CCTV SYSTEM

Introduction to CCTV System

Why CCTV System is Important?

"A picture is worth a thousand words"

Why CCTV System is Important?

- Deterrent
  - Security (camera) presence in the premis deters would be wrong doers
  - Properly manned control room provide surveillance and detect possible would be malicious activity. Can be enhanced with analytic features e.g: line crossing, unattended baggage etc
- Recorded evidence
  - Visual identification makes easy to pinpoint wrong doers
  - Visual trails
  - Video analysis allows security improvement

Component (Stage) in CCTV System

- CCTV system design can be broken down into 3 basic components (stages):-
  1. Input (i.e the camera itself) (Origin) (The EYE)
     - The source of video
     - No matter how good your system is, if the camera is fails to perform your whole system will fail
  2. Transmission medium (cabling, network switch etc.) (Highway) (Nerve cells)
     - Medium to transmit the video
     - Again, if your camera is good but the transmission of the data is bad, the final result will still be bad
  3. Output (i.e NVR, display) (Destination) (The BRAIN)
     - What to do with the video
     - Yet again, if the camera and transmission perform flawlessly, but the data is not managed and presented properly to the user the whole system will still fails.
- Make sure that these basic components (stages) are selected properly.

CCTV Cameras

- Let's just concentrate at the types used mostly by user (and they are called so mainly due to their shape):-

1. Dome Camera

   - Dome shape
   - Most widely used
   - Can blend nicely, friendly
   - But, lens normally are not changeable (unibody)

2. Box Camera

   - Boxy shape
   - Surface mounted, mostly outdoor application
   - Clearly indicate its presence
   - Lens are changeable

