Performing a Proper Site Survey for CCTV

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Purpose of a Site Survey

There are multiple reasons to perform a site survey prior to the ordering, purchasing and/or installation of CCTV equipment.

1. Verify requirements of mounting equipment:
   - Saves time by arriving prepared with the appropriate tools, fasteners, and other such items required to mount a dome or housing to a wall, ceiling or pole
   - Saves money by not ordering the wrong style or classified mount

2. Verify the visual alignment of the proposed camera position:
   - Saves surprises caused by ordering and/or installing the wrong lens for the scene.
   - Insures a clear point of view at the point of installation
   - Allows time to correct potential or actual image blockage
Purpose of a Site Survey

3. Verify Lighting Conditions:
   o Provides the opportunity to calculate the minimum required sensitivity of a camera insuring that what is installed will produce the required result every time.
   o Verifies what, if any lighting deficiencies the site has and if any type of speciality camera or support lighting may be required.

4. Verify the various mounting heights, distances to scene and other requirements to insure proper lensing and/or lens adjustments at point of installation.
   o Takes the guess work our of lensing and provides the client with a uniform final product.
   o Allows the designer / installer / PM to do the math in advance of ordering without having to trust or count on specification sheet results.
Purpose of a Site Survey

5. Verify the required ID levels of each camera and insure that the unit installed will produce the appropriate amount of visual detail as required by the cameras’ written purpose
   - Insures a uniform result, every time for every job
   - Saves problems after-the-fact as the playback of the associated cameras will be accurate to the SOW
   - Insures accuracy of design and design standards of expectation

6. Verify all power requirements at all locations in advance of need
System(s) Purpose

All video systems in the Security Industry – either Analog or Digital must have a written, defined purpose. Defining the requirements, parameters, and expectations of the system is especially important when working with digital systems and even more important if working with multiple sites. The written expectations and requirements of the final product will define the equipment required beyond question and insure:

1. Compatibility of equipment and results
2. Overall management strategies
3. Cost savings in advance of expensive errors and omissions
4. Uniformed Response and Visual Expectations within and between systems
Camera Purpose

- **Without a defined, written purpose, how do you know which camera will be the best and who makes it?**

  What is the minimum lighting that you will have to work with under worst conditions?

  What is the minimum resolution that you will require?

  Are there any specific features that you will require? ...
  - Back-lighting compensation
  - Day / Night
  - Edge motion detection or analytics
  - Wireless from the camera
  - Motion Detection built into the camera
  - Etcetera
Choosing a camera, regardless of Analog, Hybrid, or Digital status is done in 3 steps:

**Sensitivity**
The minimum amount of light that would be available for the camera to use under worst circumstances

**Resolution**
The minimum amount of detail as defined in Horizontal lines, require to create a useable, identifiable image

Resolution ends up being according to the weakest link.

**Features**
What extras does the camera have built in

The Process of Choice

Application narrows field of appropriate Electronics

Once narrowed the final decision becomes choice
CCTV Camera Sensitivity
Sensitivity

- Refers to the minimum amount of light required to create an image
- Determined by the amount of reflected light available
Type of Light

- Cameras see reflective light which is measured in Foot-candles (fc) or Lux
  - 1 fc = The amount of light produced by a candle as measured on a one foot radius area, one foot away provided that all light from the flame is equal and consistent at all points.
Foot-candle (fc) to Lux (lx)

- 1 Lux = 0.0929 Foot-candles
  - Round out to a 10 / 1 ratio
- 1 Lux = 0.1 Foot-candles
- 10 lx = 1 fc
Defining Light

- Ambient Light: That light that is produced via a source and aimed or directed toward an area.
- Reflective Light: That ambient light that strikes a reflective surface and is reflected back toward the source or camera:
Defining Light

- Asphalt/Water = 0.05 = 5%
- Concrete = 0.25 = 25%
- General = 0.15 = 15%
- Green Grass = 0.40 = 40%
- Red Brick = 0.25 = 25%
- Road Rock = 0.15 = 15%
- Snow = 0.95 = 95%
- Water = 0.05 = 5%

Different Colors / surfaces reflect light at different percentages
To Calculate Needed Sensitivity

- Determine the amount of ambient light available at the scene
- Calculate and subtract the reflective light loss as based upon light loss or reflective light chart
- Calculate and subtract the Lens light loss factor
Sensitivity Calculations

• Camera Purpose
  – To be able to observe and identify persons moving across the far side of the lot, at night.

