2021

SureStream – A White Paper

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VEGA SYSTEMS INC.

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Introduction

Increasingly, on-prem customers such as airports, seaports and other critical infra., require surveillance solutions with zero blind times. The never want to be in a situation, however brief, where they cannot surveil and react quickly to events.

At a Milestone XProtect installation, if all/enough surveillance servers go offline, the facility is rendered blind.

SureStream is a XProtect plugin, that that prevents such blindness even when all servers go offline. It runs on XProtect Servers and Smart Clients. It requires zero additional hardware.

Server Outages

A typical surveillance system has vastly many more cameras than servers. For reasons illustrated below, simultaneous failure of the few servers is more likely than simultaneous failures of the many cameras.

Power Source Diversity

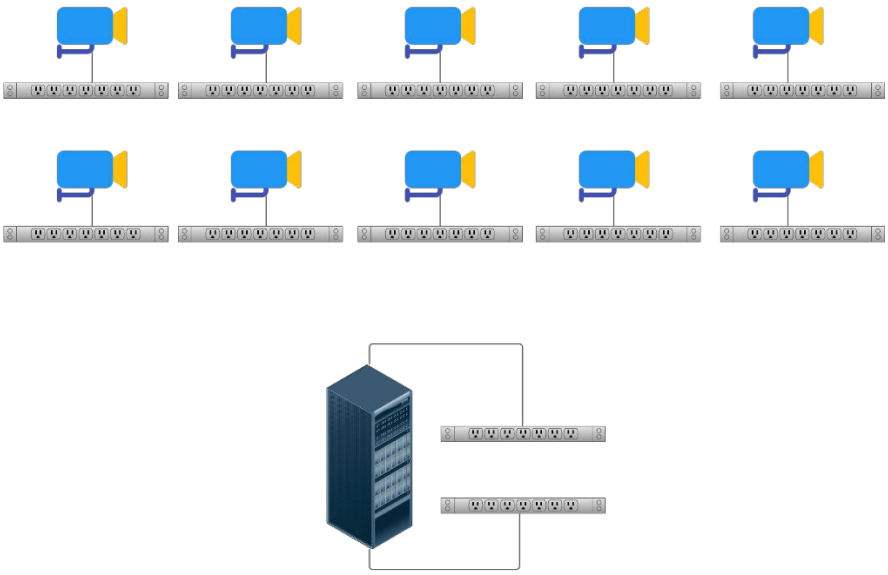

Figure 1: Power diversity distribution

Figure 1 shows that many power sources need to fail simultaneously for all cameras to fail. Few need to fail for all servers to go offline. Server failure due to power issues is therefore more likely.

Network Diversity

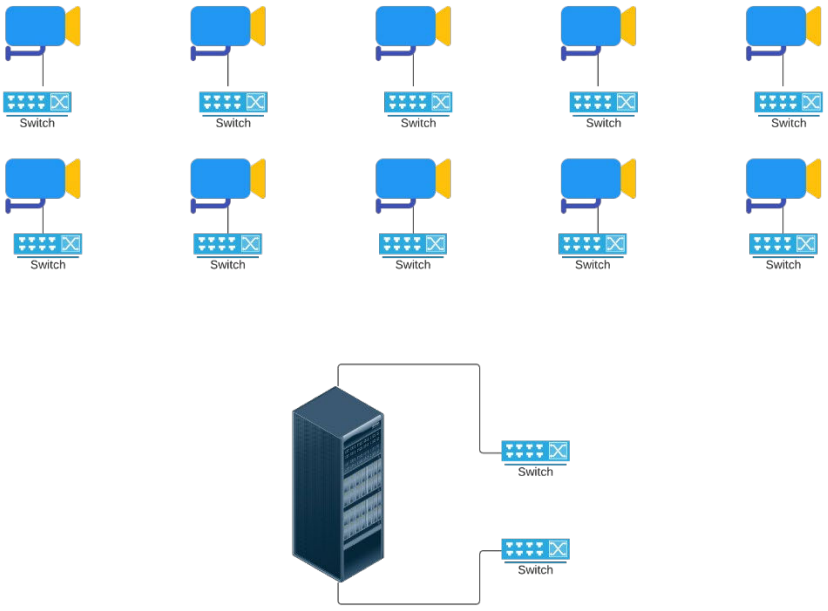

Figure 2: Network Diversity

Seen in Figure 2: many network paths need to fail for all cameras to fail. Few need to fail for all servers to go offline. Server failure due to network issues is more likely.

