Module 5: Facility Characterization

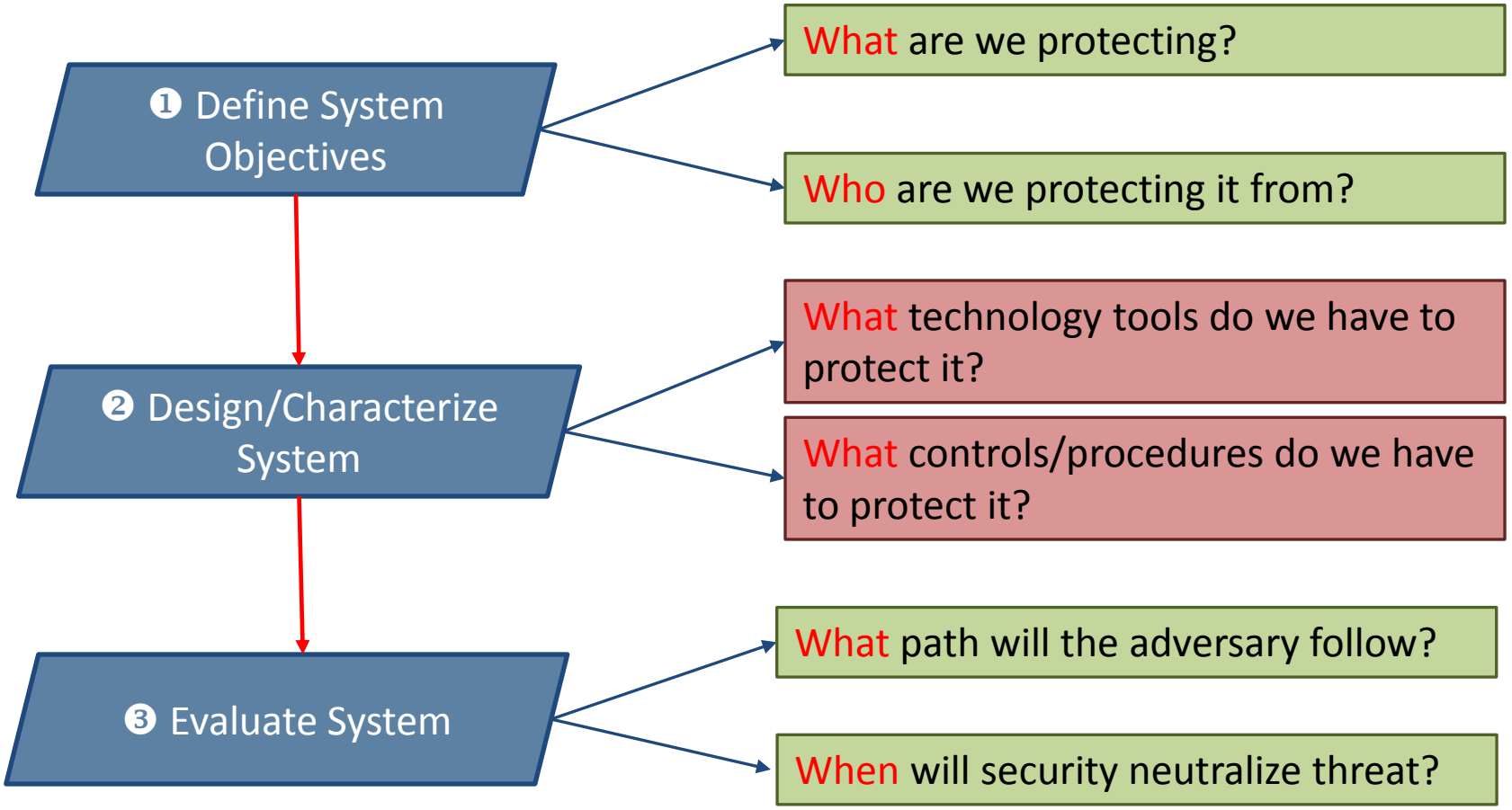
National Nuclear Security Administration

Briefing Overview

- A security system must accomplish its objectives either by deterrence or a combination of:
  - Detection
  - Delay
  - Response
- There is a balance between the use of hardware and the use of guards
- A well designed system provides protection-in-depth, minimizes failures, and exhibits balanced protection

Systematic Approach To Design & Analysis

3 Step Process



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Facility Characterization

- Requires the investigation of anything that impacts the performance of the MPC&A system
- This includes:
  - Site information
  - Physical protection system (PPS) components
  - Material Control & Accounting Systems
  - Information Sources
    - Documentation
    - Open sources
    - Site survey
    - Test data
    - Military and police

Facility Characterization

Types of information to collect:

- Physical conditions
- Facility operations
- Facility policies and procedures
- Insider access/authority/knowledge and insider groups
- Regulatory requirements
- Safety considerations
- Legal issues
- Organizational protection goals and objectives
- Others?

