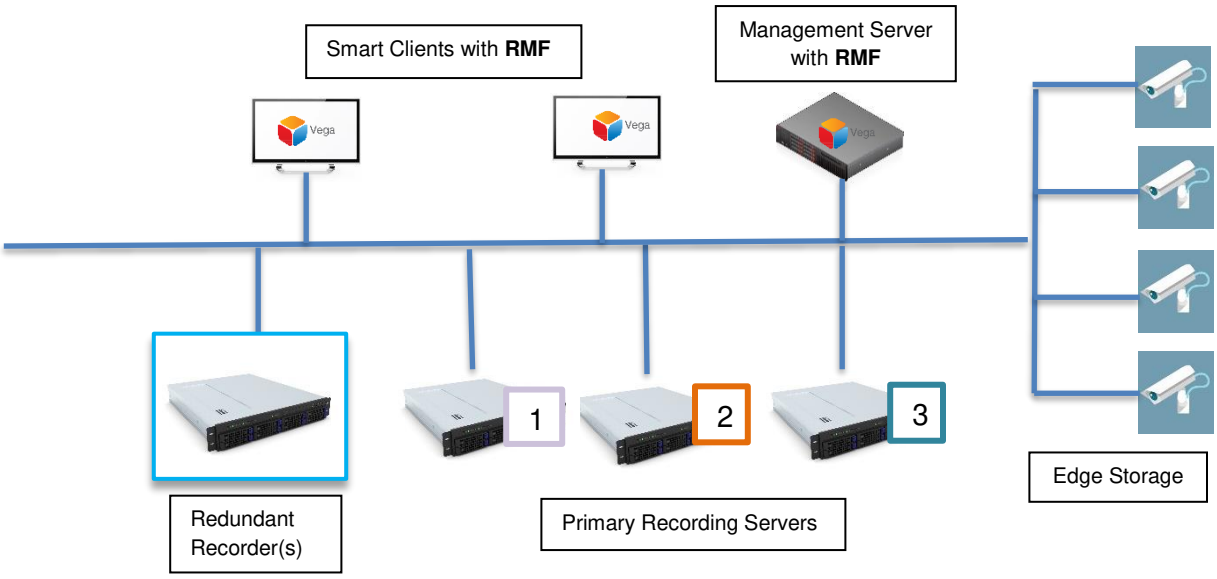
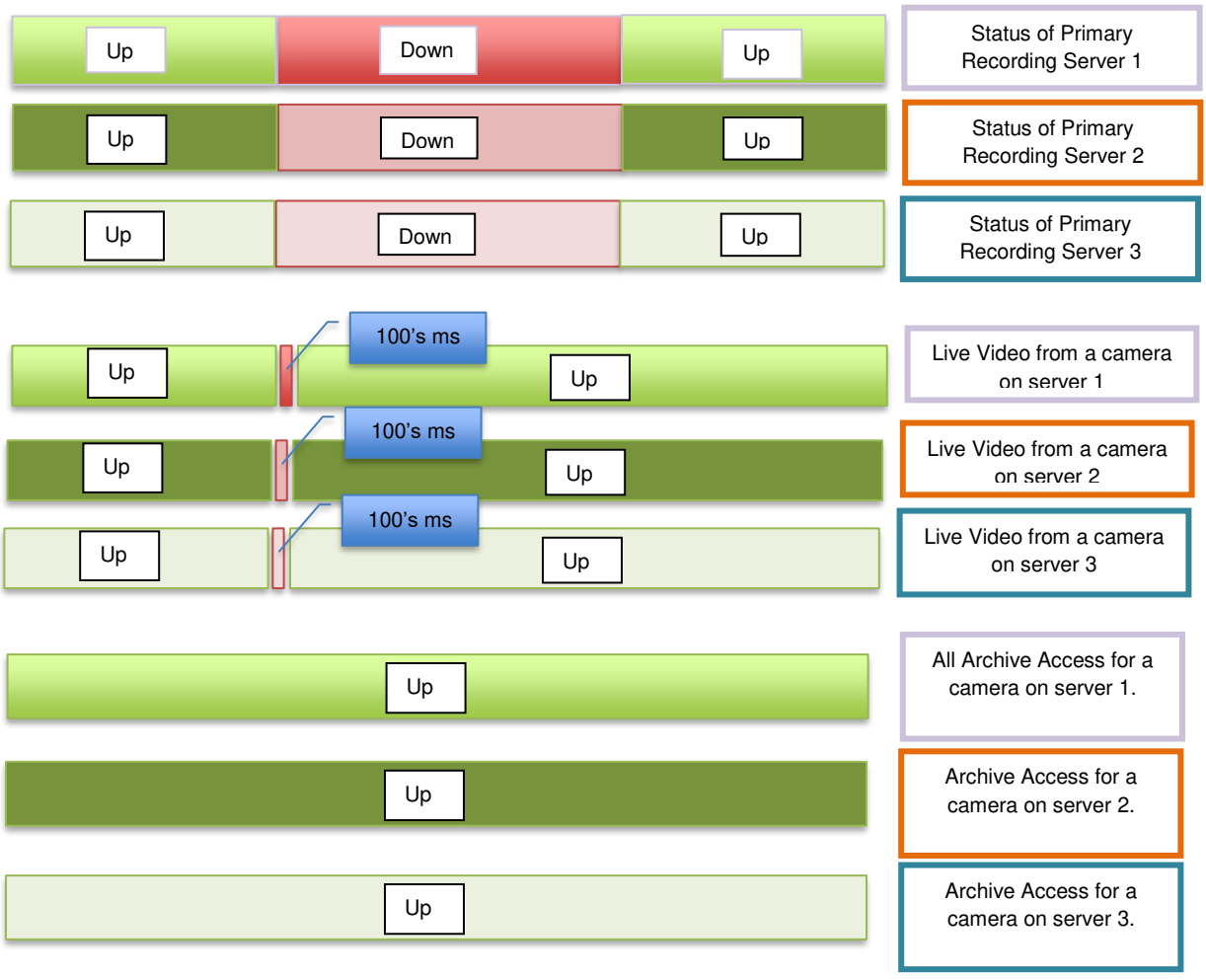