Software Updates

Figure 3: Server Software Updates

Servers need periodic software updates. Multi-server installations need simultaneous updates on all servers to prevent consistency issues. Servers are offline during this time. The facility is rendered blind during this process. This update process could take hours.

By contrast, camera firmware updates complete within minutes. Can be staggered. Affects only one camera at a time. Does not render the whole facility blind.

Ideally: Server Downtime ≠ Surveillance Downtime

Because of the above reasons any high availability architecture must insulate catastrophic failures from server downtimes.

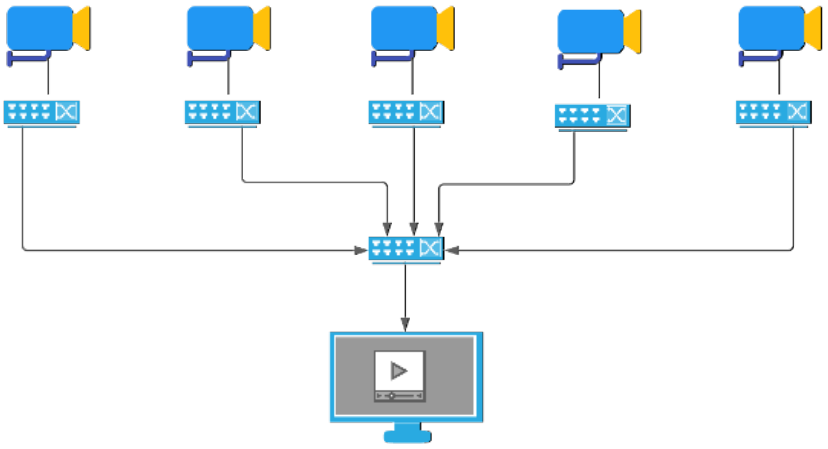

Figure 4: Diversity of paths leads to robustness

For example, Figure 4 shows an architecture in which a consumer (e.g., a Smart Client monitor) leverages network diversity to retrieve content. Each camera provides content directly to a consumer via a mostly independent path. This is server independent.

By contrast, Figure 5 shows an architecture in which the consumer sources all content from a single server. Fewer items must fail for the consumer to run dry. Clearly this is less robust.

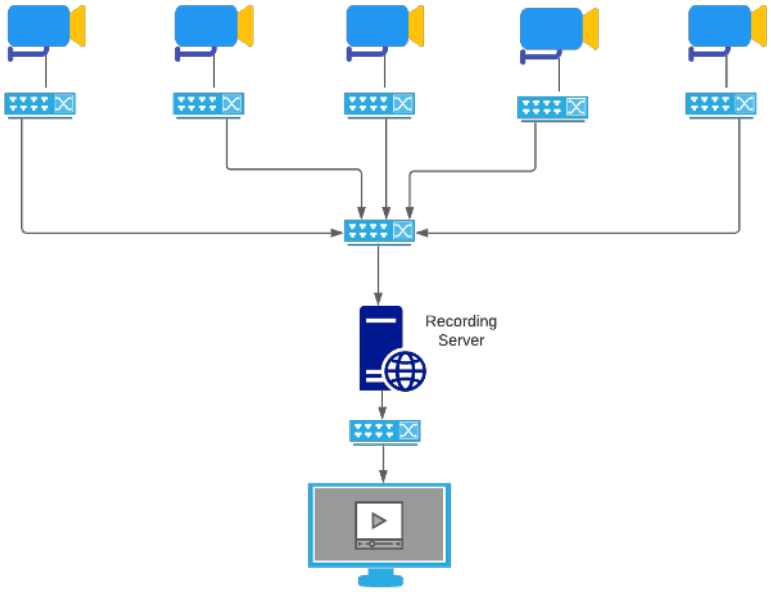

Figure 5: All content from a single path

SureStream

SureStream is built of the principles illustrated so far.