Physical Conditions

- Site boundaries, fences, barriers
- Topography, weather, and environment
- Building construction materials for walls, ceilings, floors, doors, windows, etc.
- Areas and rooms
- Access points
- Heating, ventilation, air conditioning
- Communication paths and types
- Power distribution system
- Environmentally controlled areas
- Locations of nuclear materials and vulnerable equipment
- Locations of non-target, hazardous material

Facility operations

Operational Activities

- Products and processes
- Operational hours
- Number, types, and locations of employees
- Visitors and vendors
- Access management

On-site location and movement of materials

- Shipping and receiving process
- Intra-site movements/convoy
- Internal processes
- Tracking mechanisms

Characterize The System

1. Physical *Protection* is a collection of integrated components specifically designed to allow response forces to detect penetration and respond to it.
   - Physical Protection has a presence at every level of the site
2. Material *Control* is a collection of integrated components and procedures designed to control the location and use of nuclear materials through containment and surveillance
   - Material Control is present at the vault through the protected area
3. Material *Accounting* provides a complete, accurate, and timely record of the nuclear material inventory and tools used to calculate the inventory

Security System Goals

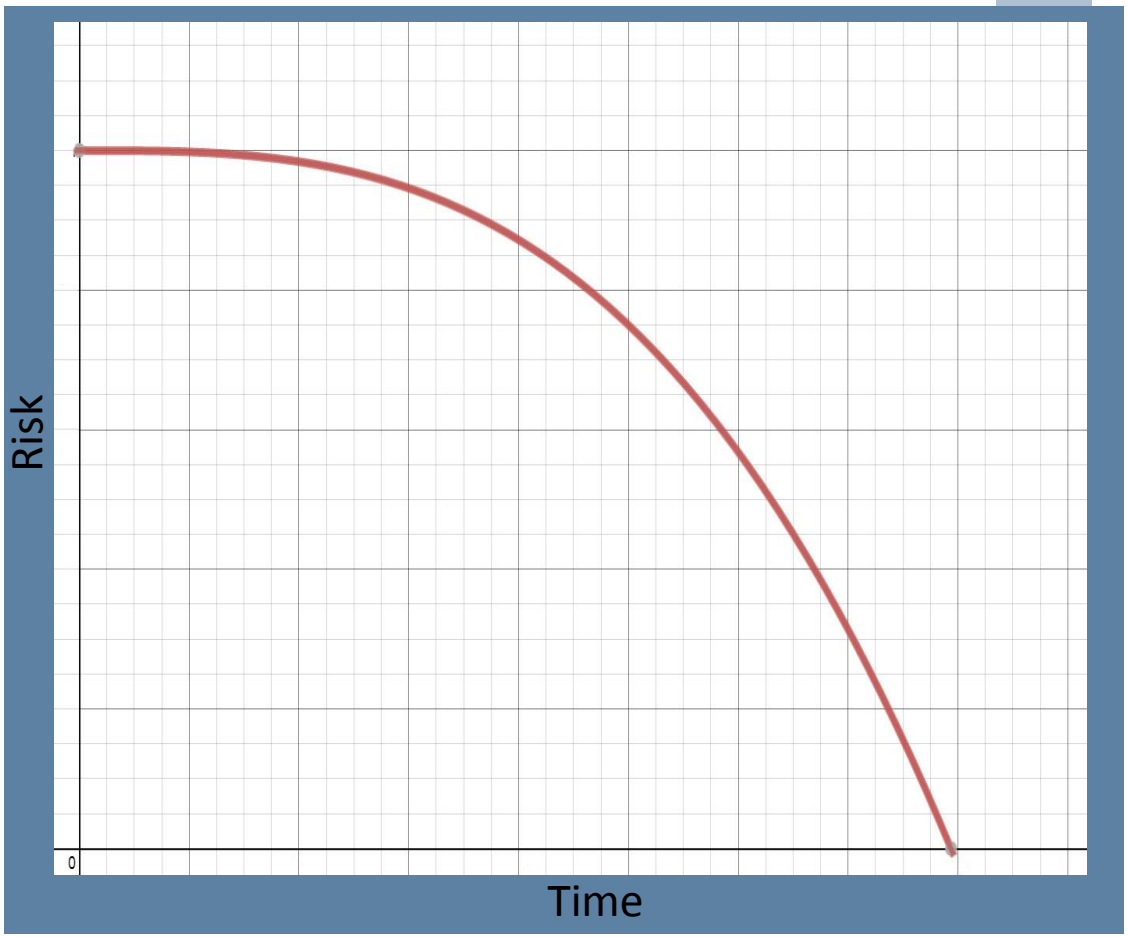
Design Strategies

1. Deter the adversary
   - Implement a system that potential adversaries perceive as too difficult to defeat and thus do not attack
   - Deterrence is difficult to quantify or measure
   - Not all adversaries can be deterred
2. Defeat the adversary
   - Required functions: detection, delay, response
     - Integrated as a system
   - Recommended design approach and the one used in design of systems protecting critical assets

Security Protection Goals

Relationship between Risk and Time

- Probability of a security system's chance for success increases the longer it takes the adversary to complete their mission.
- Goal of a system should be to integrate detection and delay with response times and capabilities.



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Physical Protection

Integrated System Components

DETECTION

- Intrusion Sensing
  - Exterior Sensors
  - Interior Sensors
- Contraband Detection
- Entry Control
- Alarm Assessment
- Alarm Communication & Display

