Cutting costs without losing forensic value.

Three examples of cost savings when using Axis' Zipstream technology

AXIS
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1. What if you could save $30,000?

In any video surveillance system, storage represents a significant part of the cost. Studies of total cost of ownership show that storage can constitute 20-25% of the initial investment. This means that **technical solutions that reduce storage needs** will have a great impact on the total cost of the system.

Axis' Zipstream technology is a camera technology that reduces storage requirements with **an average of 50% or more** – in some scenarios with as much as 90% – without compromising the forensic quality of the video. How do these numbers translate into actual dollars and cents?

This white paper presents a study of three installations of video surveillance systems, and shows **how much money** Zipstream has the potential to save in each installation.

See Section 9, Useful links, for more information on total cost of ownership.

2. What is Axis' Zipstream technology?

Axis' Zipstream technology significantly reduces storage requirements without costly and complicated integration, using the current infrastructure. Zipstream is included in supported Axis cameras **free of charge**.

Optimized for video surveillance, Zipstream is a radically more efficient **H.264** implementation, lowering bandwidth and storage requirements by an average 50% or more for many common 24/7 surveillance use cases. Zipstream is backward compatible with any video management system (VMS) with H.264 support, without any need for upgrades.

Zipstream analyzes the video stream in real-time, making sure that interesting details and motion are preserved with the given video quality, while other, less interesting areas are filtered harder to reduce the stored data.

Today, Zipstream is available for H.264-based products but there is nothing in the technology that prevents the solution from migrating to H.265 encoders when that becomes technically possible. Zipstream is a constantly evolving techology and after the release of this white paper Zipstream has been upgraded to also support pan, tilt, and zoom (PTZ) cameras. A dynamic frame rate feature has also been introduced in Zipstream which reduces the bitrate to almost zero when there is no activity in the scene, offering significant additional savings compared to the examples presented in this white paper.

See Section 9, Useful links, for more information on Axis' Zipstream technology.

2.1 Possible reductions

Bit rate is the number of bits conveyed or processed per unit of time. Zipstream works by reducing the bit rate of the recorded video. A reduced bit rate means that less information needs to be transferred over the network. However, the reduction will vary depending on the light and movement conditions and details of the scene. For example, an overnight scene with sparse small and fast car movements where video is recorded constantly, such as the scene displayed in Figure 1, can give a reduction **up to 90%**. On the other hand, the bit rate reduction can be less efficient in situations with motion all over the scene, such as scenes with a lot of visual noise. In such cases, the reduction can be **insignificant**.

The amount saved on storage can be used to strengthen the overall system either by adding more cameras, or by selecting cameras and components with higher performance that otherwise would not fit the budget. The savings could also be used to extend the retention time of recorded video, keeping forensic evidence for a longer period.
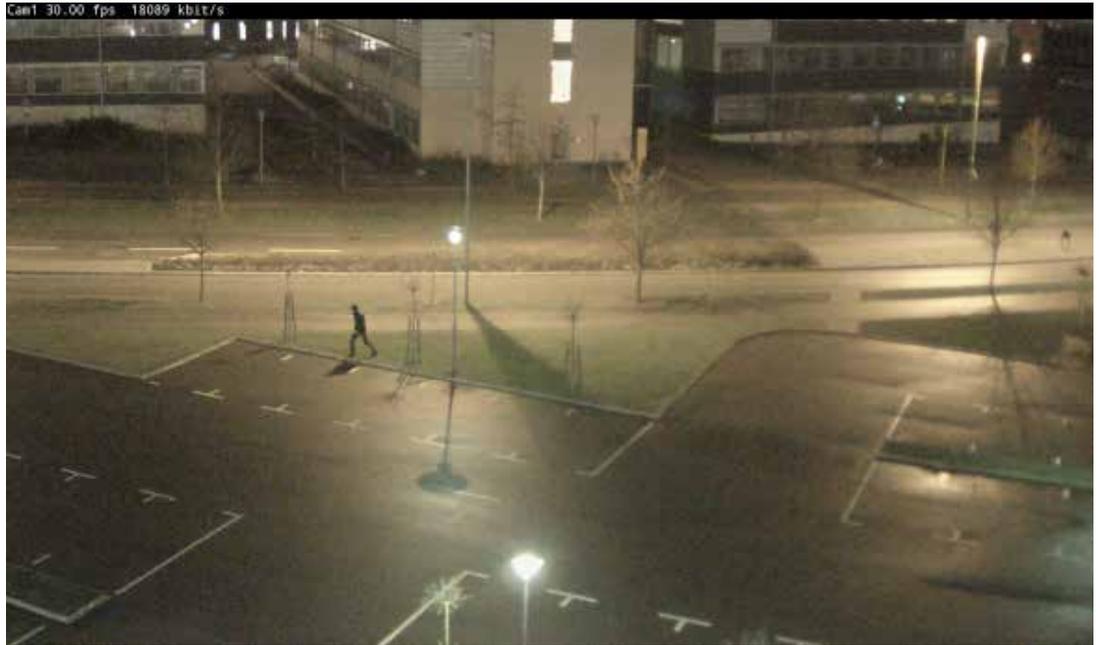
Figure 1: Example of a scene where Zipstream gives a high bit rate reduction.