SureStream enables all authenticated XProtect Smart Clients receive unicast/multicast streams directly from cameras, bypassing servers. Once authenticated, server failures have zero impact on live video. It thus insulates surveillance failure from server failure.

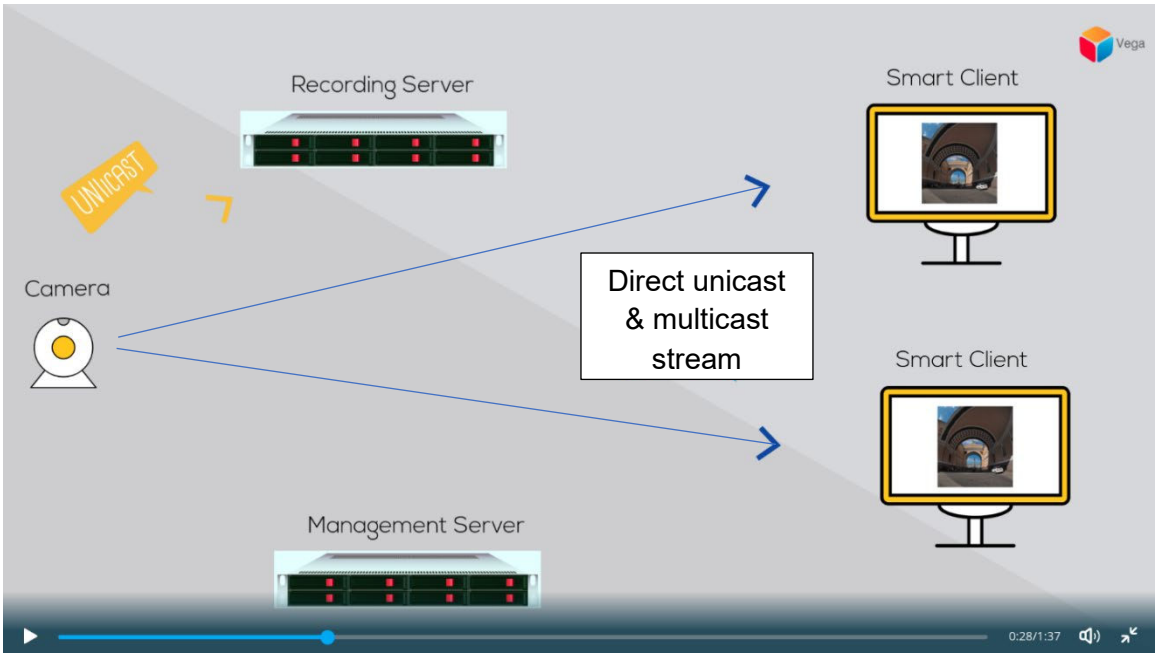

Figure 6: SureStream

Live Video Robustness with SureStream: An Analysis

We say that a surveillance system is in outage when users cannot view video from any camera. We compare the chance that a surveillance system will reach this state when XProtect is deployed with and without SureStream in on-premises deployments.

All the probabilities below are uniformly distributed over time. For example, a failure chance of p implies that, we can expect the component to fail for $p * 60 * 24$ minutes in one day.