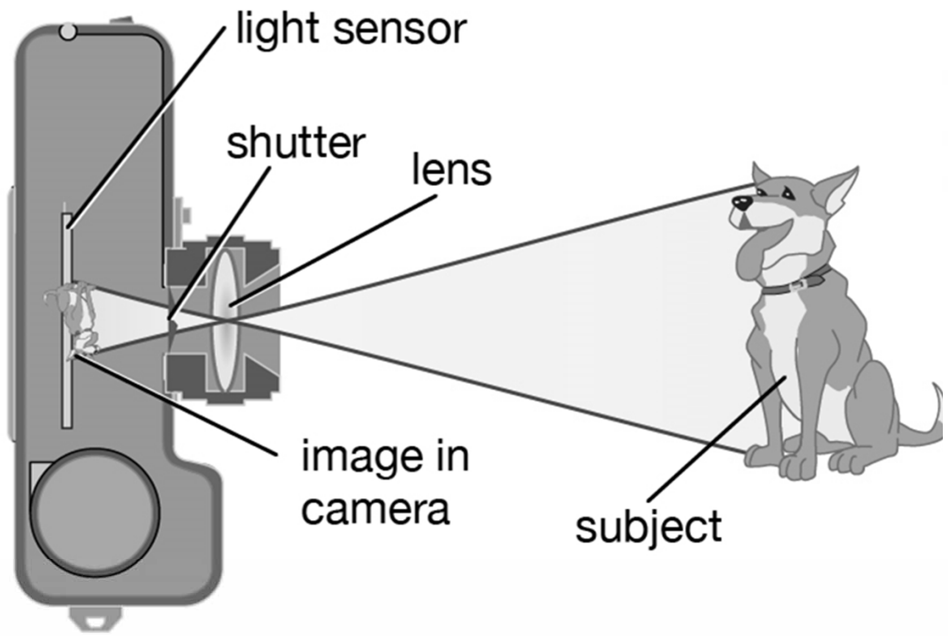
CCTV Cameras

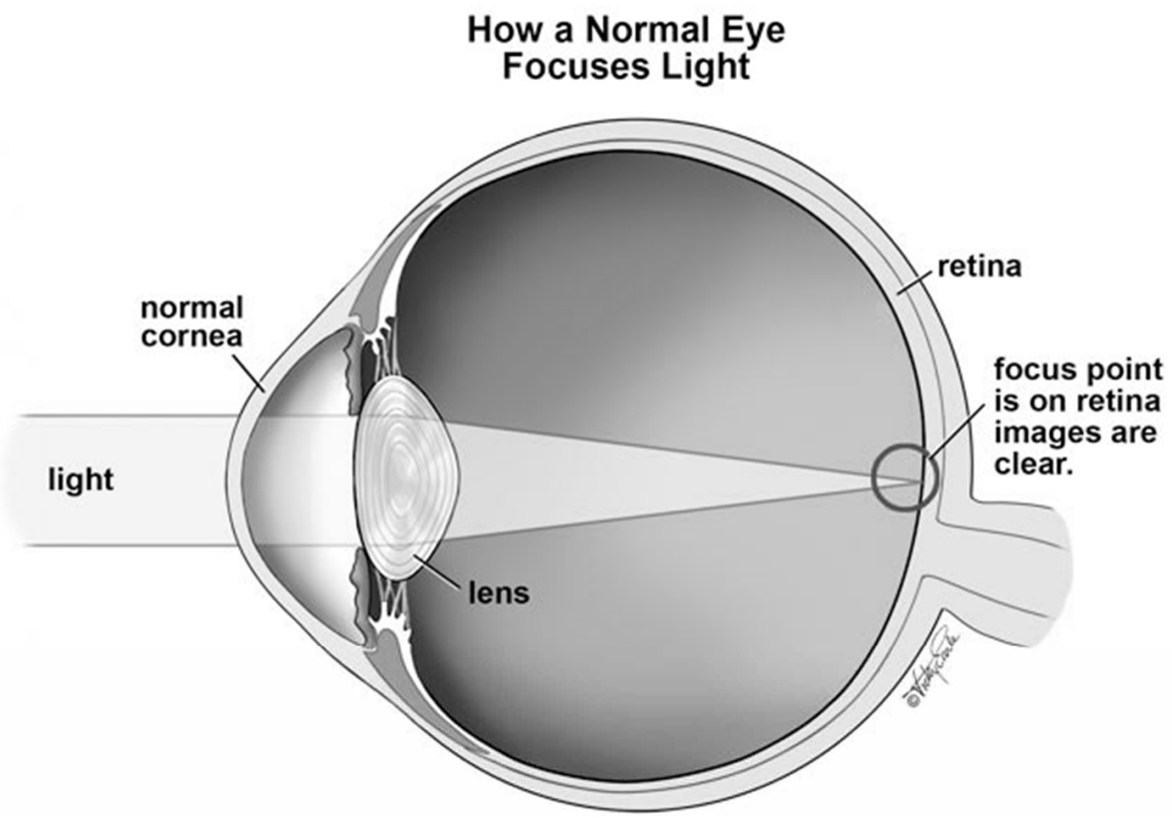
3. Bullet Camera
    - Surface mounted, mostly outdoor application
    - Clearly indicate its presence
    - But, lens normally are not changeable

4. PTZ Camera
    - Pan, tilt & zoom
    - Mostly outdoor application
    - Clearly indicate its presence
    - Zoom lens are not changeable
    - Expansive compare to others

CCTV Cameras

- The important things are what to look for (specifications) of that camera. Regardless being dome or box, some of the important features to look for are:-





CCTV Cameras

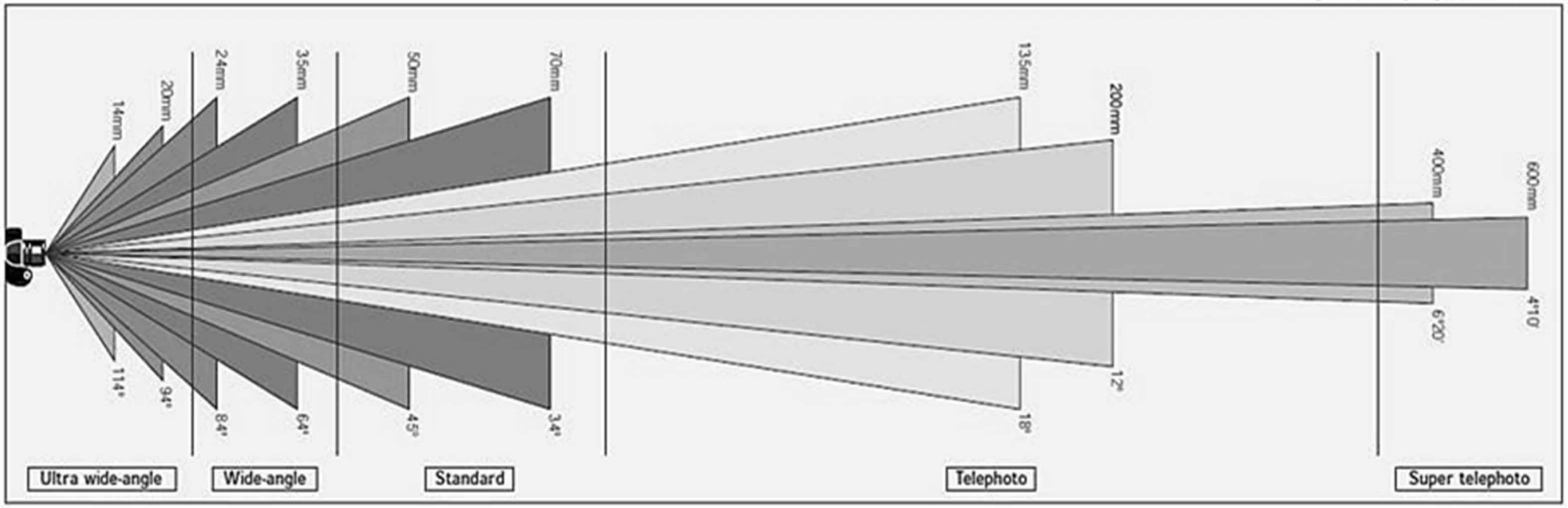
- Lens
  - Focus light (image) onto the sensor
  - Measure in mm, e.g: 2.8mm, 4.0mm, 90mm etc. Ratio of longer to shorter focal length gives magnification (zoom), e.g: 10x using 50-500mm lens.
  - Lens has angle of view (coverage angle). Short focal length has wider angle of view compared to longer focal length, BUT..