3. Different storage solutions

3.1 NAS and SAN

There are of course different kinds of storage solutions, but one thing they have in common is that they can all be used with Zipstream. Edge storage enables video recording directly to an onboard SD card or a network-attached storage (NAS) device in Axis network cameras and video encoders.

See Section 9, Useful links, for more information on edge storage.

A storage area network (SAN) allows for even more storage space, flexibility and recoverability. It builds **redundancy** into the storage device, allowing video, or any other data, to be saved simultaneously in more than one location.

3.2 Other redundant storage

Other options to provide redundant storage are a redundant array of independent disks (RAIDs), data replication, server clustering, and multiple video recipients. A RAID is a method of arranging standard, off-the-shelf hard drives so that the operating system sees them as one large hard disk.

In data replication, file servers in a network are configured to replicate data among each other, providing a backup if one server fails. With multiple video recipients, the video is simultaneously sent to two different servers in separate locations, whereas in server clustering two servers work with the same storage device, such as a RAID system. If one server fails, the other identically configured server takes over. These servers can even share the same IP address, which makes the failover completely transparent for the user.

All the redundant storage solutions provide a **backup for recovering video** if a portion of the storage system becomes unreadable.

3.3 Cloud storage

Another possibility is to store data in the cloud. With a subscription-based surveillance service, investments can be reduced and the solution can be prevented from becoming outdated. Since everything is hosted in the cloud, it is easy to upgrade a system with new features, applications and services to support business. Cloud storage is an interesting alternative for smaller businesses looking for an efficient solution, or for companies with multiple sites, such as convenience store chains. Axis partners offer a complete, hosted network video solution as a service. The costs differ depending on the required services, but the amount of storage is naturally a very important factor. Reducing storage needs directly results in lower cost.

4. Cost saving examples

Three different scenarios, based on actual customer cases, illustrate the extent of possible cost savings for systems of different sizes. Scenario 1 is a small system with eight cameras installed in a retail store. Scenario 2 is a mid-size system with 34 cameras installed in a manufacturing facility, and scenario 3 is a large system consisting of 185 cameras installed in and around a power plant.

Even though the basic reason for surveillance is to protect people and assets, these three examples represent different needs. The environment, the size of the facility and the potential damage all influence the requirements for a system in regards to robustness and performance.

For all three scenarios, the following conditions apply:
> Constant recording, 24 hours a day, 7 days a week
> Recording at the maximum resolution of the cameras (either HDTV 720p or HDTV 1080p, depending on model)
> Recording at 18 frames per second
> Video is stored for 30 days (that is, the retention time is 30 days)

AXIS Design Tool has been used to estimate storage needs for these systems. With the help of AXIS Design Tool, a scenario can be picked for any Axis camera, and viewing, recording and compression options can be selected to get bandwidth and storage estimates that match the applicable surveillance situation.

See Section 9, Useful links, for more information on AXIS Design Tool.

Lighting conditions have a large impact on bandwidth requirements. Cameras mounted in environments with low, difficult or changing light typically consume more network bandwidth than cameras in environments with stable, sufficient light. To simplify things, cameras in the scenarios are specified as mounted in either 'normal light' or 'low light'. In these examples, Zipstream is assumed to give the same bandwidth reduction regardless of lighting conditions. However, low-light conditions generate more data, since low-light images contain more noise. This makes the actual savings counted in bits per second notable.