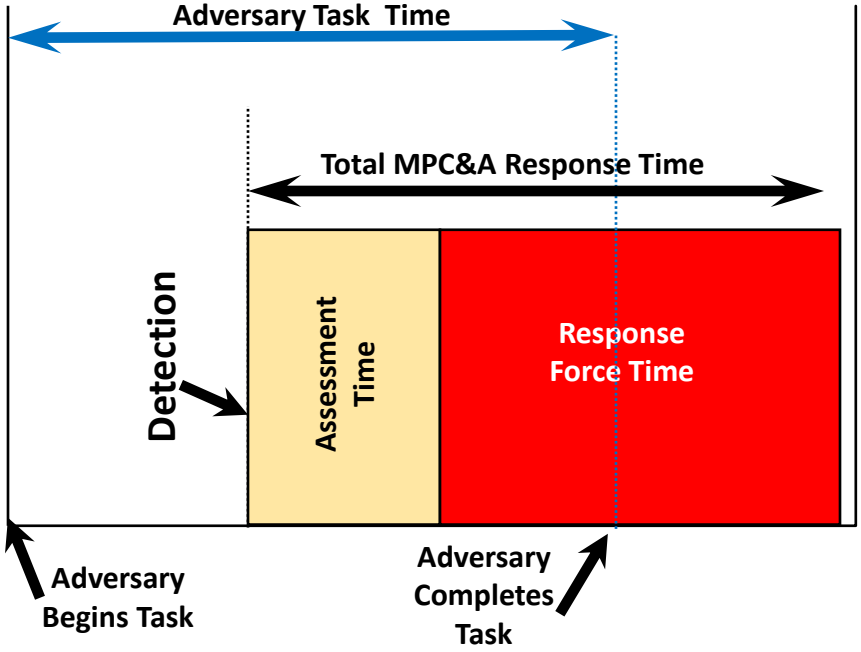
DELAY

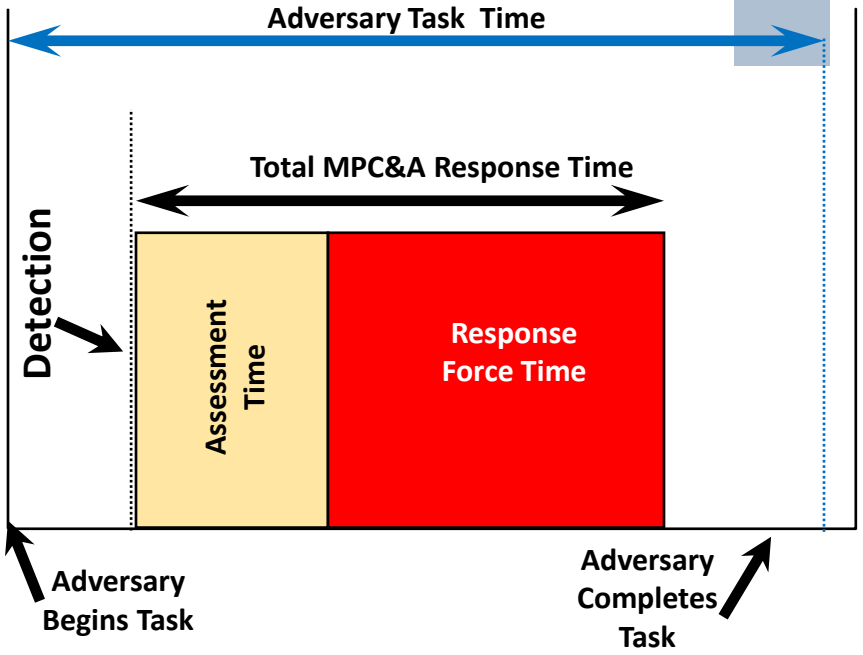
- Passive Barriers
- Active Barriers

RESPONSE

- Guards, Response Force (RF)
- Interruption
  - Communication to RF
  - Deployment of RF
- Neutralization

Integration





Protection Elements: Detection

Detection

- Objective is to sense covert / overt adversary action