*Figure 5: Single XProtect site with RMF + Edge Storage*



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# Multi-Site Installations

A multi-site installation is defined as one that has more than one management server.

Several projects need two geographically separated, redundant recordings of surveillance video. While a combination of on-camera storage and primary recording servers could be an option, this has some limitations.

1. First, archive footage on-camera becomes vulnerable to camera vandalism.
2. Second, in XProtect, in the event of recording server failure, edge video is in-accessible. In effect, there is no access redundancy.

So, at many sites, the requirement for redundant recording is met through two separate XProtect installations, each at a different data center. These two data centers record video from the same cameras in parallel.

This is already a DR set up. However, end user experience is not immune to recording server failures at a site. Some limitations of this multi-site architecture are:

1. The underlying architecture is not transparent to the user. There is no way to centrally set bookmarks, manage alarms.
2. Live video from a camera is lost when the corresponding recording server fails. The end user must manually open the correct stream from the correct recording server at the other site to continue to view the stream. This is cumbersome.
3. Playback hits the same issue as (2).

RMF remedies all these issues. RMF supports multi-site installations through federation. It allows the customer *to leverage their investment by having recording servers at the two sites work in synergy and provide a unified video, functional interface to the end user.*
Its benefits are:

1. Makes the architecture transparent. Duplicates/Filters bookmarks and alarms automatically.
2. Automatic, fast switching of live and playback video at failure events.
3. Complete freedom to have independent camera to recording server mapping at each site.
    a. RMF automapping adapts to each site's mapping changes.

Figure 6 depicts multi-site support with RMF.