The storage costs are based on actual prices from leading suppliers of storage solutions (December 2015). For the small system, the price is an off-the-shelf list price. For the mid-size and large systems, the prices come from actual quotes received from suppliers based on the specific system requirements, for example, that the storage should be able to handle the throughput of video recording and have professional redundancy capabilities.

4.1 Scenario 1 – Retail store

The first scenario is a small system with entry-level cameras installed in a retail store. Protecting people, both customers and employees, is an essential part of every retail business, especially when you have to keep late-night hours and handle valuable goods. Profitable stores keep people walking in, and stop goods from 'walking out'. The owner is not likely to actively use the system on a daily basis, but only view recordings in case of an incident. The ability not only to detect but also to identify potential intruders and supply authorities with solid forensic evidence is vital.

See Section 9, Useful links, for more information on small systems and solutions for retail.

Figure 2: Retail store.

The system has eight network cameras:
> 6 AXIS M1124 Network Cameras
> 2 AXIS P3224-LVE Network Cameras

AXIS M1124 is an affordable HDTV 720p camera for professional surveillance. In this scenario, the AXIS M1124 cameras are mounted inside the store where the lights are turned on 24 hours a day. AXIS P3224-LVE is outdoor-ready and comes with OptimizedIR illumination, also in HDTV 720p. In this scenario, the AXIS P3224-LVE cameras are mounted outdoors, at loading docks and entrances, where the ambient light sometimes is low.

See Section 9, Useful links, for more information on Axis' OptimizedIR technology.

The eight cameras in this system have a total storage requirement of **4.04 terabyte** (TB), based on AXIS Design Tool calculations. The selected storage solution is a Seagate NAS with a list price of approximately **$900**.

4.1.1 Cost savings

With an estimated Zipstream reduction of stored data by 50%, the storage cost saving amounts to **$450**, or $56 per camera. However, the relation between price and performance is not linear for small systems. Even if the user could find a NAS with a lower capacity at a somewhat lower cost, it will not be possible to purchase a NAS with exactly half the hard disk capacity at exactly half the price.

Instead, the user could keep the specified NAS and use the increased storage capacity to enhance forensic evidence information. This can be done, for example, by increasing the frame rate of the cameras or extending retention time. Another possibility could be to add more cameras to the system, such as specific cameras for eye-level identification at the entrance, or cameras with built-in IR. Using cameras with built-in IR illumination also has the benefit of reducing the power consumption of the store, since lighting can be turned off at night.
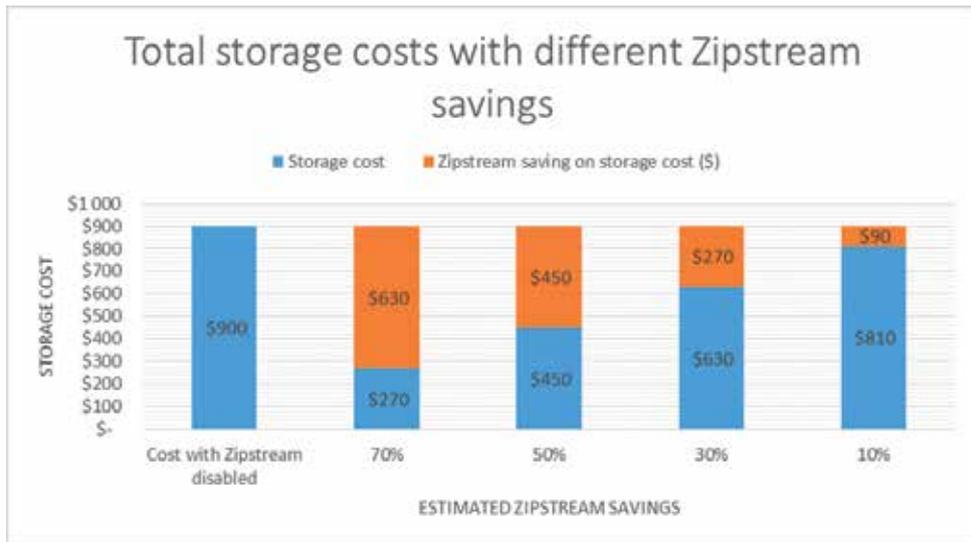
Figure 3: Estimated savings in storage cost in Scenario 1.