35mm

50-500mm

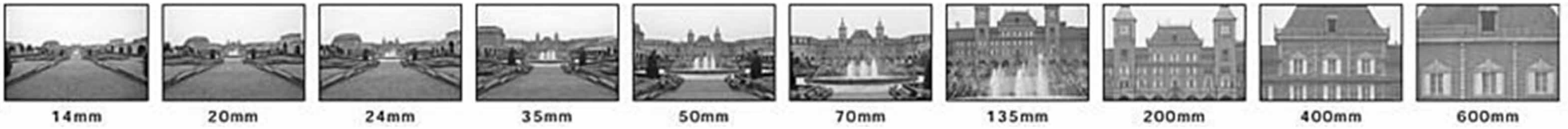
CCTV Cameras

- Lens
  - Short focal length has wide angle but only good at short distance, whilst long focal length has narrow angle of view but good for long distance viewing.

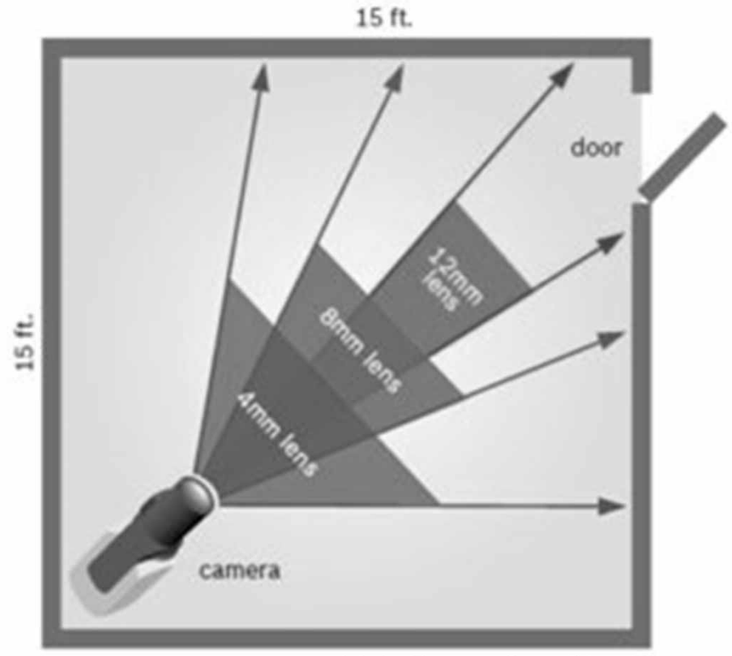


CCTV Cameras

- Lens
  - Because of coverage angle, we have field of view (FOV). FOV is what we see.



- For CCTV camera we can have fixed focal, vari-focal and zoom lens
- In fixed focal, FOV is limited to only 1 scene.
- Minimum required is vari-focal (e.g: 4 – 12mm), why?
- PTZ camera uses zoom lens (e.g: 4 – 120mm, 30X)



CCTV Cameras

- Lens
  - So, the question is how far can a camera covers?
  - We need to understand the concept of DORI (detection, observation, recognition & identification) at target FOV. Minimum resolution as per BS EN 50132-7:-
    - ✓ Detection: ≥ 25 pixel/m FOV height
    - ✓ Observation: ≥ 62 pixel/m FOV height
    - ✓ Recognition: ≥ 125 pixel/m FOV height
    - ✓ Identification: ≥ 250 pixel/m FOV height