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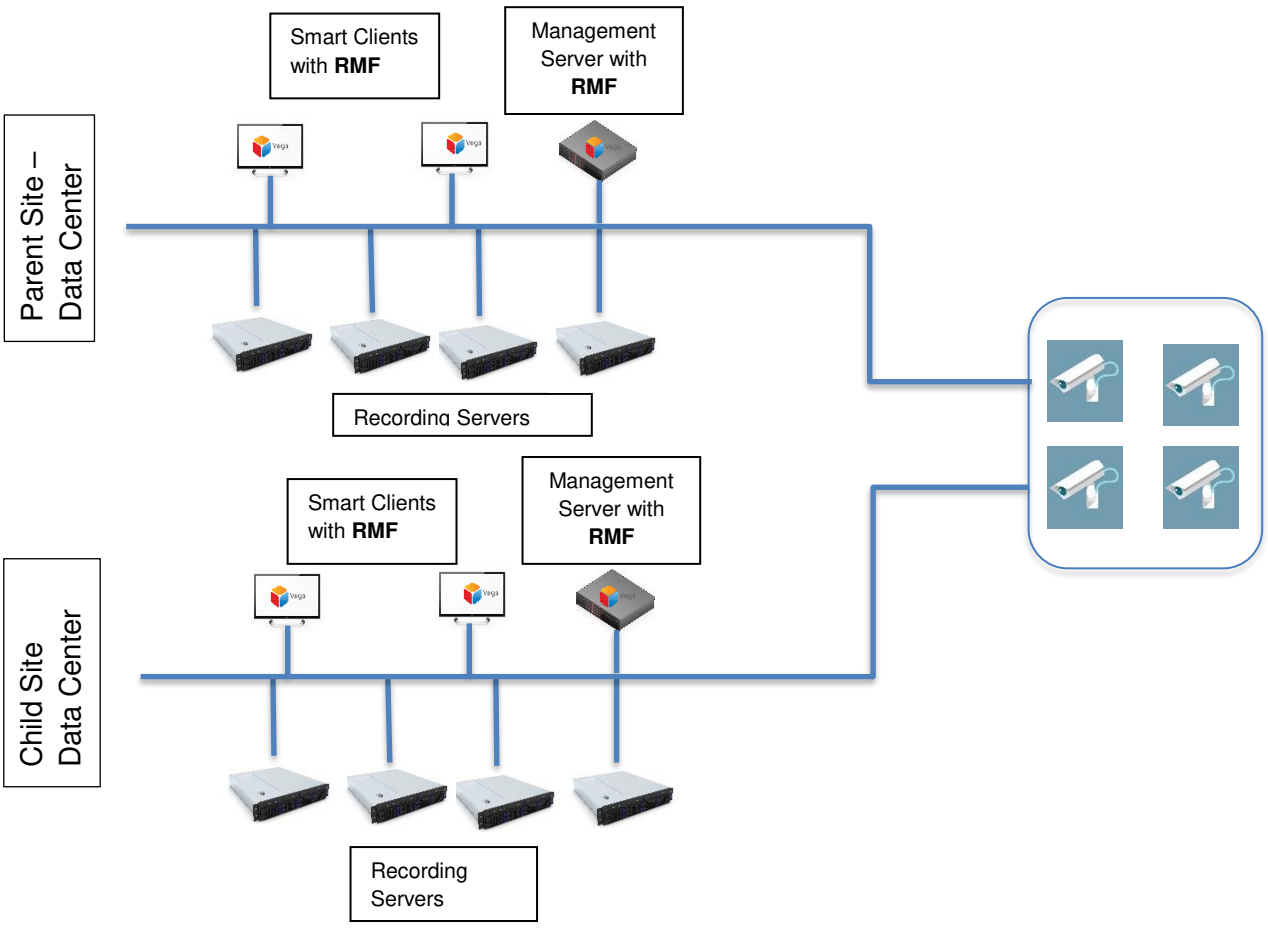
*Figure 6: Multi-Site Support with RMF*



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# Bandwidth

With Dual-Recording, there are two streams from the camera, one to each recording server.