- Initiate alarm, report, and display alarm
- Assess information and judge validity
  - Detection without assessment is not considered detection

Sensor Activated → Alarm Signal Initiated → Alarm Reported → Alarm Assessed

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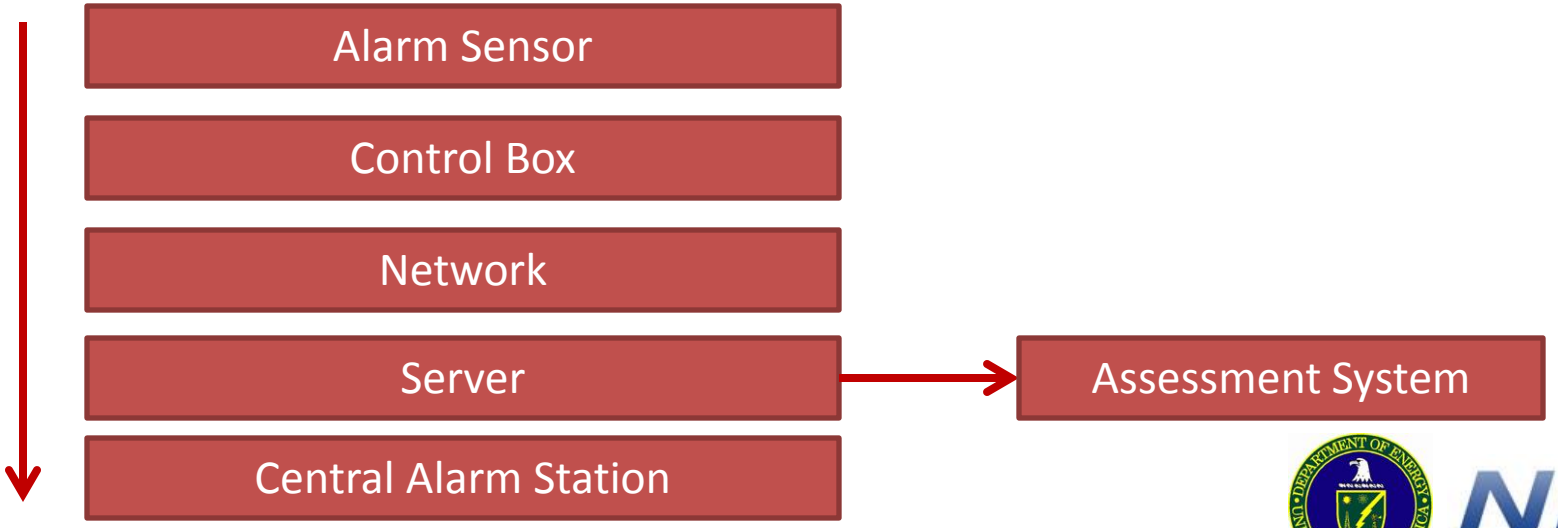
Protection Elements: Detection