XProtect with Rec. Server, Failover Server and Without SureStream

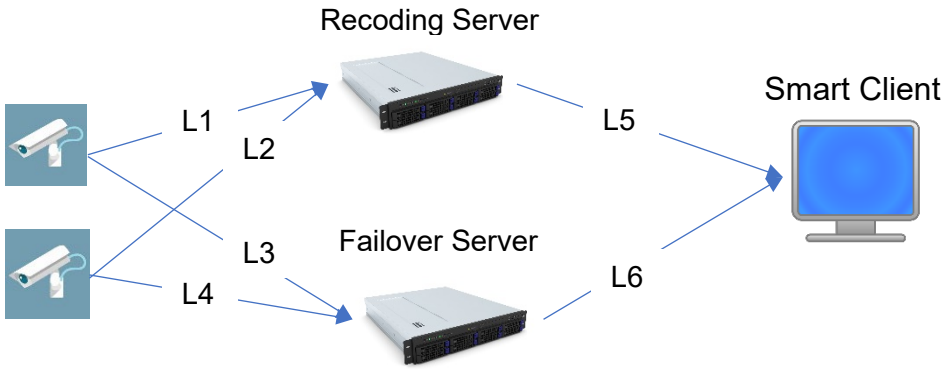

Figure 7: A XProtect architecture with Recording and Failover servers, without SureStream

In Figure 7,

1. The failover server functions only when the Recording server fails.
2. We assume, L1 – L6 are network links with equal probability of failure. We will call this failure chance as l. It follows, the chance of no failure is $1 - l$.
3. We assume, the recording server and failover server have equal probability of failure. We call this failure chance as r. It follows, the chance of no failure is $1 - r$
4. We assume, all cameras have equal chance of failure. We call this failure probability as c. It follows, the chance of no failure is $1 - c$.

The outage chance (f) that no video reaches the Smart Client (SC) Machine is

$$
\begin{aligned}
& f \\
& = (chance\ that\ the\ recording\ server\ is\ ok\ \boldsymbol{AND}\ no\ video\ reaches\ SC\ when\ rec.\ is\ ok) \\
& + (chance\ that\ the\ recording\ server\ is\ down\ \boldsymbol{AND}\ no\ video\ reaches\ SC\ when\ rec\ is\ down)
\end{aligned}
$$

$$f = (1 - r) * (chance\ that\ no\ video\ reaches\ SC\ when\ rec.ok) + r * (chance\ that\ no\ video\ reaches\ the\ SC\ when\ rec.down)$$

Above, the $chance\ that\ no\ video\ reaches\ the\ SC\ when\ the\ recording\ server\ is\ ok$, 'k' is

$$k = chance\ that\ link\ L5\ is\ ok\ and\ no\ video\ reaches\ SC\ when\ rec\ ok + chance\ that\ L5\ is\ down\ and\ no\ video\ reaches\ SC\ when\ rec\ ok.$$

$$= (1 - l) * (chance\ no\ video\ reaches\ SC\ when\ L5\ is\ ok\ and\ rec\ is\ ok.) + l * (chance\ no\ video\ reaches\ SC\ when\ L5\ is\ down\ and\ rec\ is\ ok.)$$

Above, $chance\ no\ video\ reaches\ SC\ when\ L5\ is\ ok\ and\ rec\ is\ ok.$, v is

$$v = chance\ that\ no\ video\ from\ first\ camera\ reaches\ the\ SC\ when\ rec\ and\ L5\ are\ ok$$
$$\boldsymbol{AND}$$
$$chance\ that\ no\ video\ from\ second\ camera\ reaches\ SC\ when\ rec\ and\ L5\ are\ ok$$
$$\boldsymbol{AND}$$
$$chance\ that\ no\ video\ from\ third\ camera\ reaches\ SC\ when\ rec\ and\ L5\ are\ ok$$
$$\boldsymbol{AND}$$
$$\dots$$

Above,

$$chance\ that\ no\ video\ from\ first\ camera\ reaches\ the\ SC\ when\ rec\ and\ L5\ are\ ok$$
$$= 1 - chance\ that\ video\ from\ the\ first\ camera\ reaches\ SC\ when\ rec\ and\ L5\ are\ ok$$
$$= 1 - chance\ that\ first\ camera\ is\ OK\ \boldsymbol{AND}\ link\ L1\ is\ ok$$
$$= 1 - (1 - c) * (1 - l)$$

