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Introduction to Interior and Exterior Sensors

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Module Objectives

- Provide a general overview of sensors
- Describe interior and exterior sensor fundamentals and principles
- Discuss features of a good interior and exterior sensor system
- Describe performance criteria and parameters that influence sensor performance testing

Parts of a Physical Protection System

- **Detection and Assessment**
  - *Exterior intrusion sensors*
  - *Interior intrusion sensors*
  - Alarm assessment
  - Entry control and contraband detection
  - Alarm communication and display
- **Delay**
- **Response**

Sensor Fundamentals

- Sensor classification
  - Principle of operation
- Alarm definitions
- Sensor performance characteristics
  - Installation
  - Maintenance
  - Cost

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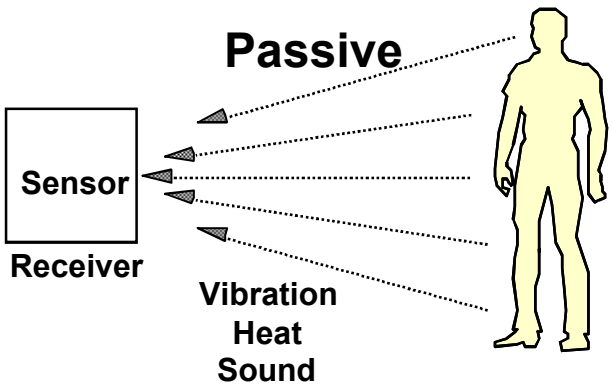
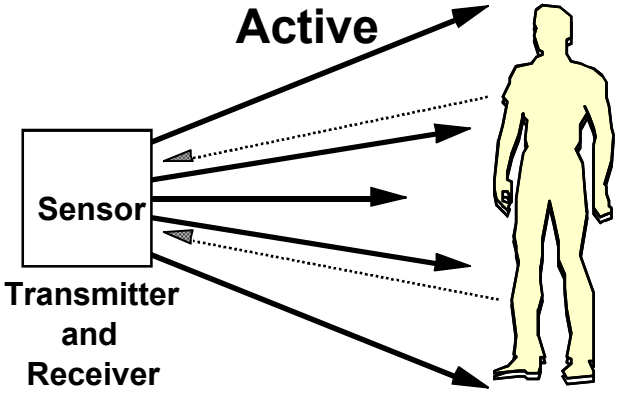
Sensor Classification

- Passive or active
- Covert or visible
- Line of sight or terrain following
- Volumetric or line detection
- Mode of application

Exterior	Interior
Buried line	Boundary penetration
Fence-associated	Interior motion
Freestanding	Proximity

Passive or Active





- **Passive** – Sensor receives energy, does not radiate energy
  - Vibration
  - Heat
  - Sound
  - Capacitance

- **Active** – Sensor receives and radiates energy
  - Microwave
  - Infrared
  - RF

