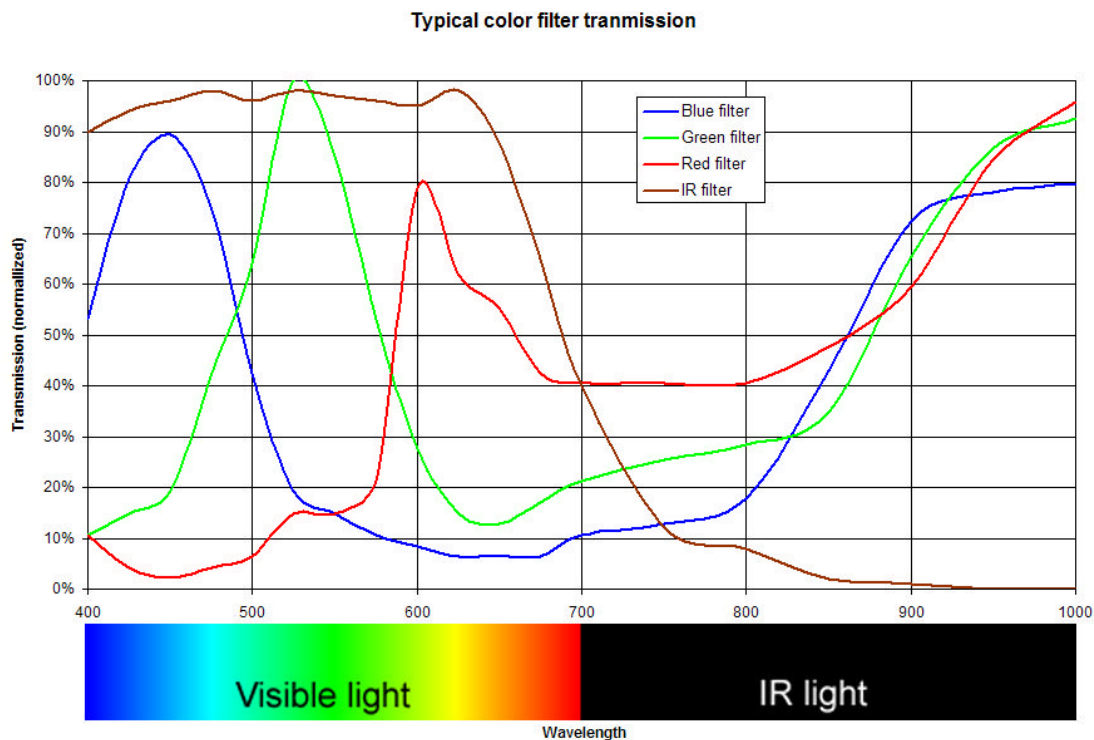


Day/night demystified

Mark Peterson, [Theia Technologies](#)

Mere mortals see only visible light, whereas security cameras can see both visible and infrared (IR) light. Many light sources including the sun create both visible and IR light. Security cameras use color filters (blue, green, and red) to create a color image but each filter also allows IR light to pass through onto the sensor, muddying the colors. Since most lenses are designed for visible light only, most security cameras have an IR filter to block the IR light. This filter improves both the color fidelity and focus sharpness of the image.

But those cameras considered true day/night can physically switch the IR filter out of the light path allowing the camera to see both naturally occurring and artificially created IR light. These cameras require day/night lenses to keep the scene in focus both day and night. Day/night lenses are generally more expensive because of the added complexity of focusing a broader color spectrum (from visible through IR) onto the sensor.



This chart shows the transmission of typical color filters in the visible (from 400nm to 700nm) and IR (greater than 700nm).

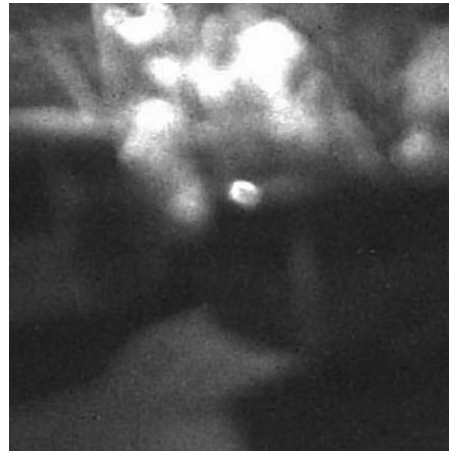
What is a true Day/Night camera?

A true day/night camera will have a movable IR filter. During day performance, the IR filter is in place blocking all the IR light, creating a nice color image. In this case, the IR filter (represented in brown on the chart above) will block all IR light greater than about 750nm. At night, when the amount of light decreases, the IR filter is replaced with a clear glass dummy filter. The clear glass allows all available visible and IR light to reach the sensor and be recorded.

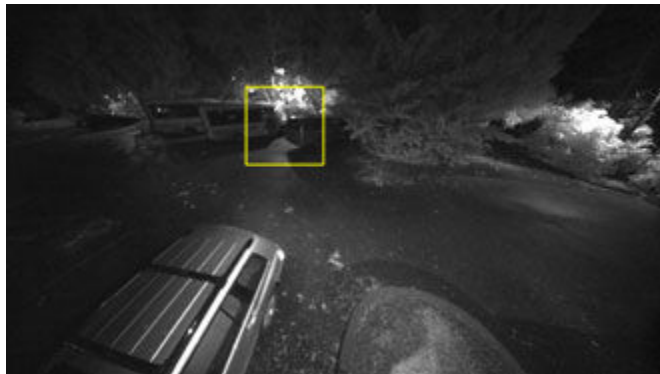
So removing the IR filter makes each pixel sensitive to IR light, improving the light sensitivity, but at the expense of color fidelity. To counteract the degraded color in night mode, the software for most day/night cameras de-saturates the colors creating a monochrome image.