So, for n, cameras,

$$v = \left(1 - (1 - c) * (1 - l)\right)^n = (l + c - lc)^n$$

So, $chance\ that\ no\ video\ reaches\ the\ smart\ client\ when\ the\ recording\ server\ is\ ok$, 'k' is:

$$k = (1 - l) * (l + c - lc)^n + l * (chance\ no\ video\ reaches\ SC\ when\ L5\ is\ down\ and\ rec\ is\ ok)$$

But $(chance\ no\ video\ reaches\ SC\ when\ L5\ is\ down\ and\ rec\ is\ ok)$ is 100% or chance of 1.
So,

$$k = (1 - l)(l + c - lc)^n + l$$

And,

$$f = (1 - r) * \left((1 - l)(l + c - lc)^n + l\right) + r * (chance\ that\ no\ video\ reaches\ the\ smart\ client\ when\ rec.down)$$

Above, the $chance\ that\ no\ video\ reaches\ the\ smart\ client\ when\ rec.down$, q can be computed as,

$$q = chance\ that\ failover\ server\ is\ ok\ \boldsymbol{AND}\ no\ video\ reaches\ SC\ when\ failover\ is\ ok + chance\ that\ failover\ server\ is\ down\ \boldsymbol{AND}\ no\ video\ reaches\ SC\ when\ failover\ down$$

$$q = (1-r) * k + r * 1$$
$$= (1-r)\big((1-l)(l+c-lc)^n + l\big) + r$$

So, the outage chance,

$$f = (1-r) * \big((1-l)(l+c-lc)^n + l\big) + r\Big((1-r)\big((1-l)(l+c-lc)^n + l\big) + r\Big)$$

A XProtect Architecture with SureStream

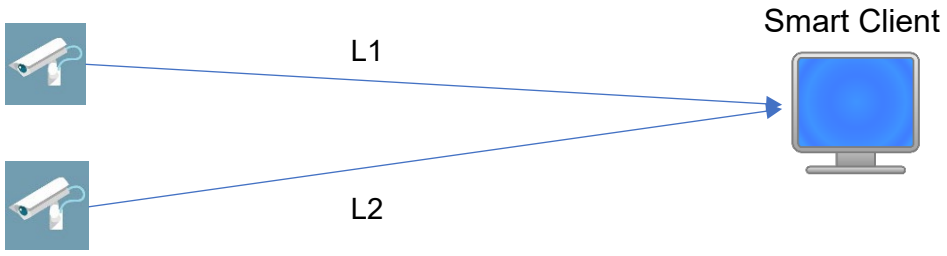

Figure 8: An architecture with SureStream

Figure 8, shows an architecture with SureStream, with cameras streaming directly to clients. Note that we assume network paths are independent, since SureStream provides a diversity of video paths to the Smart Client.

Here the outage chance, i.e., $chance\ no\ video\ reaches\ SC$, w, is

$$w = chance\ that\ no\ video\ from\ first\ camera\ reaches\ the\ SC$$
$$\boldsymbol{AND}$$
$$chance\ that\ no\ video\ from\ second\ camera$$
$$\boldsymbol{AND}$$
$$chance\ that\ no\ video\ from\ third\ camera\ reaches\ SC$$
$$\boldsymbol{AND}$$
$$\ldots$$
$$w = \big(1-(1-c)(1-l)\big)^n$$
$$= (l+c-lc)^n$$

