

## **OptimizedIR in Axis' cameras**

Leveraging new, smart and long-life LED technology



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## Introduction

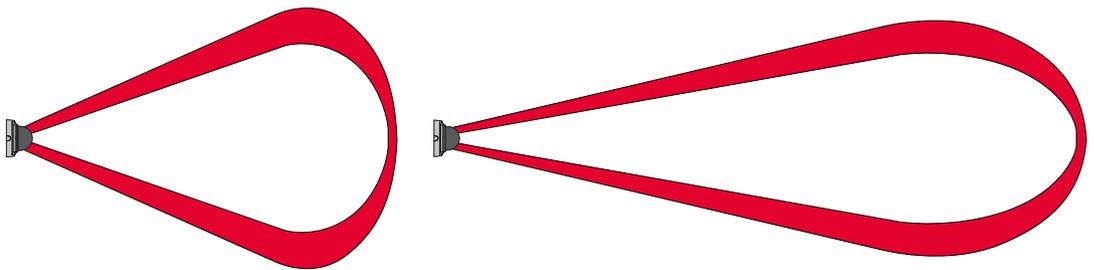
Axis offers easy-to-install network cameras with infrared (IR) illumination, where the IR LEDs are built-in. These cameras are identified with a suffix -L, which indicates that the camera includes infrared Light. All Axis cameras with IR illumination also share some common characteristics:

- Extremely power-efficient IR LED's
- Fewer IR LED's compared to legacy alternatives
- Low power consumption IR LED's with minimum heat dissipation
- Long-life LED's that eliminate maintenance

The IR LED are covered by a high-precision, custom-made lens to offer an even IR illumination over the scene

The characteristics of these new generation IR LED's, contribute to a cost-efficient and environmental-friendly IR solution with a high-quality, low-noise video also when the environment is completely dark.

In addition to the above features, Axis has included a unique technology known as Axis' OptimizedIR in select models. Axis' intelligent, unique and patented OptimizedIR solution makes these selected network cameras easy and quick to install and most importantly, the IR illumination angle automatically adapts to the camera field of view, ensuring that no illumination power is wasted.



*Figure 1: With Axis' OptimizedIR the IR illumination angle (in red) automatically follows when adjusting the zoom level at installation. The camera's field of view is illustrated in white*

### 1. Why do you need IR illumination?

All Axis' network cameras with built-in IR illumination are day & night cameras that deliver color images during the day and black and white images during the night. Near-infrared light, which spans from 780 nanometers (nm) up to about 3000 nm, is beyond what the human eye can see, but most camera sensors can detect it and make use of it. The cameras have an IR-cut filter that removes IR light during the day. IR light is filtered out so that it does not distort the colors of images as the human eye sees them. As light diminishes below a certain level, the camera can automatically remove the IR-cut filter allowing the camera to make use of near-IR light. Figure 2 shows how a color image sensor responds to visible and near-IR light.

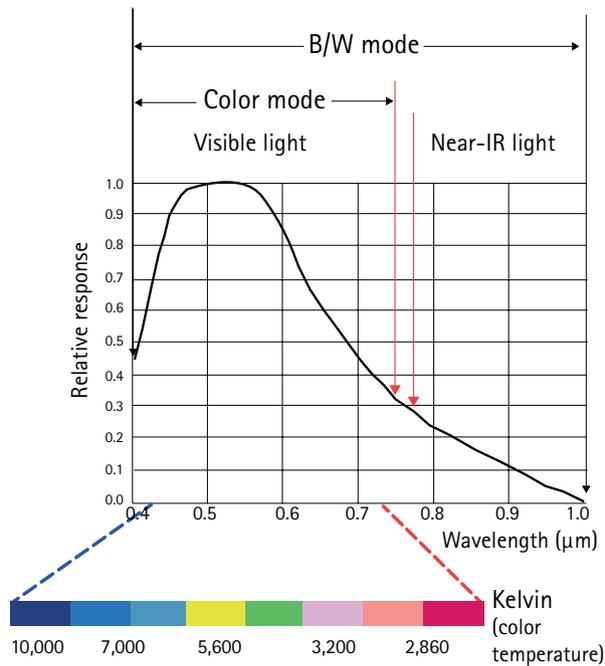


Figure 2: Color image sensor response to visible and near-IR light

See Section 5, Useful links, 'Day & Night network cameras' and 'Lighting for Network Video – Lighting Design Guide', for more information on IR illumination.