4.2 Scenario 2 – Manufacturing facility

Scenario 2 is a mid-size system with professional cameras installed at a manufacturing facility. This scenario is a typical mid-size business with a need for a surveillance system designed for an active operator. The need includes, but is not limited to, protecting people and assets. At a manufacturing facility, the loss of material or other disturbances in the production represent huge costs. Monitoring the direct surroundings is important to detect abnormalities early. This scenario is also a typical case of a surveillance system designed to be extended should the need arise. The system could be extended by adding cameras to cover more areas, or by incorporating functionalities such as access control, audio announcements or video analytics.

See Section 9, Useful links, for more information on mid-size solutions or specific solutions for industrial applications.

Figure 4: Manufacturing facility.

In all, there are 34 network cameras:
> 8 AXIS M1124 Network Cameras
> 8 AXIS P3224-LVE Network Cameras
> 8 AXIS P1365-E Network Cameras
> 8 AXIS P3225-LVE Network Cameras
> 2 AXIS P5624-E PTZ Dome Network Cameras

AXIS M1124 is used in various indoor areas that are lit at night, whereas unlit areas are monitored by AXIS P3224-LVE that includes IR illumination. AXIS P1365-E is an outdoor-ready HDTV 1080p surveillance camera that works in all light conditions. It is used along the perimeter, in the parking lot and other open areas that are lit. The outdoor-ready AXIS P3225-LVE that is optimized for forensic video in HDTV 1080p and includes IR illumination is used on buildings, in poorly lit situations. Finally, on fence posts and the four corners of the premises, there are AXIS P5624-E PTZ Dome Network Cameras that deliver continuous 360° pan in HDTV 720p.

The cameras have a total storage requirement of **31.8 TB** according to AXIS Design Tool. The chosen storage solution is a Dell Direct Attached Storage T330 server with expansion disks with an effective capacity of 33 TB. The storage cost in this system is **$10,571**.

4.2.1 Cost savings

With an estimated Zipstream reduction of stored data by 50%, the storage cost saving amounts to **$5,044**, or $148 per camera. Since Axis has adapted Zipstream to support PTZ cameras, savings are estimated given current standards. Figure 5 shows the estimated savings in storage costs for different estimated Zipstream savings.

The money saved can be used to expand the video surveillance system with an access control system. This way access credentials and schedules to control who has access to your premises can be managed in the same system. Also, an IP-based access management system is scalable, so it can be extended when requirements change.
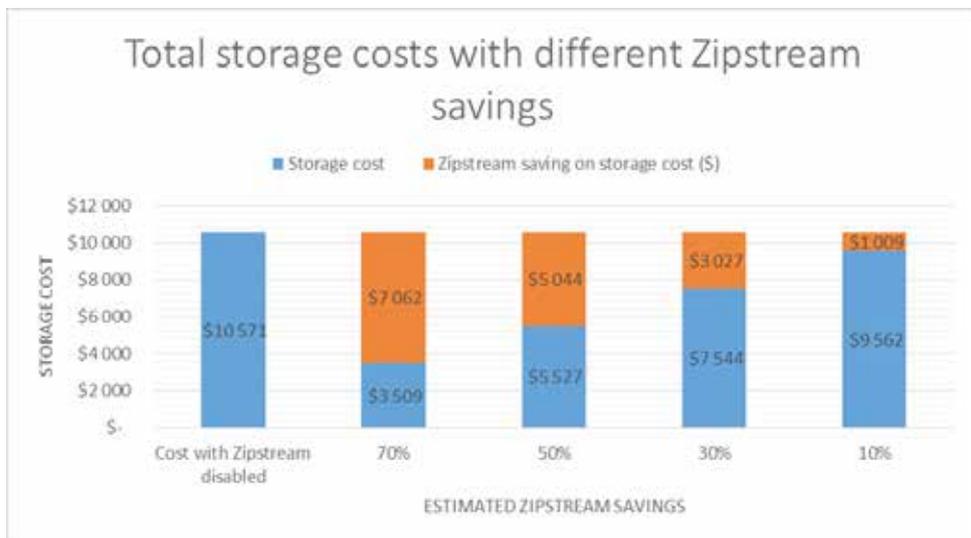

Figure 5: Estimated savings in storage cost in Scenario 2.