Performance Metrics are broken into 2 categories:

1. Function (Probability of detection P_D)
   - Probability of sensor alarm (P_S)
   - Probability of alarm communication (P_{AC})
2. Time
   - Alarm Signal Communication Time (T_{AC})



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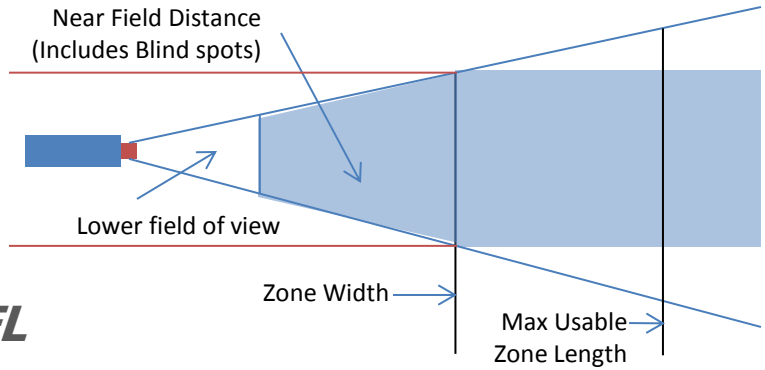
Protection Elements: Detection

- Nuisance Alarms and sensitivity of sensors can reduce P_D
- P_D for a sensor depends on:
  - Sensor hardware design
  - Installation conditions
  - Sensitivity setting
  - Weather conditions (exterior sensors)
  - Maintained condition
  - Target (adversary) size and speed

Protection Elements: Assessment

- Performance measures (Function & Time)
  - Probability of assessment P_A
    - Probability of video signal (P_V)
    - Probability of correct assessment (P_A)
    - Alarm assessment time (T_A)
    - Communication time (T_{AC})
    - Nuisance alarm rate (NAR)
- High NARs increase probability of incorrect assessment
- A long time delay between sensor alarm and assessment lowers P_D



$$H_{FOV} = W_I D/FL$$

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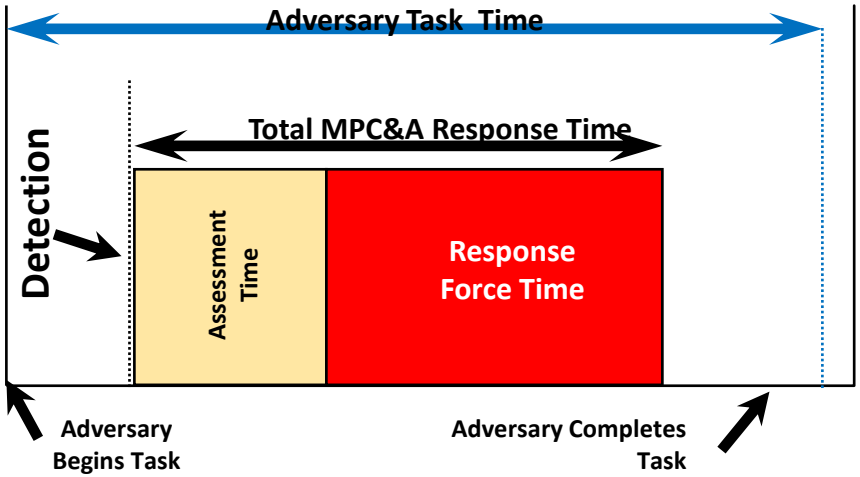
Protection Elements: Delay

- Installing delay upgrades can increase the adversary task time.
- Features of a good barrier system
  - Provides delay immediately after detection
  - Exhibits balanced design; no weak links
  - Uses delay-in depth (requiring different tools/skills)
  - Maximized at the target area
  - Delay features are present 100% of time or take compensatory measures
  - Design a penalty into parts

Sensor
Fence



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Protection Elements: Delay Metrics

- Performance measures (Function & Time
  - Time to penetrate or bypass barriers
  - Time to travel across areas
- Delay must occur after detection
  - Delay before detection is deterrence
- Can be composed of
  - Passive Barriers
  - Active Barriers
  - Response (Interruption)
  - Traversal time