### Why use IR illumination instead of white light?

Only thermal cameras can provide usable images in complete darkness. Day&night cameras need some kind of light source to be able to provide usable images. Even though IR light is not visible to the human eye, the sensor of a color camera is generally sensitive not only to visible light but also to IR light according to the Figure 2 – provided that the IR cut filter is removed.

Using IR illumination instead of white light has several advantages. With IR illumination, there is no light pollution. IR illumination makes discreet or covert surveillance possible in places where white light would be too intrusive, such as in nighttime traffic surveillance, or when you need to monitor people without anyone noticing. On the other hand, since people in this case are not aware that they are being monitored, there is no deterrent effect, which might be desirable in some situations.

The images in grayscale have better contrast, less noise, and better definition if compared to color images in corresponding low-light situations. This is an advantage when color information is not required, such as in license plate recognition (LPR). On the other hand, when color information is needed, IR illumination is not a feasible solution. For color video in low-light situations, an extremely light-sensitive camera – such as Axis cameras with Lightfinder technology – is a better option. See Section 5, Useful links, 'Lightfinder – Outstanding performance in difficult lighting conditions', for more information on Axis' Lightfinder technology.

The most recent IR illuminators on the market have low power consumption and they also lasts a lot longer – typically around 10 years and requires zero maintenance – compared to a halogen light which can last as little as 5 months. The IR LEDs used in Axis' OptimizedIR technology are very low in power consumption, which allow the camera to be powered by standard PoE. The images in grayscale, produced with the help of an IR illumination, contain less image noise if compared to black and white images produced without the IR source. The result is an image that occupies less storage space, hence reducing storage costs. Compared with images without the aid of IR illumination, images provided by using IR illumination in indoor installations saves up to 95% bit rate and storage space. In dark outdoor installations, it saves up to 75% bit rate and storage space.

### When do you use IR illumination?

IR illumination is used when visible light is not an option, when color information is not critical and when the natural IR lighting is not sufficient. The black and white images have better contrast than color images, which makes images in black and white suitable for video analytics, for example license plate recognition (LPR). Figure 3 shows an example of traffic surveillance with a day & night camera and the aid of a stand-alone IR illuminator.



Figure 3: IR illumination used for license plate recognition (LPR)

### How do you use IR illumination?

Indoors, light is reflected from all surrounding surfaces, such as the walls and ceiling, which gives more light on the subject. Outdoors, all light except for the light hitting and reflecting off the subject, is lost. This means that it is much easier to get a well illuminated image indoors. To improve the image quality outdoors, the camera with built-in IR should be aimed downwards not to lose more light than necessary. Figure 4 shows an example of the placement of an outdoor camera.



Figure 4: Placement of an outdoor camera

### Comparison with thermal cameras

Cameras with built-in IR have both advantages and disadvantages compared with thermal cameras. Cameras with built-in IR can be used as stand-alone systems, but can also be integrated into existing surveillance systems. Thermal cameras can complement an existing system, but they cannot replace it; color cameras are generally needed somewhere in the system for identification purposes. Both technologies have different purposes: thermal to detect, infrared to recognize. See Section 5, Useful links, 'Some like it hot – Thermal cameras in surveillance', for more information on thermal cameras.

Cameras with built-in IR have better resolution, image quality, definition, and field of view than thermal cameras. They are also less expensive. However, their viewing distance is shorter than what thermal cameras can provide. Axis' cameras with OptimizedIR solution can be used at a distance shorter than 40 m (131 ft.), whereas thermal cameras have a range of detection up to 5 km (5400 yards) with the right model and in the right conditions. Figures 5 and 6 show a comparison between a thermal camera and an Axis network camera with OptimizedIR.