The system integrator/installer has full control in setting the frame rate/resolution of the redundant stream from each camera. These can be chosen to meet bandwidth budgets.

The client-side network has no additional bandwidth requirements.

# A Cost Example

We consider a 500-camera installation with primary recording servers. We then compute the incremental cost of adding hardware required by RMF and compare this with the incremental cost of adding failover hardware. To make a fair comparison between RMF and failover, we equalize:

1. The concurrent failover capacity.
2. Retention duration.

The XProtect Server calculator from https://www.milestonesys.com/xprotect-server-calculator/ was used to come up with server requirements for both Primary and RMF Redundant servers. The failover servers have the same parameters as Primary servers.

The parameters for the primary (failover) server, recording H.264 video is as in Figure 7.

Cameras

| Camera Name | Manufacturer / Model | Qty | Resolution / Codec / Complexity | Continous FPS | Event FPS | Hours | Motion / Event % | Retention (Days) | Bitrate (Kbps) |
|---|---|---|---|---|---|---|---|---|---|
| Axis | Axis 206 | 500 | HD1080 (1920x1080) --- Select --- Medium | 0 | 30 | 24 | 50 | 30 | 7016.62 |

*Figure 7: Primary Server Recording Parameters*

The recording parameters for the RMF server, also recording H.264 is as in Figure 8.

Cameras

| Camera Name | Manufacturer / Model | Qty | Resolution / Codec / Complexity | Continous FPS | Event FPS | Hours | Motion / Event % | Retention (Days) | Bitrate (Kbps) |
|---|---|---|---|---|---|---|---|---|---|
| Camera | --- Select --- 206 | 500 | VGA (640x480) --- Select --- --- Select --- | 0 | 5 | 24 | 50 | 30 | 210.38 |

*Figure 8: Redundant Server Recording Parameters*



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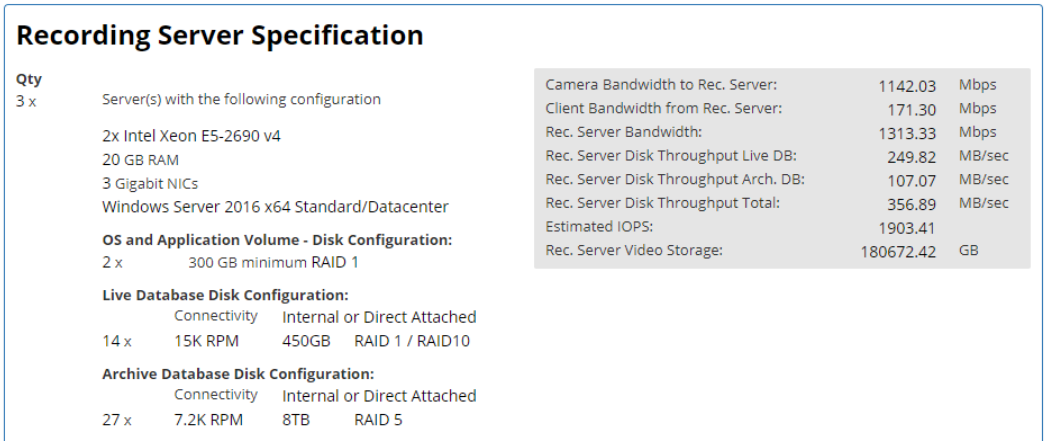
The XProtect Server calculator suggests a server configuration for primary (failover) servers as in Figure 9.