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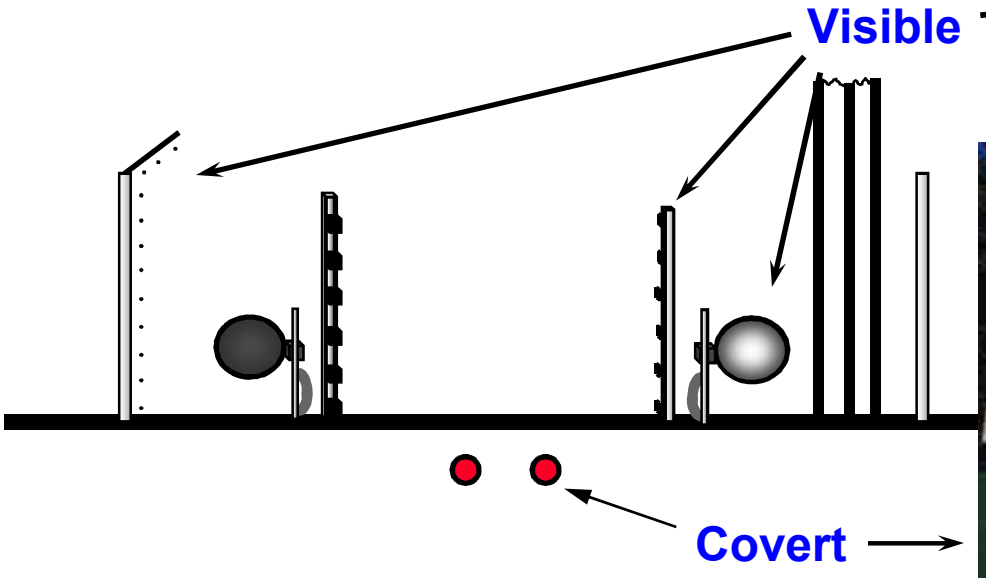
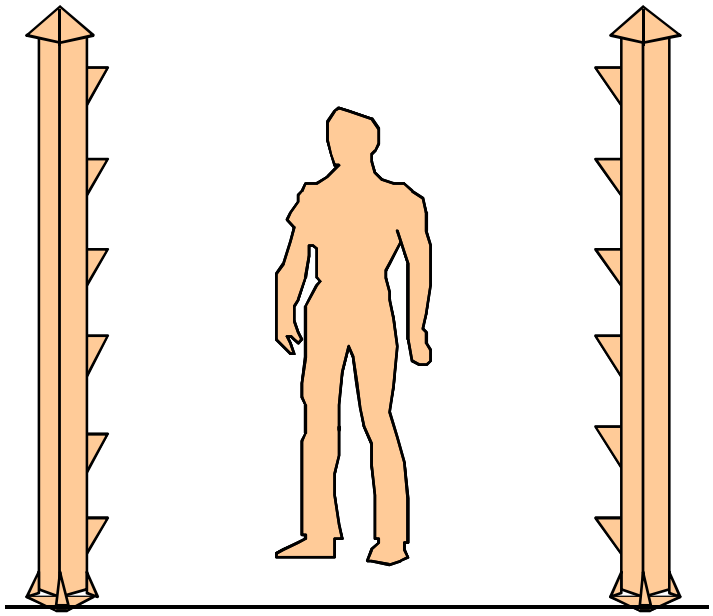
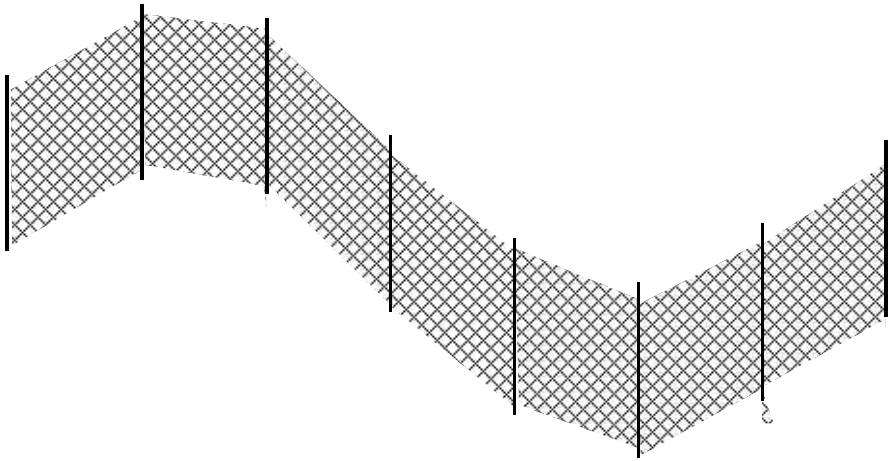
Covert or Visible

- **Covert**
  - Sensors hidden from view
  - More difficult for intruder to detect
- **Visible**
  - Sensors in plain view of intruder
  - Simpler to install and repair