4.3 Scenario 3 – Power plant

The third scenario is a large system with high-end cameras installed in and around a power plant.

Maintaining a large or complex site requires an advanced security and surveillance solution that is customized to meet business and operational needs. Responsibility for a critical facility means that you will have to be prepared for all sorts of threats. Everything from incidents and thefts to terrorism and natural disasters can cause process disruption and safety hazards. Without electricity, society immediately comes to a standstill. Typically, these kinds of installations need to meet regulations for critical infrastructure installations. In some cases, monitoring production efficiency is just as important as the security of the facility. The scenario in this solution is tailor-made to do both. Examples of specific needs are to detect and locate intruders over long perimeters in remote locations, to secure surveillance even in harsh conditions, as well as to monitor production processes.

See Section 9, Useful links, for more information on large-scale systems or energy facilities.

Figure 6: Power plant.

In all, the system comprises 185 cameras:
> 20 AXIS P1365 Network Cameras
> 50 AXIS Q1615-E Network Cameras
> 50 AXIS P3225-LV Network Cameras
> 45 AXIS Q3505-VE Network Cameras
> 20 AXIS Q6114-E PTZ Dome Network Cameras

AXIS P1365 is an HDTV 1080p surveillance camera that works in all light conditions. In this scenario, it is used in various large indoor areas. AXIS Q1615-E is an outdoor-ready camera providing forensic detail and high speed, used along the perimeter, in parking lots and other open areas. Half of the installed AXIS Q1615-E are used in areas that are artificially lit, and the other half in areas without lighting. AXIS P3225-LV that is optimized for forensic video in HDTV 1080p is used in various indoor areas with low light. AXIS Q3505-VE is a vandal-resistant, outdoor-ready fixed dome for high-security applications. AXIS Q3505-VE is used on all buildings, covering entrances and other well-lit areas, as well as in low light situations. AXIS Q6114-E is an HDTV 720p PTZ camera with Axis' Sharpdome technology and Axis' Lightfinder technology. It is used on all fence poles, on the corners of main buildings, and at all entrance gates. Thanks to Sharpdome and Lightfinder, this camera can be used in low lighting conditions.

See Section 9, Useful links, for more information on Sharpdome and Lightfinder.

These cameras have a total storage requirement of **230 TB**. The chosen storage solution is a Dell Direct Attached Storage T630 server with expansion disks with an effective capacity of 235 TB. The storage cost in this system is **$68,595**.

4.3.1   Cost savings

With an estimated Zipstream reduction of stored data by 50%, the storage cost saving amounts to **$29,862**, or $161 per camera. Since Axis has adapted Zipstream to support PTZ cameras, savings are estimated given current standards. Figure 7 shows the estimated savings in storage costs for different estimated Zipstream savings.

In a large-scale system, the storage cost savings become substantial. These savings can be used to add thermal cameras that create images based on the heat radiating from any object, vehicle or person even if they are camouflaged. This allows operators to detect and act on suspicious activity. Another possible investment is to upgrade the visual network cameras with video analytics specially designed to enhance perimeter protection.
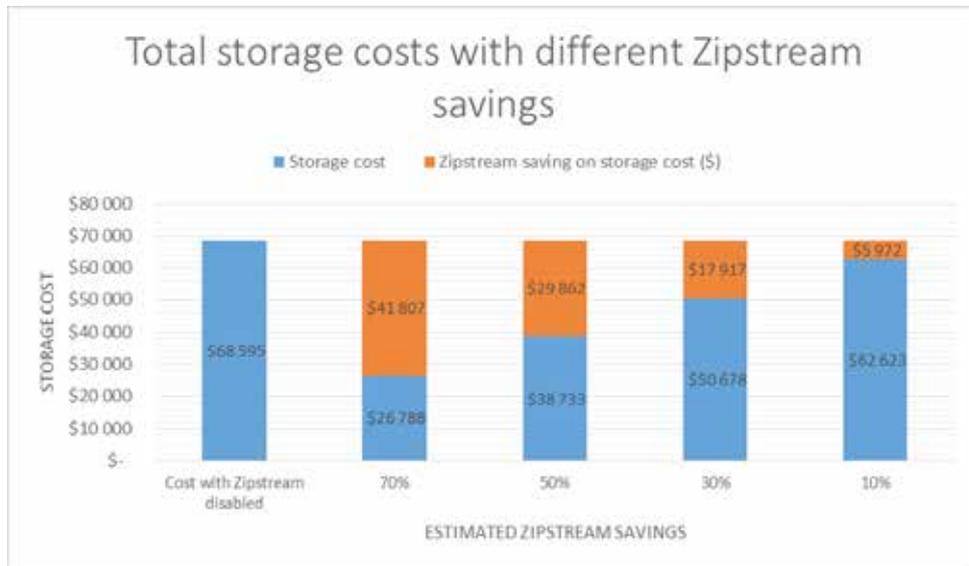
Figure 7: Estimated savings in storage cost in Scenario 3.