Protection Elements: Response

- Determine types of response
  - Number of responders
  - Response times
  - Rules of engagement
  - Roles and trained capabilities
  - Weapons, equipment, vehicles
  - Tactics, strategies, and access
- Response force initial locations and deployment positions
- Review response procedures
- Review assessment, communication, and deployment times

Protection Elements: Response

Response Posture

- Two types of response used to counter attempted unauthorized removal (theft) of nuclear material or act of sabotage
  - ***Interruption***

    Stopping the progress of the adversary by the response force
  - ***Neutralization***

    Rendering the adversary actions and plans ineffective

Probability of Interruption * Probability of Neutralization = System Effectiveness

Protection Elements: Response Metrics

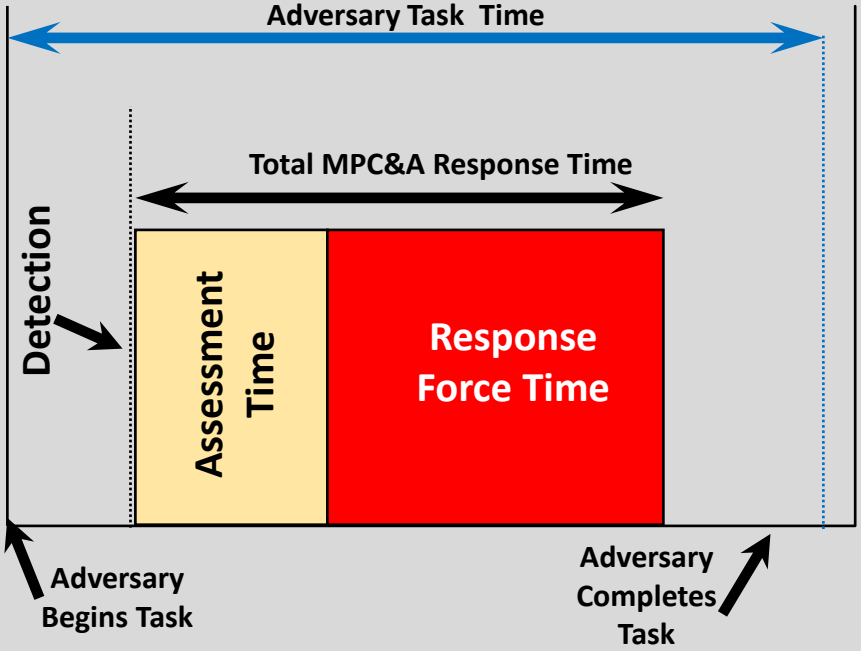
Goals & Performance Metrics

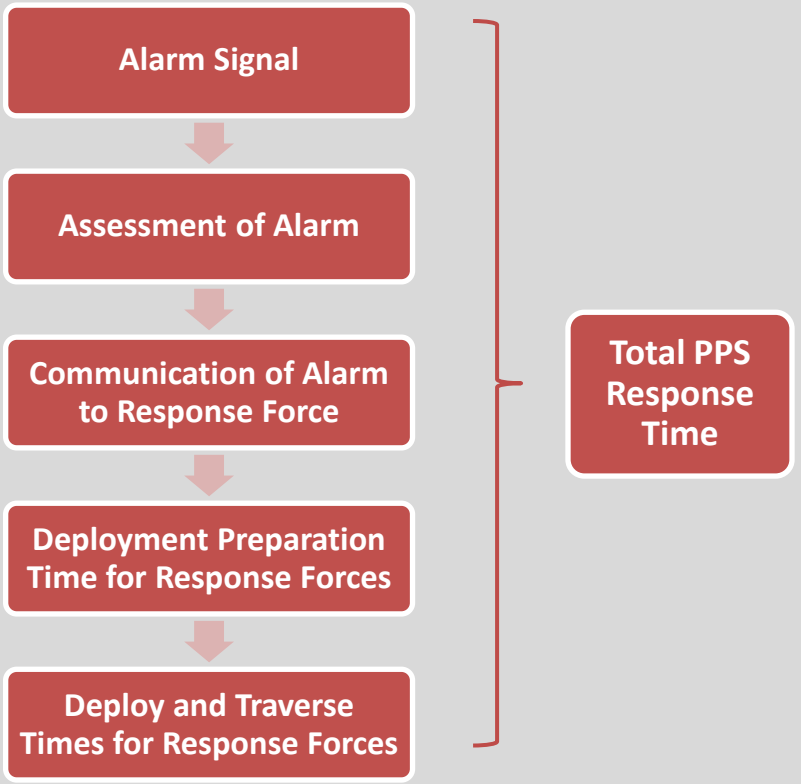
- The role of an immediate response force is to:
  1. Interrupt adversary progression of attack
  2. Neutralize adversary team or render the adversary ineffective

Interruption is a measure of detection, communication, delay, and response functions

Neutralization is a measure of response success, given arrival.