Line-of-Sight or Terrain-Following

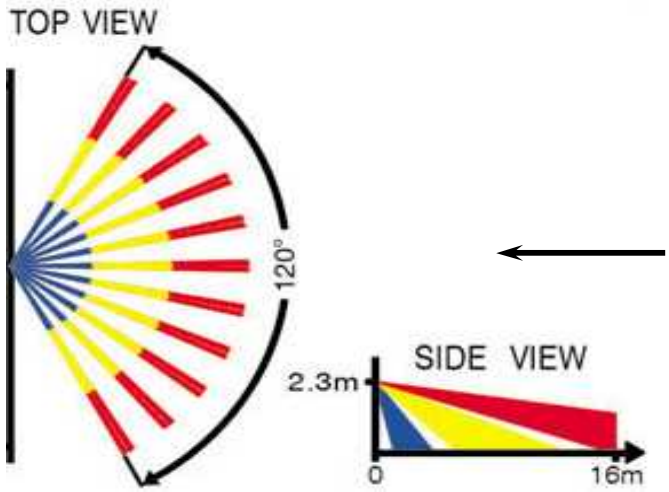




- **Line-of-sight**
  - No obstacles in the detection space
  - Requires flat ground surface
- **Terrain-following**
  - Sensors detect on flat or irregular terrain

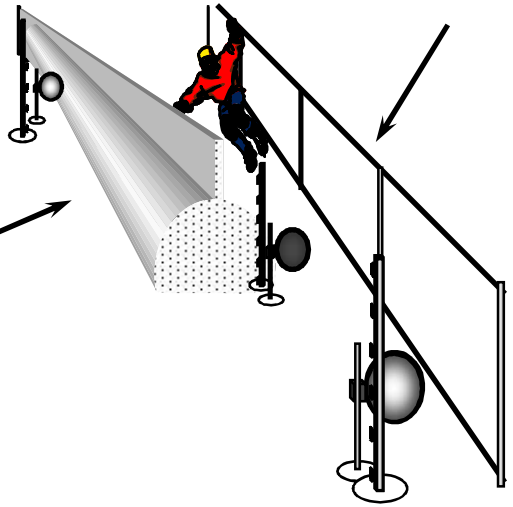
Volumetric or Line Detection

- **Volumetric**
  - Detection in a volume of space
  - Detection volume usually not visible
- **Line detection**
  - Detection along a line
  - Detection zone easily identified



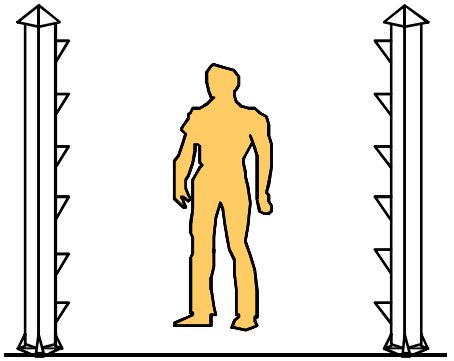
Volumetric

Line Detection

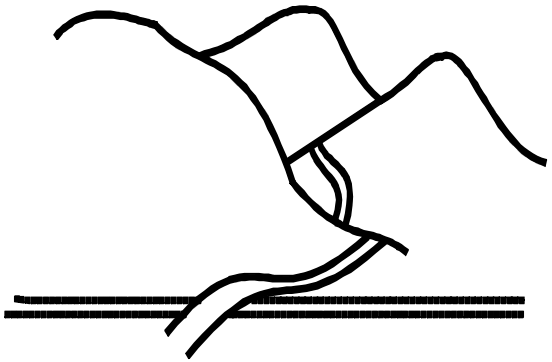


Sensor Mode of Application - Exterior

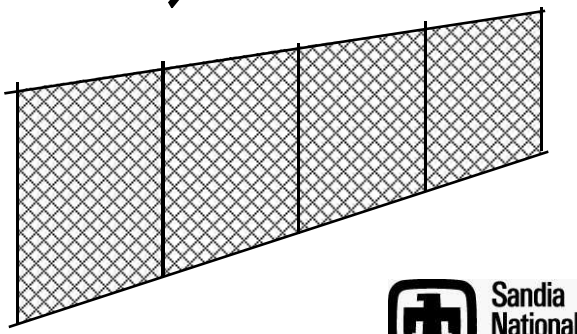
- **Freestanding**
  - Sensor mounted on its own support