Detection


Observation


Recognition


Identification

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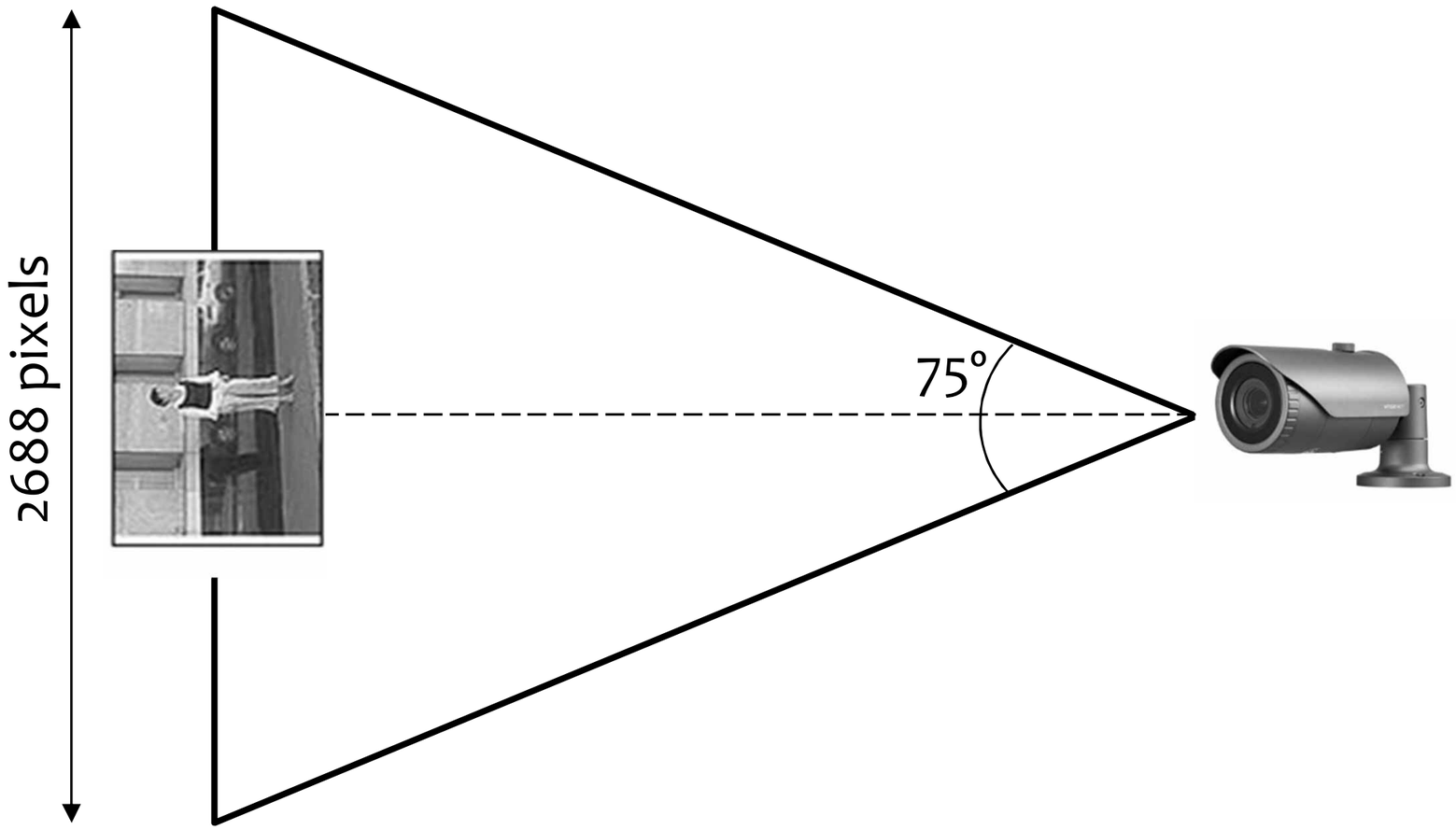
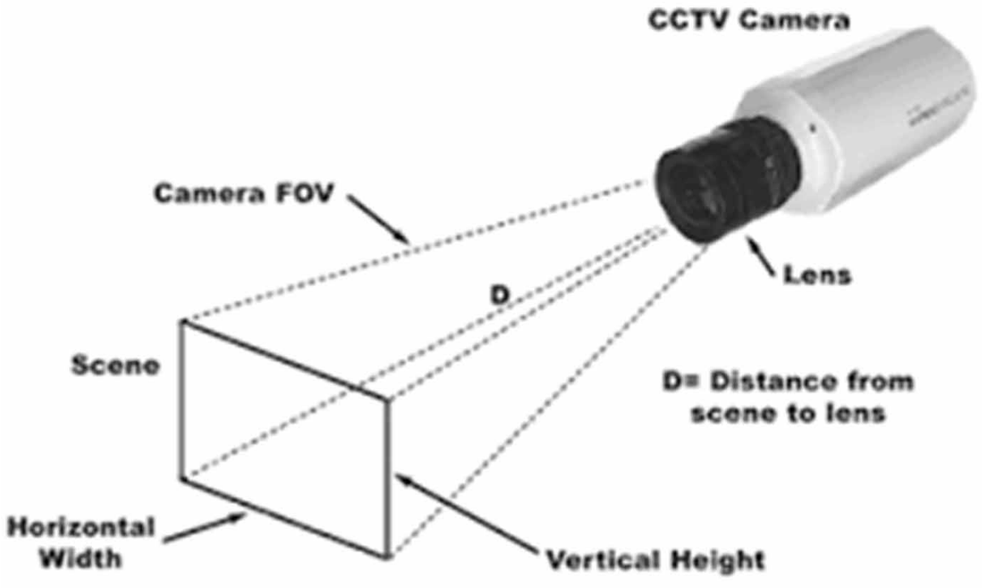
- e.g: 2688 x 1520 pixels (H x V), 75° horizontal coverage