Figure 5 and 6: To the left an image from an Axis thermal camera, and to the right an image from an Axis network camera with OptimizedIR.

## 2. Built-in or stand-alone IR illumination?

A day & night network camera can either work with a stand-alone IR illumination, or integrate the IR illumination into the camera. Axis has chosen 850 nm LED illuminators for most of its built-in or stand-alone IR solutions instead of 940 nm LEDs because color sensors are generally more sensitive to 850nm than to 940 nm LEDs. Hence, the camera can reach farther when using an 850 nm LED illuminator than with a 940nm LED illuminator. The disadvantage of using 850 nm LEDs is that they show up as a faint red glow, while 940nm LEDs provide completely covert illumination.

Axis network cameras with built-in IR and OptimizedIR have several advantages, such as very simple installation and integration. They do not require external cables or any extra power supply since their IR LEDs are power-supplied from the camera, using standard, environmental-friendly Power over Ethernet IEEE 802.3af.

Network cameras with built-in IR conveniently deliver surveillance all in one package and have a very low environmental impact, since only a camera needs to be installed and no additional IR light sources. This is especially important when installing cameras in older or listed buildings, such as museums and historical buildings. For the same reason, each built-in IR system becomes less expensive, since fewer components will have to be installed – and fewer units installed also mean fewer units to service.

There are two areas where standalone IR illumination remains a better option than built-in IR illumination. Network cameras with standalone IR illumination have, in many cases, a longer viewing distance than cameras with built-in IR. Also, there is a wider range of cameras available that work with stand-alone IR illumination, which gives more flexibility when choosing a camera.

A second option is when a stand-alone IR illuminator produces more light, and the illumination can be aimed more freely. Up to now, network cameras with built-in IR have rarely been adjustable, which can cause the IR illumination to mismatch the camera field of view or the image being overexposed. However, Axis network cameras with OptimizedIR are adjustable owing to their built-in intelligence. See Section 3, 'How Axis' network cameras with built-in IR work', for more information.

A stand-alone IR illuminator produces more light, and the illumination can be aimed more freely. Up to now, network cameras with built-in IR have rarely been adjustable, which can cause the IR illumination to mismatch the camera field of view or the image being overexposed. However, most of Axis network cameras with built-in IR are adjustable owing to their built-in intelligence. See Section 3, 'How Axis' network cameras with built-in IR work', for more information.

### 3. How Axis' network cameras with OptimizedIR work

In general, an even and cool operating temperature on the sensor and more light, the better the image quality will be. However, more light produced by the camera may heat the image sensor, resulting in an increase of noise disturbance in the image. Axis OptimizedIR technology gives the maximum possible amount of light at the scene combined with the minimum possible heat in the sensor, ensuring excellent image quality. Axis' OptimizedIR technology gives an even illumination across the entire image.

The combination of the camera intelligence and the IR LEDs with their high-precision, custom-made lenses makes Axis network cameras with OptimizedIR unique on the market. Axis network cameras are safe to use according to the European standard EN 62471:2008 based on the international standard IEC 62471. Since they comply with this standard it means that the cameras are not harmful to the eyes of any living creature that might look straight at the camera.

#### Axis' OptimizedIR technology

The IR illumination solution has been developed especially by Axis and is custom-made for the illumination requirements of each Axis' camera model with the designation -L that supports Axis' OptimizedIR technology.

The IR solution has been optimized for the camera's view angles and gives a very even illumination across the entire area of illumination.

In Axis cameras with OptimizedIR, the illumination intelligence adjusts the distribution angles of the illumination to make it evenly distributed across the entire area.



*Figure 7: An image taken with an Axis camera with OptimizedIR featuring three LEDs.*

#### Intelligence

A too narrowly illuminated area will produce 'white out or glare' in the middle of the scene, and some areas will not be correctly illuminated. On the other hand, a too widely illuminated area means that light will shine on objects outside the area of interest, and also that the viewing distance will be reduced. Depending on camera model, the IR illumination with OptimizedIR can reach over 40 m (131 ft.) with low, environmental-friendly power consumption, supplied by standard Power over Ethernet (IEEE 802.3af).