Do you need a day/night lens?

A day/night lens may be used on any camera, however a high quality day/night lens is required when using a day/night camera.. Day/night lenses, such as Theia Technologies' new SY110 lens, are designed with the criteria that they focus the infrared light to the same plane as the visible light. This means that the scene is in focus whether using visible light, IR light, or both. Without a day/night lens, the camera would give a soft focus effect at night when both IR and visible light are used at the same time.



Using a standard lens with a day/night camera at night and IR illumination can produce an out-of-focus image. The section indicated by the yellow box in the left image is magnified in the right image.



Under the same conditions except replacing the standard lens with a day/night lens such as Theia's new SY110 lens keeps the image in focus day and night.

Theia's new SY110 lens provides day/night performance for megapixel cameras in applications such as parking lots, warehouses, power transformer lots, lobbies, ATMs, etc. Any place where a large area or wide angle of view is needed, the SY110 lens can give up to 120 degree horizontal field of view without distortion.

Illumination sources

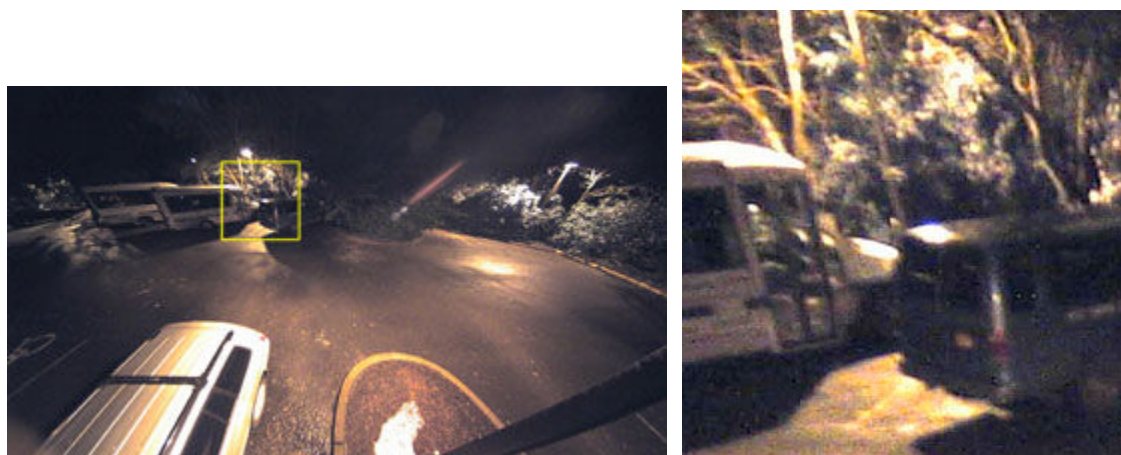
Artificial IR illumination can be provided by IR Light Emitting Diodes (LEDs). These can enhance the naturally occurring light in the scene. These lights can be

mounted anywhere as long as the IR light can shine on the object that the camera is watching. There is no requirement that the IR lights be mounted at or near the camera, they can be scattered throughout a parking lot for instance, bathing the entire area in IR light.

However, many visible light sources such as street lights, warehouse lights, incandescent lights, not to mention the sun and moon, also emit IR light that can be recorded by the camera's sensor. If the scene has such a light source at night, a day/night camera can record the scene without the aid of additional IR illumination.

Do you even need a day/night camera?

If there is enough visible light in the scene a standard camera (with IR filter) can be used for night security applications. Illumination sources like those mentioned above, may provide sufficient visible light that use of a day/night camera in night mode may not be necessary at all. In this case the use of a day/night lens is optional.



In this parking lot there is sufficient visible illumination that a standard camera and lens such as Theia's SY125 lens can be used at night. The section indicated by the yellow box in the left image is magnified in the right image.

When there is adequate visible light at night, a non-day/night lens, like Theia's SY125 lens for example, can be used with a standard, non-day/night camera. The SY125 lens, with its 135 degree field of view without fisheye distortion can be used when an ultra wide field of view is needed. The lens can support cameras up to five megapixels in applications such as malls, prisons, public spaces, and mobile surveillance platforms to name a few.

Conclusion

For nighttime surveillance, if there is enough visible light in the scene it may not be necessary to use a day/night camera and lens. However if a day/night camera is called for, it must be complemented with a quality day/night lens. In this case, artificial illumination with IR LEDs can enhance existing light from streetlights and other sources.

Mark Peterson is the VP Advanced Technology at [Theia Technologies](http://TheiaTechnologies.com).

Theia Technologies (www.TheiaTech.com), founded in 2006, designs and provides ultra wide-angle megapixel lenses for security and machine vision applications in the residential, commercial, and military and civilian government sectors. Theia's new SY110 is the widest Day/Night megapixel lens available on the market today. Our award winning Linear Optical Technology™ provides up to 135 degree horizontal field of view with very low distortion. The patented technology corrects barrel distortion and improves image resolution over typical lenses. Theia has several issued and pending US and foreign patents for lens technologies.