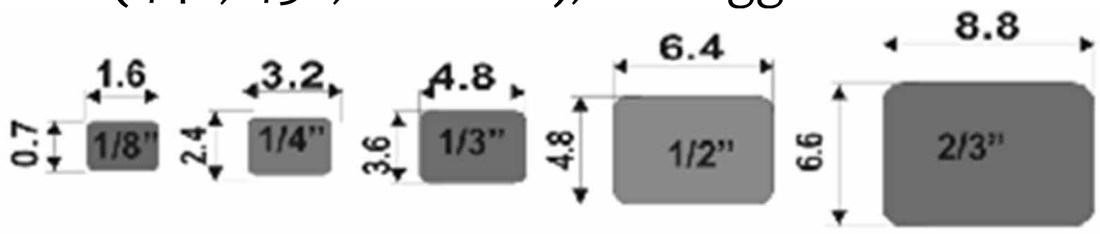
CCTV Cameras

- Lens
  - For example: if we use a full HD 3mm camera to view a target scene at 6m away, the FOV is 10.3m (width) X 5.8m (height). Full HD resolution is 1920 (width) X 1080 (height) pixels. So the FOV resolution at target is 1080/5.8 pixel/m or 186 pixel/m which is recognition level.



CCTV Cameras

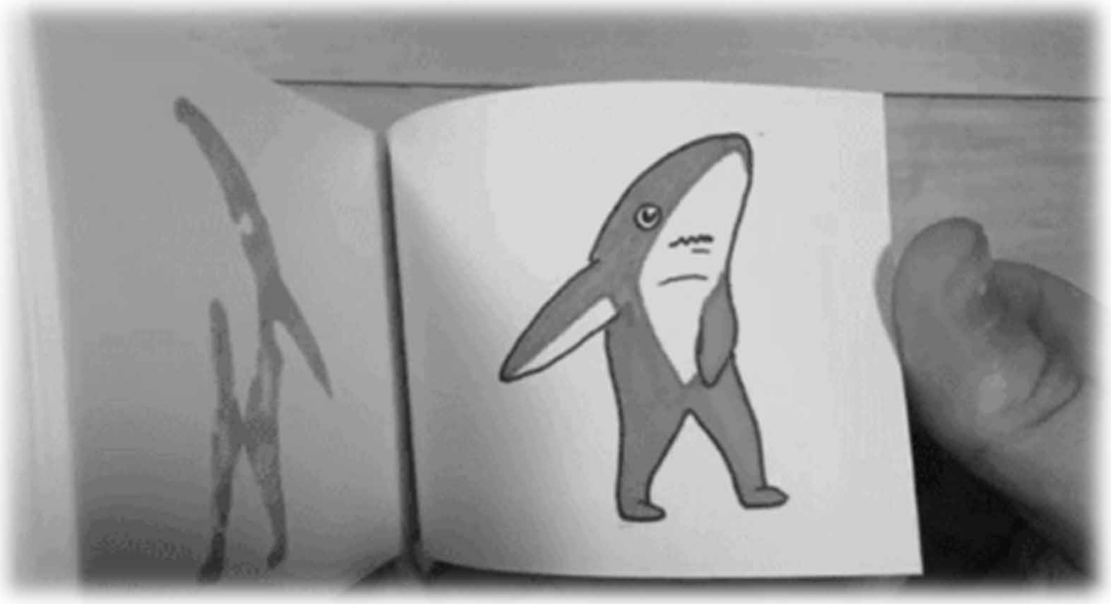
- Image/light **sensor**
  - Converts light focussed by lens to electronic signals (think of our retina) using CMOS
  - Many sizes (1/4”, 1/3”, ½.8” etc), the bigger the better. Why?



  - Sensor resolution (how fine the picture is) in megapixel determine video resolution, e.g: HD is 1280 x 720, full HD is 1920 x 1080 etc

CCTV Cameras

- Image/light **sensor**
  - Frame rate (or frame per second, fps). Video is made from how many still images per second. Full frame is 25 fps.



CCTV Cameras

- Other parameters
  - Sensitivity – The minimum light required to produce acceptable light level (IRE) in colour or B&W

Minimum Illumination (50 IRE)	Color: 0.1 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps)
	B/W: 0.07 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps)
Minimum Illumination (30 IRE)	Color: 0.06 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps)
	B/W: 0.05 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps)

  - Day/Night – Able to perform in day (colour) and low light (B&W) conditions (determine by sensitivity). Normally by IR cut filter.
  - IR – Able to perform in 0 lux condition. Illumination (or light) provided by IR light.
  - Compression – Raw video (image) is big data. Need to compress to reduce bandwidth. Minimum required compression is H.264.