4.4 Summary of cost saving examples

With a 50% bandwidth reduction, Zipstream delivers the cost savings in Table 1 for the three systems.

Table 1 Summary of Zipstream cost savings

System size	No. of cameras	Storage cost (without Zipstream)	Storage cost saving (with Zipstream)	Storage cost saving per camera (with Zipstream)
Small	8	$900	$450*	$56*
Mid-size	34	$10,571	$5,044	$148
Large	185	$68,595	$29,862	$161

*See Section 4.1.1.

4.5 Storage considerations

As these scenarios show, storage costs need to be considered when designing a network video surveillance system. Of course, the cost is directly related to the size of the installation. In order to make sure that forensic evidence is not lost, some sort of backup is needed. In a small-scale system, edge storage in combination with a NAS is generally sufficient. In mid-size or large-scale systems, a redundant storage arrangement with RAIDs or other techniques to replicate data should be considered.

Zipstream effectively reduces the need, and thereby the cost, of storage. However, in order to keep the forensic value, the following best practices should be applied:

> Keep default compression settings. This controls the amount of compression applied to important forensic details.
> Use a variable bit rate. Using a constant bit rate as a storage reduction strategy is not recommended, since cameras then may have to discard important forensic details in critical situations due to the bit rate limitation.

5. Other benefits when using Zipstream

Apart from saving costs when designing and setting up a system, there are other benefits when using Zipstream. The existing network, equipment and applications can be reused, and **no additional installation work** is required. This, and the fact that Zipstream is included in supported Axis cameras **free of charge**, makes it extremely cost-efficient.

Apart from reducing the required storage space, Zipstream can be used to **increase forensic detail**, as higher resolution and frame rate improve image quality. Zipstream isolates and preserves important forensic details such as faces, tattoos and clothing patterns, while smoothing out irrelevant parts such as white walls, lawns and vegetation. Increased frame rate gives smoother video with natural movements.

Zipstream can **increase retention time** since less storage is needed per recorded minute, enabling longer recordings using the existing storage space. With Zipstream, less information needs to be transferred over the network, **reducing network traffic**. The result is less load and stress on servers, which enables the use of smaller and less expensive network switches. In combination with edge storage, Zipstream reduces data traffic over the network even more.

6. Conclusion

The three scenarios show that cost savings increase rapidly as the need for storage increases. With a calculated Zipstream bandwidth reduction of 50%, **tens of thousands of dollars can be saved** on storage in a large system.

Each system is different, and there are no guarantees on how much bandwidth Zipstream can save in a specific surveillance system. However, experience from real cases shows that 50% is a realistic figure, and in many cases the savings are well beyond that – sometimes as much as 90%. To estimate how much money can be saved in a specific system, test the Zipstream cameras in the environment where they are going to be used, and measure the actual bandwidth reduction.

Zipstream was introduced in early 2015 in certain new network camera models as well as in selected existing ones. As the technology has evolved, it has become available in several new models of fixed network cameras, fixed dome cameras and even thermal network cameras. It can also be found in small, cost-efficient models. In the future, Axis' Zipstream technology will be available in more and more products, most recently PTZ cameras. Axis' aim is to continue to improve its capabilities, making future versions even more efficient at reducing bandwidth requirements.

Axis constantly innovates in order to contribute to a smarter, safer world. By focusing on quality in everything we do, we offer security solutions you can trust. The scenarios described in this paper have been calculated using our tools that support the vital phase of designing and setting up a system that meets the customer's needs.

There are more tools specifically tailored for different phases in a project. Axis Communications' Academy offers our partners a full range of training services and the only global professional certification within the video surveillance industry. In addition, Axis' extended warranty and local support teams stay with you after the system installation.