- **Buried line**
  - Sensor in the form of a line buried in the ground



- **Fence associated**
  - Sensor mounted on a fence or forms a sensor fence



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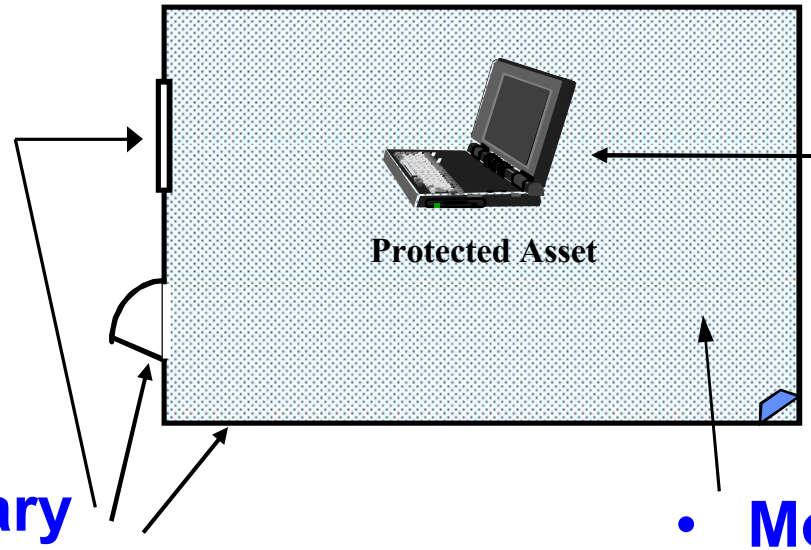
Modes of Application - Interior



- **Proximity**
  - Detection at an object
- **Boundary**
  - Detection at doors, windows, walls, vents, floors, ceilings, etc.
  - Detection zone easily identified
- **Motion**
  - Detection in a volume of space
  - Detection volume usually not visible

Sensor Performance Characteristics

- **Probability of detection (P_D)**
  - **Likelihood of detecting an adversary within the zone covered by an intrusion detection sensor**
- **Nuisance Alarm Rate (NAR) and False Alarm Rate (FAR)**
  - **NAR: Expected rate of alarms from an intrusion detection sensor unrelated to intrusion attempts**
  - **FAR: Expected rate of alarms from an intrusion detection sensor not caused by intrusion attempts which cannot be attributed to known causes**

Performance Criteria for Intrusion Detection Sensors

Elements of criteria:

- **Potential intruder's**
  - **Weight, size, shape**
  - **Zone crossing speed**
  - **Approaching method – crawl, walk, run, rolling**
- **Expressed in terms of P_D**
  - **Some percentage of probability**
  - **At a particular percentage confidence level**
- **Nuisance alarm rate**
  - **No more than x alarms per day per zone**
  - **If continuous alarm assessment is available, a higher false and nuisance alarm rate may be tolerated**

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Performance Characteristics of Intrusion Detection Sensors