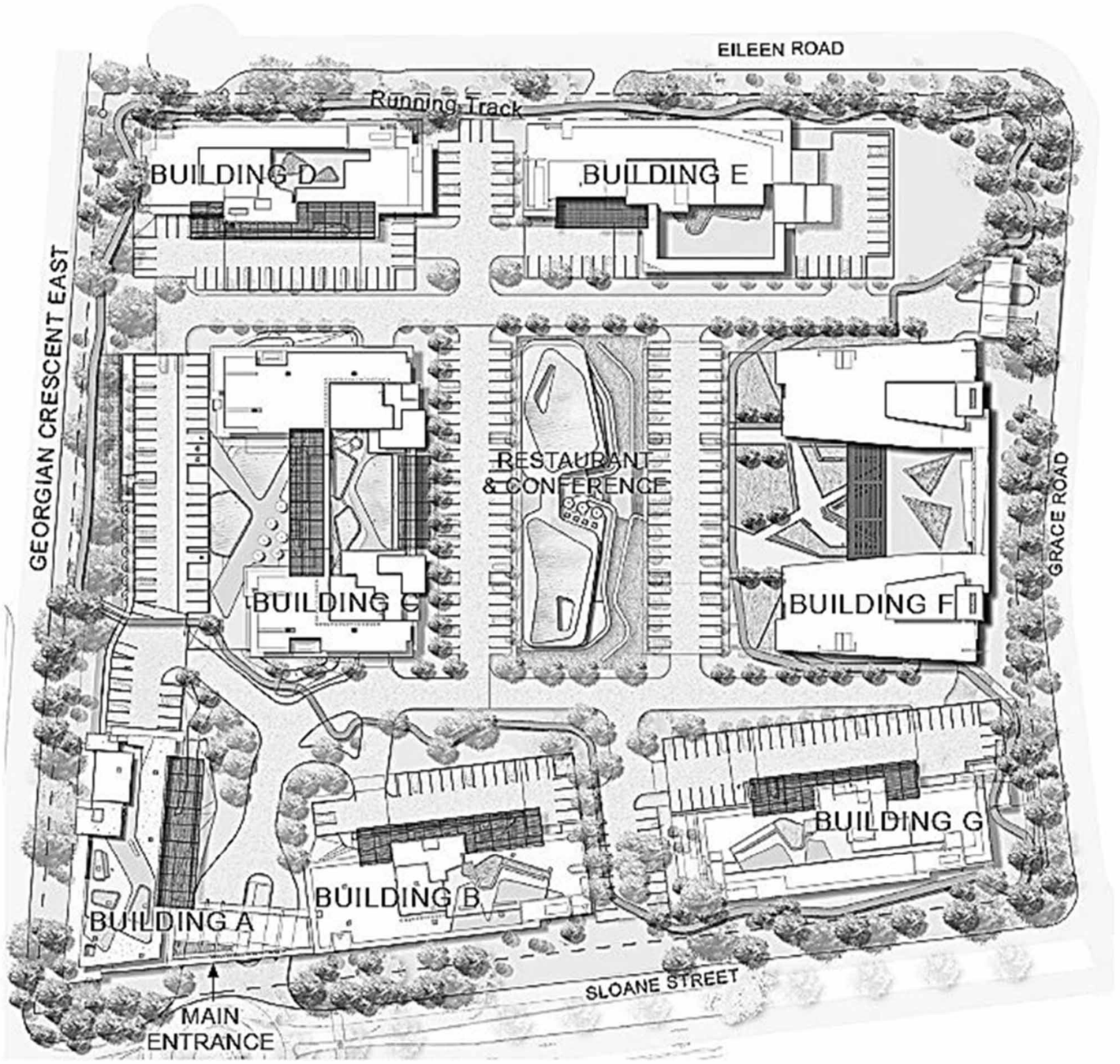
CCTV Cameras

- Other parameters
  - Wide dynamic range (WDR) – To compensate over-exposed and under-exposed images

  - Onvif
  - Ingress protection (IP) and vandal resistant (IK)
  - Number of stream