**Recording Server Specification**

**Qty**
3 x Server(s) with the following configuration

2x Intel Xeon E5-2690 v4
20 GB RAM
3 Gigabit NICs
Windows Server 2016 x64 Standard/Datacenter

**OS and Application Volume - Disk Configuration:**
2 x 300 GB minimum RAID 1

**Live Database Disk Configuration:**

| | Connectivity | Internal or Direct Attached | |
|---|---|---|---|
| 14 x | 15K RPM | 450GB | RAID 1 / RAID10 |

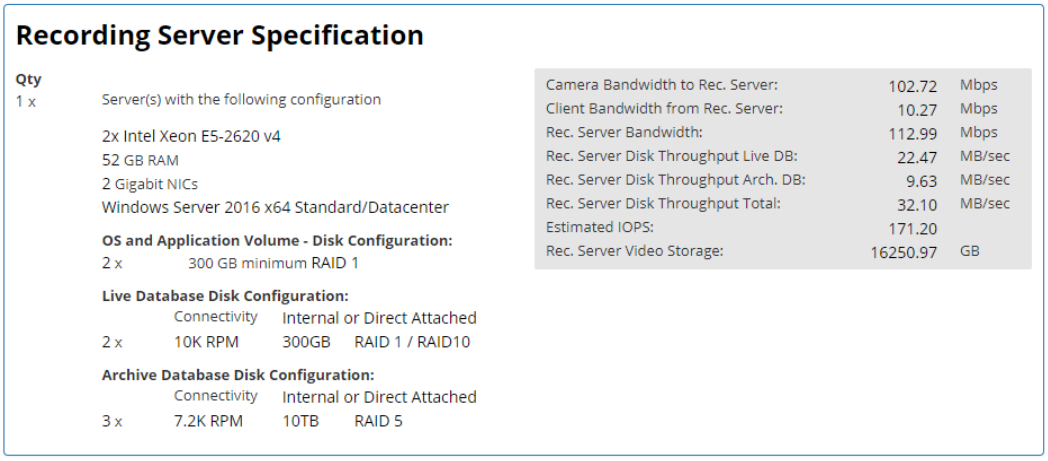
**Archive Database Disk Configuration:**

| | Connectivity | Internal or Direct Attached | |
|---|---|---|---|
| 27 x | 7.2K RPM | 8TB | RAID 5 |

| | | |
|---|---|---|
| Camera Bandwidth to Rec. Server: | 1142.03 | Mbps |
| Client Bandwidth from Rec. Server: | 171.30 | Mbps |
| Rec. Server Bandwidth: | 1313.33 | Mbps |
| Rec. Server Disk Throughput Live DB: | 249.82 | MB/sec |
| Rec. Server Disk Throughput Arch. DB: | 107.07 | MB/sec |
| Rec. Server Disk Throughput Total: | 356.89 | MB/sec |
| Estimated IOPS: | 1903.41 | |
| Rec. Server Video Storage: | 180672.42 | GB |

*Figure 9: Primary Servers and Configuration*

For the redundant server (for RMF) it suggests a configuration as shown in Figure 10.



**Recording Server Specification**

**Qty**
1 x Server(s) with the following configuration

2x Intel Xeon E5-2620 v4
52 GB RAM
2 Gigabit NICs
Windows Server 2016 x64 Standard/Datacenter

**OS and Application Volume - Disk Configuration:**
2 x 300 GB minimum RAID 1

**Live Database Disk Configuration:**

| | Connectivity | Internal or Direct Attached | |
|---|---|---|---|
| 2 x | 10K RPM | 300GB | RAID 1 / RAID10 |

**Archive Database Disk Configuration:**

| | Connectivity | Internal or Direct Attached | |
|---|---|---|---|
| 3 x | 7.2K RPM | 10TB | RAID 5 |

| | | |
|---|---|---|
| Camera Bandwidth to Rec. Server: | 102.72 | Mbps |
| Client Bandwidth from Rec. Server: | 10.27 | Mbps |
| Rec. Server Bandwidth: | 112.99 | Mbps |
| Rec. Server Disk Throughput Live DB: | 22.47 | MB/sec |
| Rec. Server Disk Throughput Arch. DB: | 9.63 | MB/sec |
| Rec. Server Disk Throughput Total: | 32.10 | MB/sec |
| Estimated IOPS: | 171.20 | |
| Rec. Server Video Storage: | 16250.97 | GB |

*Figure 10: Redundant Server and Configuration*

Quotes for the above servers and archive storage were sourced from Dell.