When the field of view is adjusted at the installation of an Axis camera with remote zoom and OptimizedIR, the angle of illumination automatically adapts to the zoom level. (This is only applicable in Axis cameras with OptimizedIR). The illumination angle follows the camera's zoom movements to always provide the maximum amount of light in the image.

Another adaptation performed by Axis' OptimizedIR technology is visible when the subject is far away from the camera and the whole area is illuminated. When the subject is approaching the camera, the exposure is adapting. When the subject is by the camera, it is illuminated and not overexposed.



*Figure 8-10: Show how the exposure adapts in Axis cameras with OptimizedIR when a subject is approaching the camera.*



### IR LEDs and power-efficiency

Using LEDs instead of other light sources, such as traditional or fluorescent bulbs, has many advantages. The ratio between the energy consumption and the illumination has been finely optimized. LEDs are quick start devices that are highly durable, insensitive to vibration, and difficult to break. They can emit light at a given wavelength without the need for a filter. All in all, they combine the lowest possible running costs with the longest operating life. See Section 5, Useful links, 'Lighting for Network Video – Lighting Design Guide', for more information on LEDs in general.

The highly power-efficient, new LED technology used by Axis cameras with OptimizedIR technology, does not additionally heat the image sensor and consequently a higher image quality. Thanks to the extremely power-efficient IR LEDs, the cameras only need few LEDs, and the IR illumination is concentrated where it is needed. This way, no light is wasted illuminating areas that are of little interest. Power efficiency is translated into high power, less heat dissipation, and the IR illumination can reach far.

With Axis' uniquely designed OptimizedIR, it is possible to obtain an evenly illuminated image with few, power-efficient LEDs. The IR illumination can reach a long distance with standard PoE thanks to the power-efficient IR LEDs.

The Power over Ethernet IEEE 802.3af standard puts high demands on the efficiency of the included components. It is a strategic environmental-friendly choice to use standard PoE in Axis network video. See Section 5, Useful links, 'Power over Ethernet', for more information on the Power over Ethernet IEEE

802.3af standard.

## 4. Conclusion

Axis' smart and unique OptimizedIR solution based on new, power-efficient LED technology and providing optimized image quality with an adaptable angle of IR illumination. The IR technology is designed for easy, cost-efficient and environmental-friendly installation.

## 5. Useful links

For more information, see the following links:

- > Axis Communications – 'Day & Night network cameras':  
[www.axis.com/products/video/camera/about\\_cameras/day\\_night.htm](http://www.axis.com/products/video/camera/about_cameras/day_night.htm)
- > Axis Communications – 'Lightfinder – Outstanding performance in difficult lighting conditions':  
[www.axis.com/files/whitepaper/wp\\_lightfinder\\_43131\\_en\\_1105\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_lightfinder_43131_en_1105_lo.pdf)
- > Axis Communications – 'Lighting for Network Video – Lighting Design Guide':  
[www.axis.com/files/whitepaper/wp\\_lighting\\_for\\_netvid\\_41222\\_en\\_1012\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_lighting_for_netvid_41222_en_1012_lo.pdf)
- Axis Communications – 'Some like it hot – Thermal cameras in surveillance':  
[www.axis.com/files/whitepaper/wp\\_axis\\_thermal\\_cameras\\_en\\_37661\\_0912\\_lo.pdf](http://www.axis.com/files/whitepaper/wp_axis_thermal_cameras_en_37661_0912_lo.pdf)
- > Axis Communications – 'Power over Ethernet':  
[www.axis.com/products/pol/system.htm](http://www.axis.com/products/pol/system.htm)

# About Axis Communications

Axis offers intelligent security solutions that enable a smarter, safer world. As the global 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 its customers and carried 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 1,600 dedicated employees in more than 40 countries around the world, supported by a network of over 60,000 partners across 179 countries. Founded in 1984, Axis is a Sweden-based company listed on NASDAQ OMX Stockholm under the ticker AXIS.

For more information about Axis, please visit our website [www.axis.com](http://www.axis.com).