Comparison

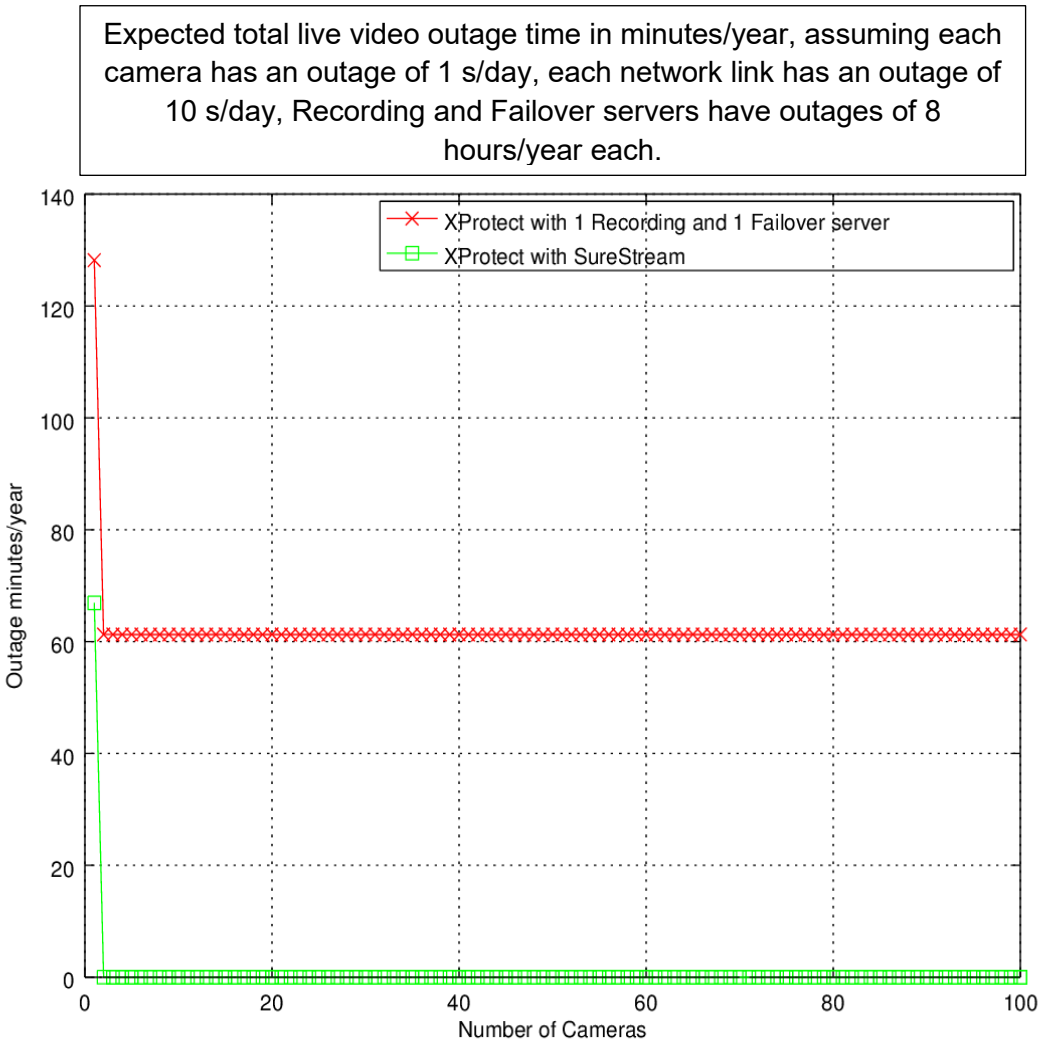

Figure 9: Live video outage time in minutes/year for an on-premises deployment

We use the results of the two previous sections to plot expected total outages with and without SureStream for the architectures presented, for various numbers of cameras. This is shown in Figure 9. XProtect with SureStream has a much lower outage number than without.

Some insights:

1. XProtect, without SureStream, even with a failover server, has points of failure, which cause video from all cameras to not reach the client. For example, when the failover server is functional, this server and the network link from it to the client affect video from *ALL* cameras.
2. SureStream does not have dependence on server hardware and offers a diversity of paths for video to reach the client. The chance that all these independent paths fail at the same time is much lower.

