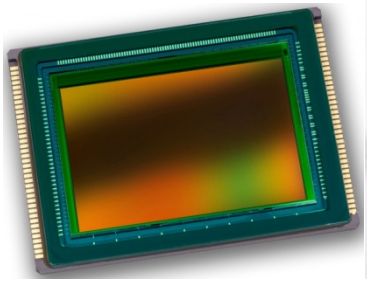
Image Sensors

C Mos v/s CCD



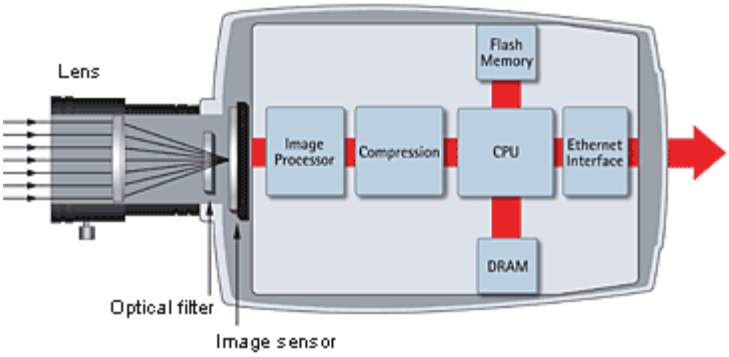
CMOS

CCD

Image Sensor

Image Sensors are located just after the lens of a Camera. An image sensor is the part of an IP camera that captures the light hitting the camera lens and turns it into electrical signals.

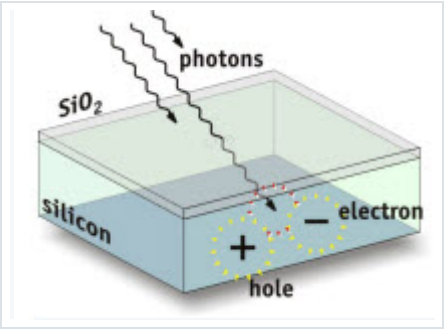
As light passes through the lens of the camera, it hits the image sensor. The sensor is made up of many little photosites (each photosite becomes a pixel in the video resolution), and the amount of light on each individual photosite determines how much light will be in each pixel of the video. Together, the light/dark sections of each pixel make up one cohesive image in the final video.



There are two types of image sensors found in IP surveillance cameras - CMOS image sensors and CCD image sensors.

- **CCD (charge-coupled device)** image sensors have been around for over 30 years, and are often found in older models of cameras
- **CMOS (complementary metal-oxide semiconductor)** image sensors utilize newer technology to record better HD resolution and fast-moving activity, and are found in the majority of recently manufactured IP cameras

Both technologies have unique strengths and weaknesses giving advantages in different applications.



Both CCD and CMOS image sensors depend on the photoelectric effect to crate electrical signal from light. Both types of imagers convert light into electric charge and process it into electronic signals.

CCD (Charged Coupled Device) Sensors

In a CCD video camera, light hitting the image sensor is converted to an electrical signal. This electron packet is then transferred, one pixel at a time, through an output node to an image processor, at which point it is converted to voltage. The voltage is then buffered and sent out from the chip as an analog signal.
This process involves an extra step over CMOS sensors and therefore requires more time and energy to process imagery. **However, because each pixel is devoted to capturing light, CCD sensors have a high output uniformity that results in cleaner, higher-quality images.**
CCD sensors are also distinct from CMOS for their use of global shutters instead of rolling shutters. Global shutters process an entire image at once by exposing the full frame for a predetermined amount of time. This means the entire sensor gathers an equal amount of light at once. Global shutters are free of the image distortion related to rapid movement or flashes of light.

CMOS (Complementary Metal Oxide Semiconductor)

CMOS sensors have circuitry at the pixel level. This means that every pixel on the sensor is read and transmitted simultaneously. The chip then uses additional technology, such as amplifiers, noise correction, and digitization, to convert the voltage to digital data. **This means that CMOS sensors do not require a separate image processor.** Because CMOS sensors are able to convert visual information to digital data more quickly than CCDs, they require less power, which preserves battery life. However, the extra technology on the sensor crowds the pixels, limiting their ability to capture light and resulting in generally poorer visual clarity in the final image.
CMOS sensors are commonly designed with rolling shutters, especially on commercial applications. This means that the image frame is exposed from one side to the other, instead of all at once as on CCD sensors. For example, a video camera using a CMOS sensor may record data in a "rolling" sweep from left to right, or top to bottom. This results in the potential for a few types of distortion not found on CCD sensors

Conclusion - CCD v/s CMOS

- The entire signal processing functions in a CCD image sensor happens outside the chip, whereas the same is incorporated on the chip itself in CMOS image sensors.
- CMOS sensors therefore consumes less power as compared to CCDS sensors.
- There may be some quality related issues in a CMOS sensor due to less sensitivity and structured noise in the chip.
- Security Camera manufacturers are taking advantage of the advances in technology to reduce power consumption in a CCD sensor.
- CMOS technology is also being developed for CCTV applications, reducing noise and increasing image quality.
- **The gap between the two technologies is converging day by day.**

Technologies and markets evolve, affecting not only what is technically feasible, but also what is commercially viable. Imager applications are varied, with different and changing requirements. Some applications are best served by CMOS imagers.
With the advances in both technologies and the complexities at play, it is not possible to make a general statement about CMOS versus CCD imagers that applies to all applications.

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