• Step one:
  – Measure the ambient light (facing the target from the camera’s perspective) at various points in the lot, at night with no cars.
Sensitivity Calculations

• Take the lowest ambient light reading and subtract reflective light loss factor
  – Black asphalt reflects 5% ambient light

\[ 2 \text{ fc} - 95\% = 0.1 \text{ fc} \]
Sensitivity Calculations

• Subtract Lens Light Loss (LL) Factor
  – Zoom lens = 2 f-stops (fs)
    LL in full zoom position.
    • 1 fs drop = 50% decrease in light
    • 1 fs up = 100% increase in light

\[ \text{0.1 fc - 1fs} = 0.05 \text{ fc} \]
\[ \text{0.05 fc - 1 fs} = 0.025 \text{ fc} \]

- 2 fs lens light loss factor
  \[ \text{0.025 fc NECESSARY Camera Sensitivity} \]
Defining Resolution
What Determines Detail in an Image

Analog and Digital
Analog Resolution

- Analog is determined by number of Pixel Points as created by the intersection of horizontal and vertical lines of resolution.
- Only as good as the weakest link in the system.
  - Analog switching equipment
  - Analog recording equipment
  - Signal loss over long distance cable runs
Digital Resolution

- Digital resolution is determined by number of Pixel Points as created by the grid pattern of the Charged Coupled Device (CCD).

- Only as good as the weakest link
  - Compression Schemes
  - Pixel resolution at the point of objective surveillance area
  - Storage capacity and storage compression scheme
  - Quality of resolution of the viewing screen

Pixel Point
Horizontal Line
Vertical Line
Digital Resolution

- Digital resolution is determined by number of Pixels creating a grid pattern
- The more pixels, the better the detail of the image, the better the resolution
  - 640 x 480
  - 1280 x 960
Resolution

Resolution becomes most important when expanding or enlarging the image:

1. Analog pixels and the spacing between Pixels enlarge or expand at the same ratio allowing for extensive enlargements prior to picture deterioration, but require more distance between the eye and the image as the image is enlarged.

2. Digital pixels are fixed squares of color and only expand to a fixed degree before overlapping each other and causing Pixilation of the image.
Analog and Digital Resolution

- Analog Video is based upon a sensor and screen ratio of 4:3.
- The larger you expand an Analog image, the further away from the image you must stand to dissemble what is being seen.

- High Definition (HD) Digital Video is based upon a Mpix sensor and screen ratio of 16:9
- Most modern Mega-pixel and some IP based cameras will offer both 4:3 or 16:9 ratios.
- With Digital images, once you go beyond the ability of the viewing pixels to expand without overlapping, it makes no difference how far away from the image you stand … it will be out of focus or beyond distinction.
1st of 3 Ways of Referencing Digital Resolution

The most Common Digital Resolution Reference is the grid size

4 CIF = 704 X 480

Note: it is very important that the camera and viewing screen specification sheets refer to “Active” or “Effective” pixels or provides a percentage number representing the amount or number of inactive pixels in the CCD (Imager).
2nd of 3 Ways of Referencing Digital Resolution

The Second most Common Digital Resolution Reference is the total Pixel Count ...

4 CIF = 704 X 480
Or
337,920 Pixel Array

Note: it is very important that the specification sheet refer to “Active” or “Effective” pixels or provides a percentage number representing the amount or number of inactive pixels in the CCD (Imager).
The third most common Digital Resolution Reference is to the imager size:

2 Megapixel or 5 Megapixel

Note: This is the language of the Mega-pixel camera and the personal camera. The larger the number of pixels available to the image, the better the definition.

Again, it is very important that the reference size of the imager is to the “Active” or “Effective” Pixels only.

The above is based upon an aspect ratio of 16:9 (1.78 HD)
Resolution

CIF = 320 x 240

4 CIF = 640 * 480

4 CIF is the equivalent of making the same image twice as wide and twice as tall but as a single image with 2 times the horizontal and 2 times the vertical resolution. The net result is critical detail in the image for after the fact identification.
Resolution – Mega-Pixel

16 CIF = 1280 * 960
Resolution determines the detail of the image ... CIF resolution is great for general images, but not for detail if trying to identify images of small objects / persons at any distance.

CIF Resolution at 10 times expansion for playback
Resolution determines the detail of the image ... 4CIF resolution is great for general images, and for detail if trying to identify images of small objects / persons at general distances.