We then normalize the server cost, storage cost and bandwidth required in both cases by corresponding numbers for RMF. Results, for this example are depicted in Figure 11.



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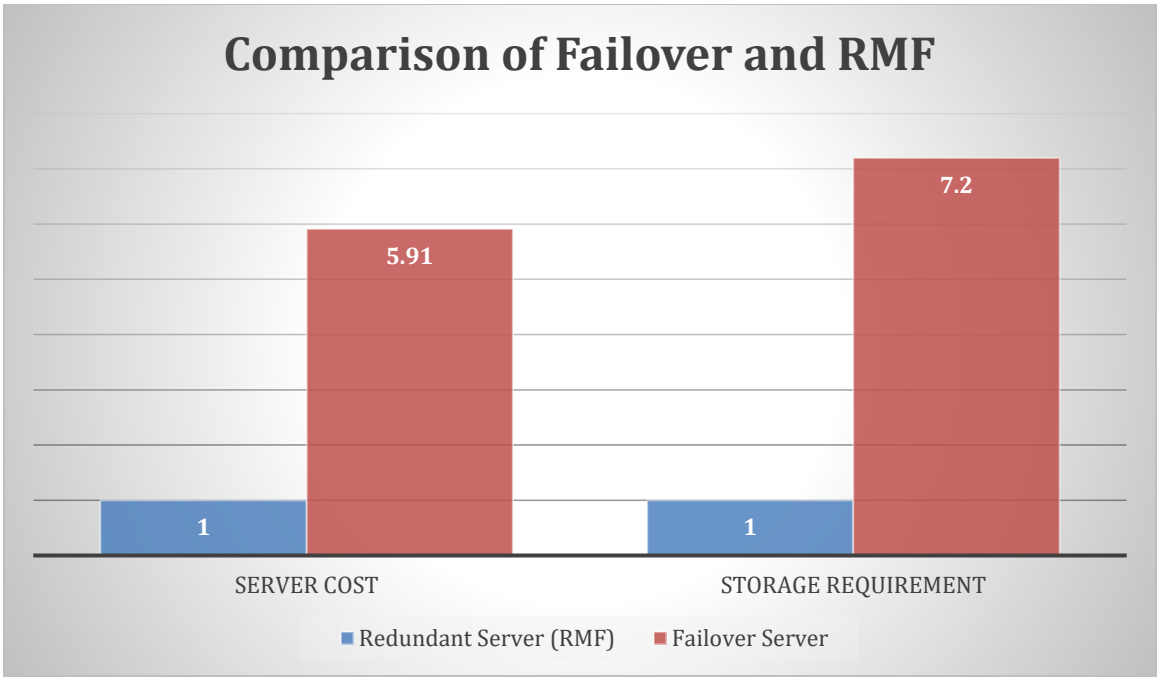


*Figure 11: Comparison of Failover and RMF for equal concurrent capacity and storage duration*



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# Summary

In this document we have shown that using RMF significantly enhances XProtect Redundancy by adding the following capabilities:

1. A few redundant recording servers can tolerate concurrent failures of all primary recording servers.
2. Live view recovery is within 100's of ms of the primary recording server failure.
3. Un-interrupted access to archive footage upon primary recording server failure.
4. The underlying architecture is transparent to the end user in both singe and multisite installations. Unified live/playback views, bookmark and alarm management.
5. In an example considered, and architecture with RMF and DR provided significant benefits compared to failover.

# About Vega Systems Inc.

Vega Systems Inc., provides innovative MIP plugins that add unique capabilities to XProtect. We help Milestone resellers worldwide, offer differentiated XProtect solutions. For more information, visit: https://www.vega25.com/surveillance.



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