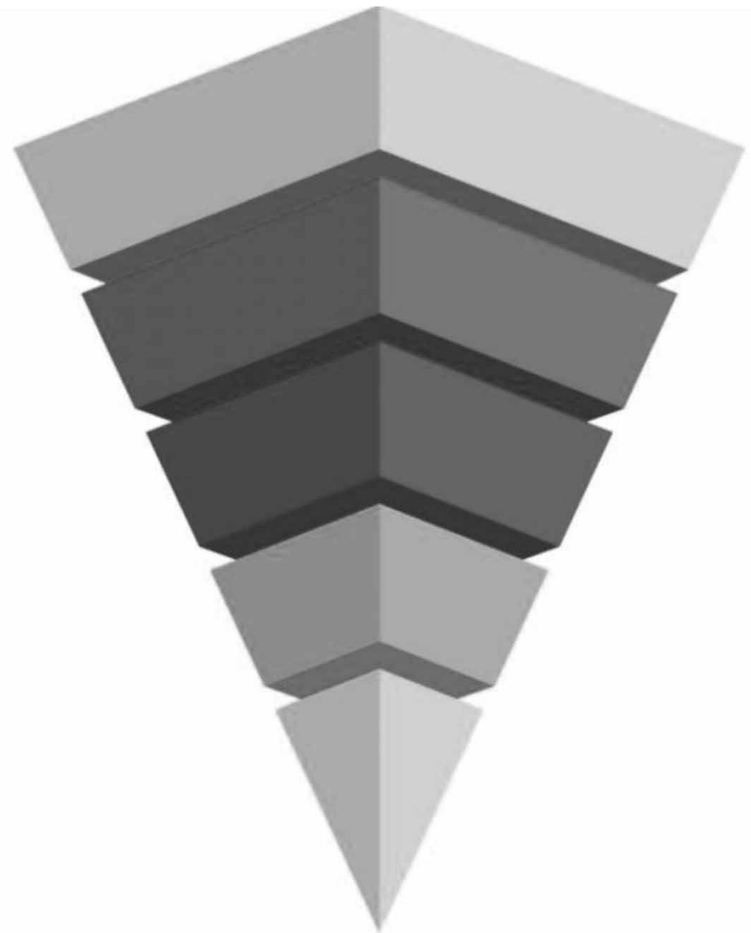
CCTV Cameras

- Camera placement

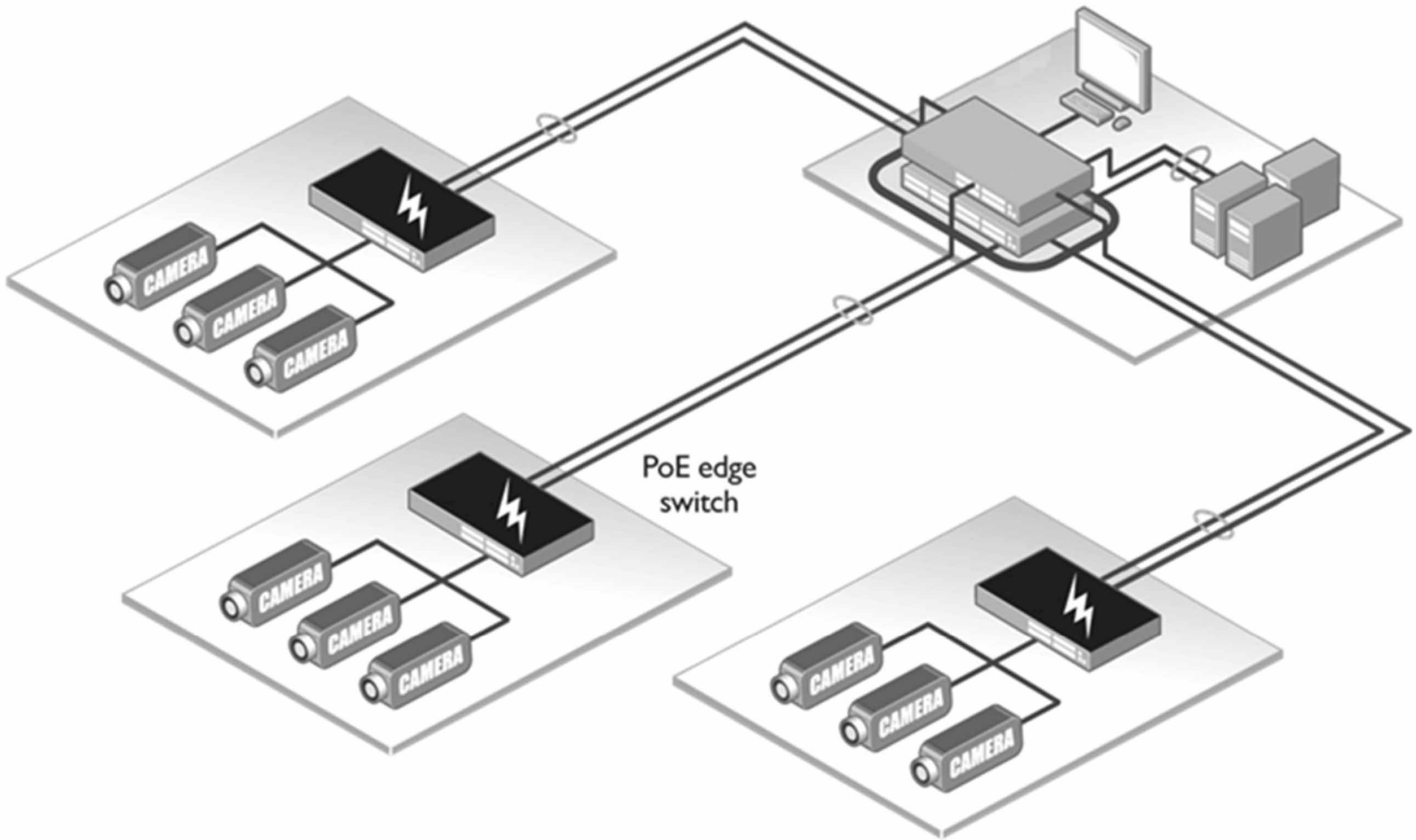


CCTV Cameras

- Need to understand function and security concept
- Where to place camera?
  - Complex, premise or building requires CCTV?
  - Entrance and exit points of the complex/premise
  - Entry and exit points of the buildings
  - Entry and exit points of each floor of the buildings
  - Entry and exit points of rooms with restricted access (e.g: strong room, CCTV control room, server room etc)
  - Other strategic locations