4CIF Resolution at 6 times expansion for playback
Resolution determines the detail of the image. 16CIF (5 Mpix) resolution is great for all images, but eats up storage space at tremendous rates so needs to be used sparingly.
Its all about Pixels-per-foot

- You can’t see details without pixels
- Face/License Plate Recognition Systems require 45 to 88 pixels Per/foot
- The Mega-pixel covers better

30 Pixel/foot coverage

- NTSC = 21’
- HDTV = 43’
- 2Mpix = 53’
- 3Mpix = 69’

Thanks to IQinVision for Slide
Resolution improves Coverage

320 x 240  NTSC/PAL  HDTV  2 Mpix

Thanks to IQinVision for Slide
Thanks to IQ inVision for Slide
How to Evaluate What You Need

**Obvious**
- Choose your areas of coverage
- Verify points of view
- **Do not overview an area just because you can**
- Learn the language of the equipment that you are reviewing
- HD cameras are the current thing but are often restricted on features
- Mega-pixel are full of features but have many proprietary features that must be tolerated or designed around.

**Obscure**
- High Density (HD) or 1080p is still mega-pixel but in a 16:9 ratio of view
- High density concentrates on resolution in a defined area
- HD has progressive scanning as opposed to single image production
- Mega-pixel concentrates on area coverage with a defined resolution
- Both technologies can be high resolution by restricting the width of the view
Why HD or Mega-Pixel

Man at 50’ 4 CIF

Man at 50’ 2 Meg-Pixel
Man 150’
4 CIF

Man 150’
5 Mega-Pixel
Math of Pixel Identification

• Horizontal Pixel count of imager divided by the width of area in feet at point of focus

- Horizontal Pixel Count = 1280
- Width of area at point of focus = 30 feet
- $1280 / 30 = 42.67$ pixels per foot available
DIGITAL STANDARDS OF ID

• Digital Standards of recognition are still in flux and are being verified via world wide testing.
• With Digital resolution there are seven levels recognition established as based upon the number of pixels per foot (PPft) available to describe the object of identification.

  – Monitor - 7 PPft at the point of focus
  – Detect - 11 PPft at the point of focus
  – Observe - 18 PPft at the point of focus
  – Recognize - 35 PPft at the point of focus
  – Identify - 46 PPft at the point of focus
  – Facial Identification 45 - 88 PPft at the point of focus
  – License Plate Identification 30 - 70 PPft at the point of focus

Remember: The associated PPft listed are becoming accepted as a guide. The Standard is in process of development working off the same guidelines, but with the necessary testing required to fix a final PPft standard.
# DIGITAL STANDARDS OF ID

<table>
<thead>
<tr>
<th>Monitor:</th>
<th>General human or vehicular traffic flows - no serious detail upon blow up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 P-P/ft at the point of focus</td>
</tr>
<tr>
<td>Detect:</td>
<td>Man sized targets large enough to be detected but not identified, no</td>
</tr>
<tr>
<td></td>
<td>significant detail on blow up</td>
</tr>
<tr>
<td></td>
<td>11 P-P/ft at the point of focus</td>
</tr>
<tr>
<td>Observe:</td>
<td>Clothing &amp; colors become distinctive, no good detail on blow up man sized</td>
</tr>
<tr>
<td></td>
<td>target</td>
</tr>
<tr>
<td></td>
<td>18 P-P/ft at the point of focus</td>
</tr>
<tr>
<td>Recognize:</td>
<td>High degree of accuracy identifying and separating known individuals - good</td>
</tr>
<tr>
<td></td>
<td>detail for general blow up of image</td>
</tr>
<tr>
<td></td>
<td>35 P-P/ft at the point of focus</td>
</tr>
<tr>
<td>Identify:</td>
<td>Establish identity of individuals beyond shadow of doubt - excellent image</td>
</tr>
<tr>
<td></td>
<td>blow up</td>
</tr>
<tr>
<td></td>
<td>46 P-P/ft at the point of focus</td>
</tr>
</tbody>
</table>

The associated P-P/ft listed are accepted as a guide. There are no set Standards to date.
DIGITAL STANDARDS OF ID

Facial Recognition Software Systems:
Extreme detail, required resolution for most Facial recognition data systems
45 - 88 P-P/ft at the point of focus – dependent upon Software Program requirements

License Plate Recognition Software Systems:
Ability to produce License plate print out for work with various LPR data systems
30 - 70 P-P/ft at the point of focus – dependent upon Software Program requirements
Closing Comments

The two most common faults of camera systems come from lack of proper site documentation and individual camera or scene requirements:

1. Camera sensitivity ... all cameras will provide a viable image in full light ... do you have enough imager “sensitivity” to produce a viable image under worst lighting conditions.

2. Resolution ... if all you need is an image, use any camera at any distance ... If you require detail (as defined by the camera purpose), do the math in advance.
Questions?

Thank you for the opportunity to be of Service to you ...

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