$$P_D = P_S * P_A$$

where

P_D = probability of detection

P_S = probability of sensing

P_A = probability of assessment

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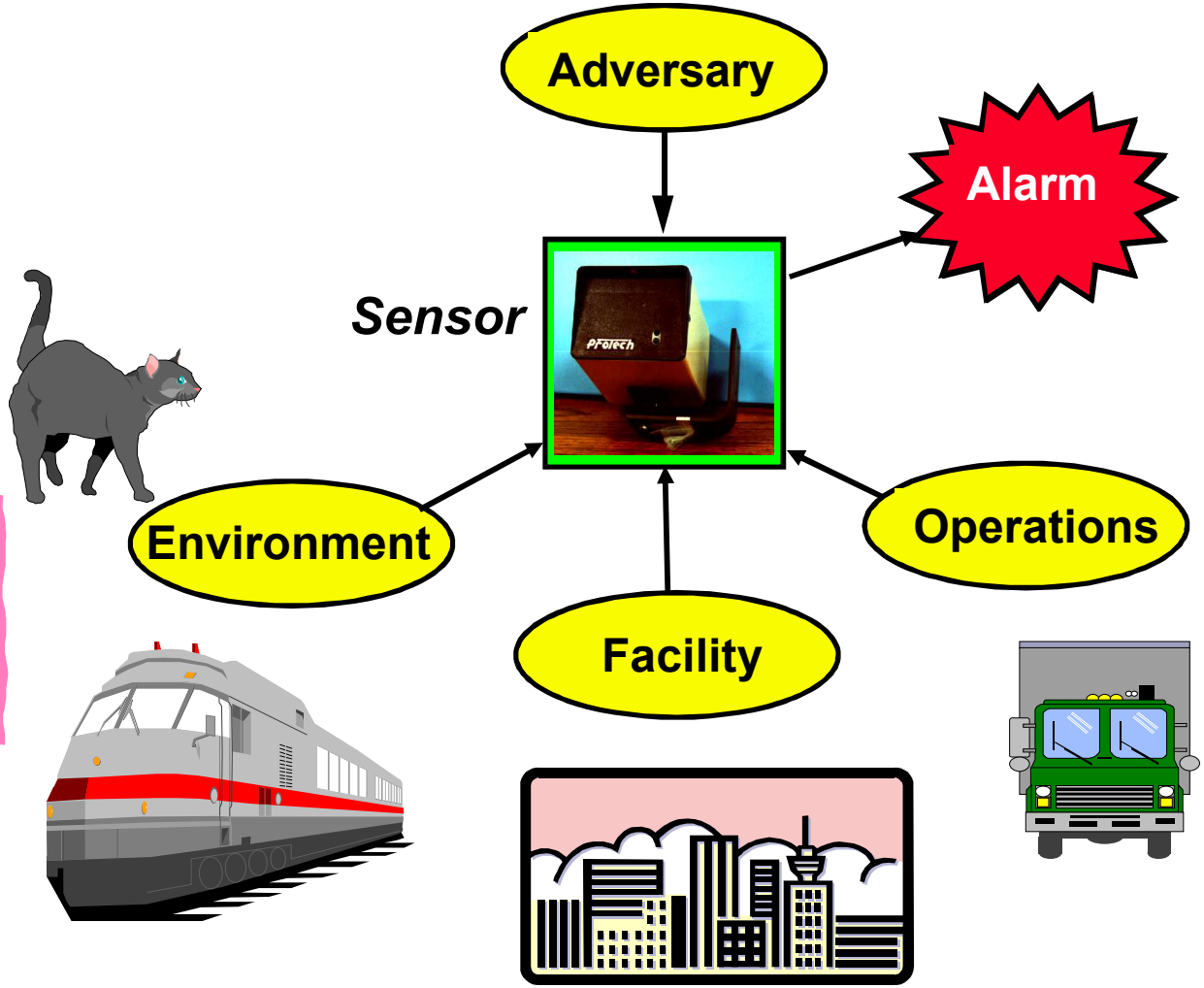
P_D for a Sensor is Conditional

- Target size and speed
- Sensor hardware
- Installation conditions
- Sensitivity setting
- Weather conditions
- Maintained condition
- Method of intrusion
  - Walking
  - Jumping
  - Tunneling

NAR / FAR Criteria

- *NAR -- Nuisance Alarm Rate*
- *FAR -- False Alarm Rate*
- **Express in terms of:**
  - **Average number of nuisance or false alarms per week per sensor at proper P_D**
  - **If observed by closed circuit TV or visual, a higher value may be acceptable**
- **Important note:**
  - **Too many nuisance or false alarms could cause complacency in assessment**

Sensor Interactions



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