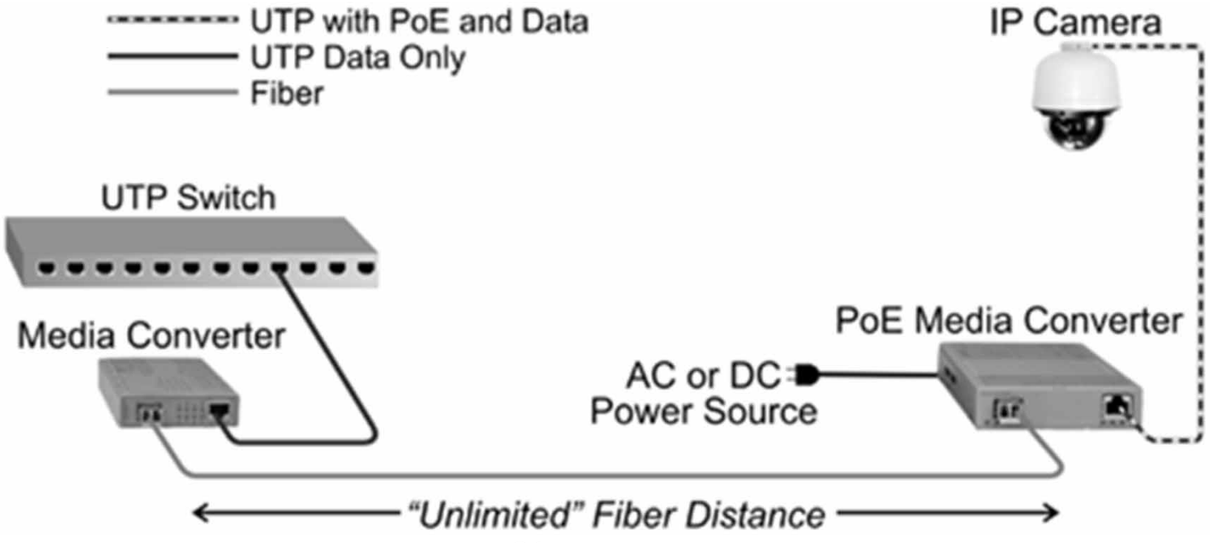


Transmission



Transmission

- Having selected the right cameras, the medium for data transmission needs to be considered:-
  1. UTP cat 6 cable
     - ✓ Connects camera to access switch
     - ✓ Provide power to camera through POE or POE+
     - ✓ Govern by limitation of cable (~ 90m)
     - ✓ Strictly for in building only
     - ✓ Beyond 90m (and external use), use combination of fibre optic cable and converters



Transmission

2. Access (edge) switch
   - ✓ Provide cameras access to IP network
   - ✓ Number of RJ-45 ports determines by how many cameras connected to it, e.g: 10-port, 24-port & 48-port
   - ✓ Provide power to camera through POE or POE+. Make sure POE total wattage is not exceeded.
   - ✓ Depending on the design, switches could be located in several wings or floors or other buildings
3. Core / Distribution switch
   - ✓ Access switches converge on core or distribution switch
   - ✓ Depending on the distance, access switches are connected to core/dist switch using UTP (STP) or SM/MM fibre optic cable
   - ✓ NVR, PC, monitors etc are normally connected to the core/dist switch

Output

- The image captured by the camera and being transmitted to the user must be managed. The output stage function is to:-
  - ✓ Manage the CCTV system
  - ✓ Video data storage
  - ✓ Video data retrieval
  - ✓ Video live viewing
- The basic components required to do these are:-
  1. CCTV management software
     - ✓ Software that manage the whole CCTV
     - ✓ The operating system for CCTV
     - ✓ Using PC or server
     - ✓ Small system use proprietary software such as Samsung, Panasonic etc. Large system use open software such as Aimetis, Milestone, Genetec etc.
     - ✓ Can be basic, or include other features such as video analytic, AI etc.

Output

2. Data storage/retrieval
   - ✓ Use network video recorder (NVR) for storage and data retrieval
   - ✓ Storage size depends on
     - ✓ Based on camera resolution, min full HD 1920 X 1080
     - ✓ Frame per second (fps), min 15 fps
     - ✓ Duration of recording (second, minute, hour, day, week, month etc), min 30 days
     - ✓ Number of cameras
   - ✓ Small scale use proprietary
   - ✓ Large scale use storage server type
3. Live viewing
   - ✓ Real-time monitoring
   - ✓ Use workstation with large monitors
   - ✓ Each monitor display several views, typical 20-30

Unit Perunding Akustik

Thank You For Listening