The time it takes to accomplish this metric should be less than the total adversary task time





Tools For Managing Time

DETECTION

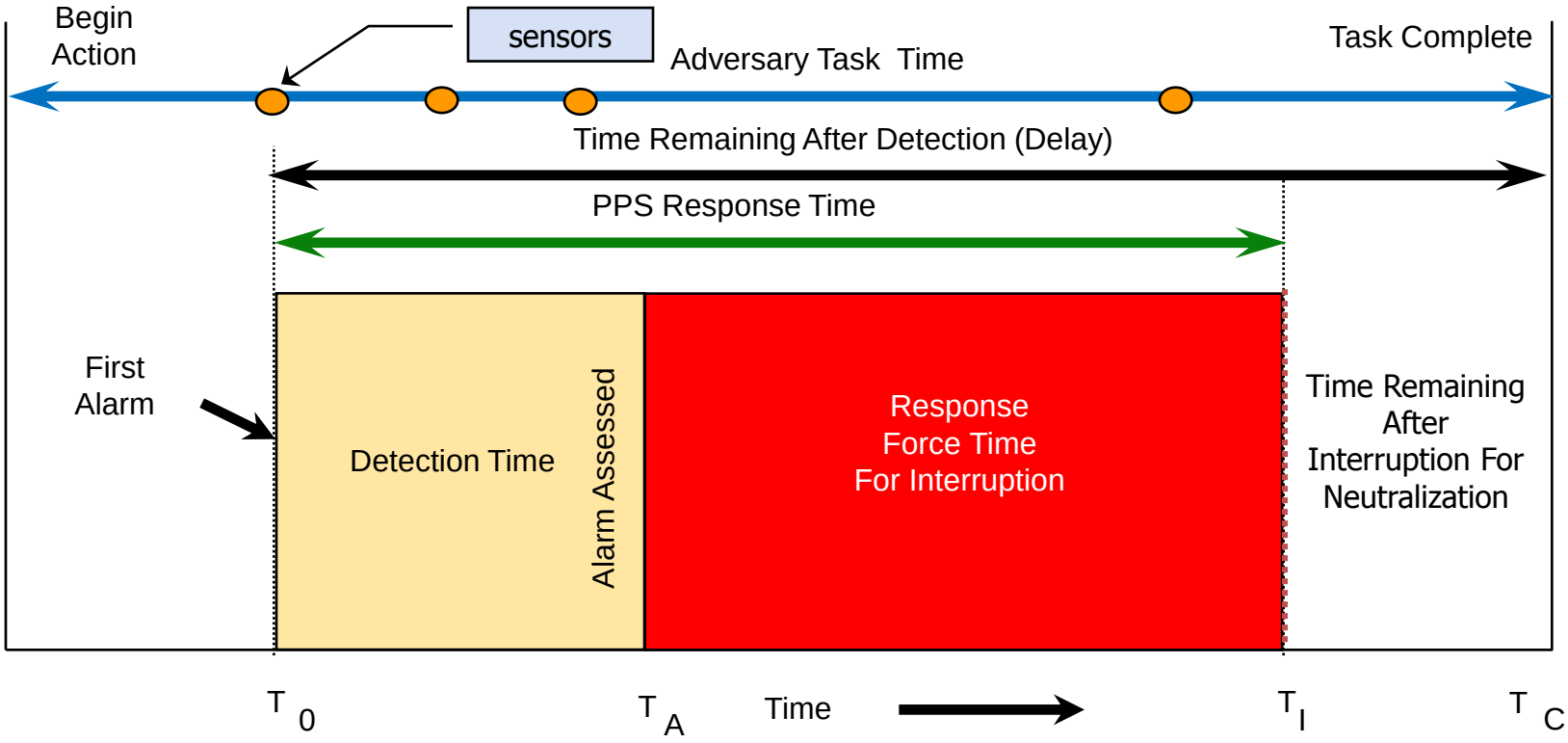
- Exterior/Interior Sensors
- Contraband Detection
- Alarm Assessment
- Alarm Communication & Display