Use Cases

Video Insurance, Rainy-day Solution

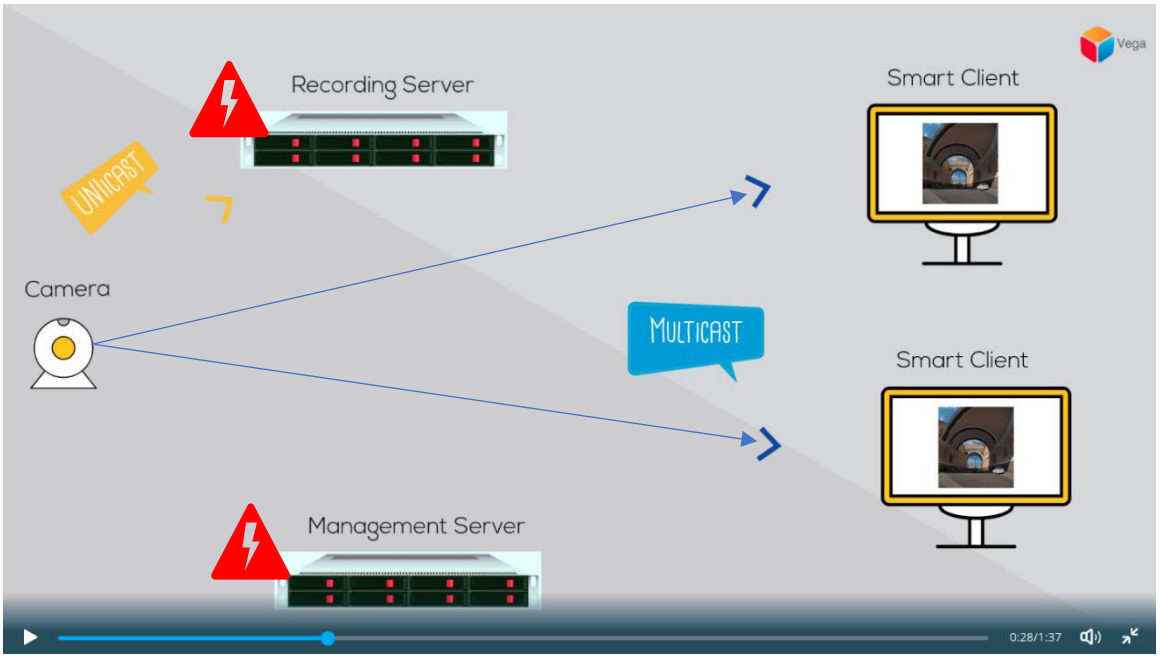

Figure 10: Rainy-day solution

SureStream is used as a video insurance, rainy-day solution at airports, seaports, museums, energy facilities, military, and the like. During server downtime episodes, customers seamlessly switch to SureStream from within their Smart Client environments. SureStream provides peace of mind to security officers that worry about catastrophic loss of surveillance.

