Topic: Surveillance Design and Field of View

Background

In designing a surveillance solution, it is important to consider the objectives of the client--what do they want to see and how well do they need to be able to see it? The area that a given camera can view (field of view) is dependent on its location and its lens. The quality of the view is also dependent on the resolution of the camera. Combined, these two considerations determine whether or not a given camera will meet the client's expectations.

Field of View

The focal length of a lens determines how large of an area the camera views at any given distance. For fixed lens cameras, moving the camera further from the targeted viewing area produces a larger view. With a varifocal lens, you can adjust the lens setting as well as camera placement to create the desired view. But that flexibility comes at a steeper camera price.

The below chart shows the width and height of view that various common lenses provide at various distances, expressed as width x height (in feet). The chart assumes that the camera uses a 1/3" image sensor. Currently, most of the cameras we sell use such a sensor.

Lens Focal Length	10 feet	20 feet	50 feet	100 feet
2.6 mm	19x14	37x28	92x69	185x139
4 mm	12x9	24x18	60x45	120x90
6 mm	8x6	16x12	40x30	80x60
8 mm	6x5	12x9	30x23	60x45
12 mm	4x3	8x6	20x15	40x30

Resolution

When you consider the large area that a small focal length can view at a distance, it would be tempting to design a solution with a few 2.6mm cameras positioned far from the intended viewing area. But it is important to consider the detail that is required when viewing a given scene. This is determined by the resolution of the camera (driven by the megapixel rating). The crucial measurement is the number of pixels per foot of viewing area. For instance, a 4-megapixel camera has a maximum resolution of 2688x1520. Using just the horizontal measurement (width), we see that the image will be 2688 pixels wide. Suppose this camera has a 6 mm lens and is positioned 50 feet from the intended viewing area. The chart above tells us that view will be 40 feet wide. So the pixel per foot measurement is 2688/40 or about 67.

So just how useful is a 67 pixel/foot view? The chart below provides some general guidelines. While this topic is somewhat subjective, our source is the Department of Homeland Security's Digital Video Quality Handbook and so should be considered authoritative.

Intended Use	Minimum Recommended Pixels per Foot
Observation (is something going on that requires further investigation?)	20
Forensics (what happened and when?)	40
Recognition (who did it?) amongst known individuals.	80
Recognition (who did it?) amongst the general public.	160
Recognition of a license plate.	50

These recommendations assume that there are good viewing conditions (clear and well-lit views). Use higher values in poorer conditions.

The chart below shows the maximum resolution for common cameras based on their megapixel rating.

Megapixels	Maximum Resolution (width x height)
2	1920x1080
4	2688x1520
8	3840x2160

One final note: a fisheye (360 degree) camera's resolution can be deceiving. While these are often high in total resolution), that resolution is spread across a very wide view. This view is often presented as 4 virtual camera views so the effective quality of a 12 megapixel camera should be considered to be closer to a 2 megapixel camera.