DELAY

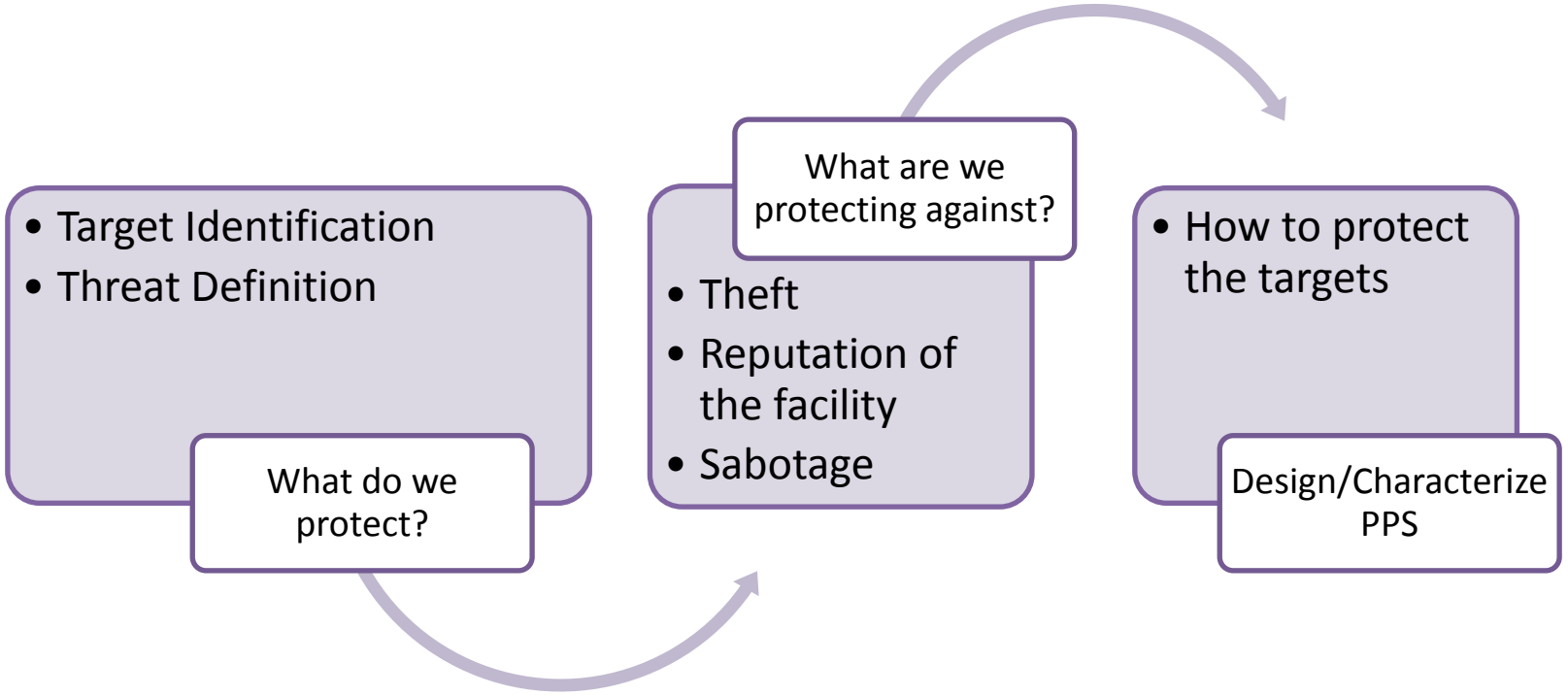
- Passive Barriers
- Active Barriers
- Response Forces
- Traversal Time

RESPONSE

- Response Force (RF)
- Interruption
  - Communication to RF
  - Deployment of RF
- Neutralization



Target Characterization



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Briefing Summary

1. Security Characterization defines the tools that are available to:
   - Detect the adversary
   - Assess the adversary
   - Delay the adversary timeline to allow
   - A response to the adversary that will:
     1. Interrupt adversary progression
     2. Eventually lead to neutralization

2. Total time for detection and response must be less than adversary task time