Local Live Stream Sourcing

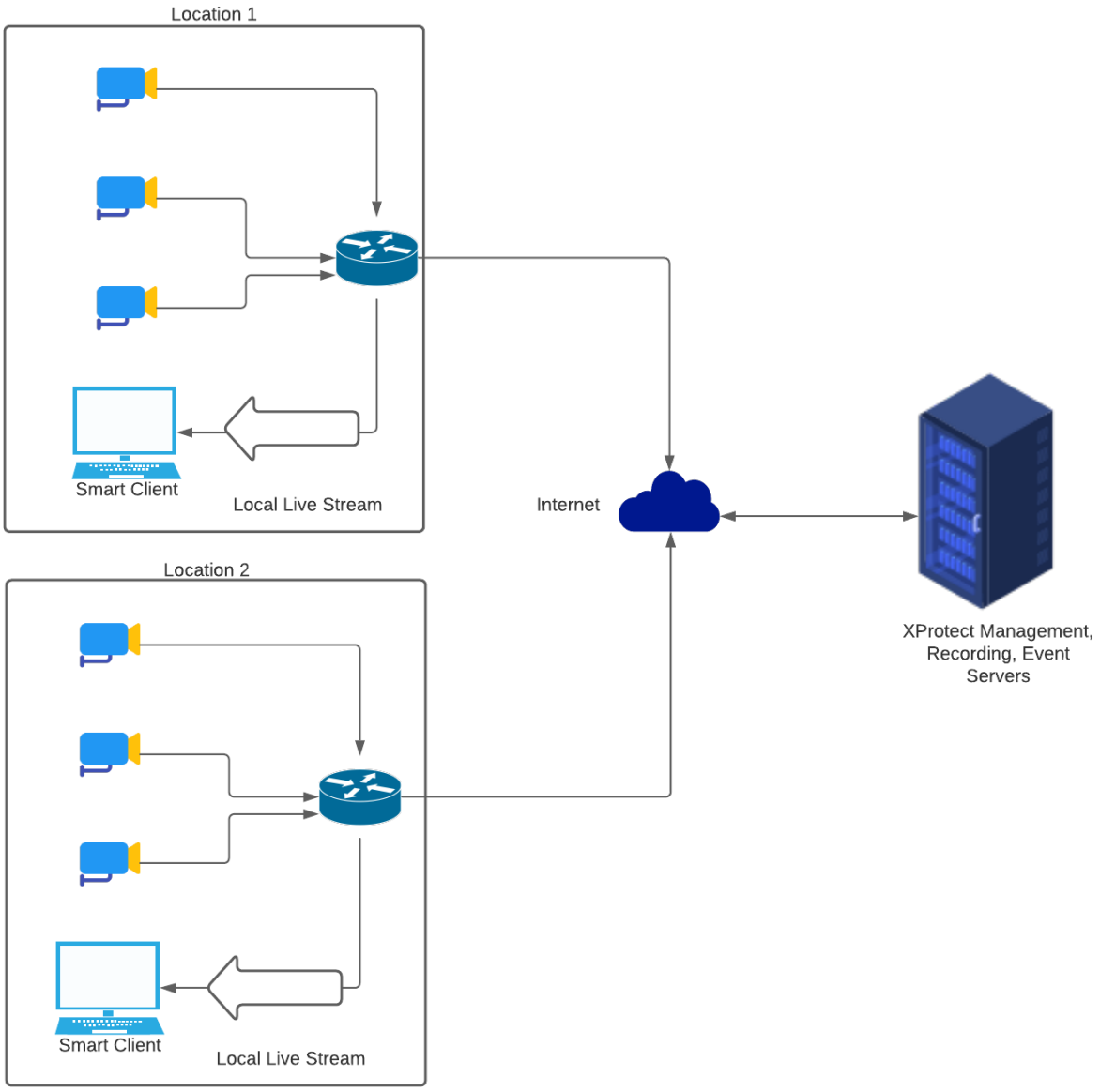

Figure 11: Local Live Stream Sourcing

Many distributed deployments have co-located cameras and clients. Servers are centrally located. See Figure 11. Examples of such deployments include – railway stations, bus stations, retail chains, city surveillance and similar, each with a central server location. Here, there is need for local operators to monitor local video locally, while all video is centrally archived for security purposes.

SureStream makes direct streaming of video from local cameras to local clients possible. What would otherwise be video round trips from cameras to servers and back to co-located clients are avoided. Helps efficient bandwidth management and reduces latency.

Summary

XProtect with SureStream provides peace of mind to security officers that worry about catastrophic loss of surveillance. It infuses server independence into XProtect deployments.

About Vega Systems Inc.

Vega Systems Inc. provides solutions for high availability video surveillance. Vega Systems' solutions are installed worldwide at airports, seaports and oil and gas facilities. For more details, visit: https://www.vega25.com.