See Section 9, Useful links, for more information on Axis Communications' Academy.

7. Awards

To this day, Zipstream has won three international awards:
> SIA New Product Showcase Award (United States)
> Australian Security Industry Award (Australia)
> Innovative Product of the Year Award (New Zealand)

Figure 8: The SIA NPS Award 2015, the ASIAL Product of the Year – CCTV award 2015, and the NZSA Innovative Product of the Year Award 2015.

SIA New Product Showcase Award
Zipstream was recognized by the Security Industry Association (SIA) in its annual New Product Showcase (NPS). Zipstream took top honors in the Video Surveillance Advanced Imaging Technologies category. Since its inception in 1979, the NPS has been the premier awards-based marketing program of the security industry. In 2015, the NPS program had 110 entries from 88 companies.

Australian Security Industry Award
Zipstream was awarded the Australian Security Industry Award for Excellence from the Australian Security Industry Association Limited (ASIAL) in the Product of the Year – CCTV category. The ASIAL chose Zipstream as the category winner for the bandwidth and storage savings that it opens up for many common 24/7 surveillance recordings due to its compatibility with the widely adopted H.264 compression standard.

Innovative Product of the Year Award
Zipstream has also won The Innovative Product of the Year Award from the New Zealand Security Association (NZSA). The NZSA Innovative Product of the Year Award 2015 honored the most outstanding development achievements in the local security industry.

See Section 9, Useful links, for more information on awards.

8. Acronyms and abbreviations

ASIAL	Australia Security Industry Association Ltd
CCTV	Closed-circuit Television
HDTV	High-definition television
IP	Internet Protocol
IR	Infrared
NAS	Network-attached storage
NPS	New Product Showcase
NZSA	New Zealand Security Association
PTZ	Pan/tilt/zoom
RAID	Redundant array of independent disks
SAN	Storage area network
SD	Secure Digital
SIA	Security Industry Association
TB	Terabyte
VMS	Video management system

9. Useful links

For more information, see the following links:

Axis Communications – 'Academy':
www.axis.com/learning-and-support

Axis Communications – 'AXIS Design Tool':
www.axis.com/tools/axis-design-tool

Axis Communications – 'Axis' Zipstream technology':
www.axis.com/technologies/zipstream

Axis Communications – 'Axis' Zipstream technology – More video, less storage':
www.axis.com/files/whitepaper/wp_zipstream_68165_en_1606_hi.pdf

Axis Communications – 'Awards':
www.axis.com/press-center/media-resources/awards

Axis Communications – 'Edge storage':
www.axis.com/technologies/edge-storage

Axis Communications – 'Energy':
www.axis.com/solutions-by-industry/critical-infrastructure/energy

Axis Communications – 'Industrial':
www.axis.com/solutions-by-industry/industrial

Axis Communications – 'Large-scale systems':
www.axis.com/end-to-end-solutions/take-security-to-the-next-level

Axis Communications – 'Lightfinder technology':
www.axis.com/learning/web-articles/technical-guide-to-network-video/lightfinder-technology

Axis Communications – 'Mid-size systems':
www.axis.com/end-to-end-solutions/active-security

Axis Communications – 'OptimizedIR':
www.axis.com/learning/web-articles/technical-guide-to-network-video/optimized-ir

Axis Communications – 'Retail':
www.axis.com/solutions-by-industry/retail

Axis Communications – 'Sharpdome technology':
www.axis.com/technologies/sharpdome-technology

Axis Communications – 'Small systems':
www.axis.com/end-to-end-solutions/small-systems

Axis Communications – 'Total Cost of Ownership':
www.axis.com/tco

About Axis Communications

Axis offers intelligent security solutions that enable a smarter, safer world. As the market leader in network video, Axis is driving the industry by continually launching innovative network products based on an open platform - delivering high value to customers through a global partner network. Axis has long-term relationships with partners and provides them with knowledge and ground-breaking network products in existing and new markets.

Axis has more than 2,100 dedicated employees in more than 50 countries around the world, supported by a global network of over 80,000 partners. Founded in 1984, Axis is a Sweden-based company listed on NASDAQ Stockholm under the ticker AXIS.

For more information about Axis, please visit our website www.axis.com.

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