

# **Sensor Applications Overview: US Perspective**

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# Customer Base for Detection/Identification

- Department of Defense
  - Battlefield environment
- Department of Homeland Security
  - Response to an incident/report
- Public
  - Transportation centers
  - Office buildings



# Chemical and Biological Sensor Standards Study

- Funded by Defense Advanced Research Projects Agency (DARPA)
- Five Key findings
  - Potential threat spans wide dynamic range
  - Requirements not well defined
  - Receiver Operating Characteristic (ROC) curves are essential for evaluation
  - Multiple operating modes are required
  - Current testing and characterization is outdated and inadequate



# Response Parameters

- Noise
  - Fluctuations in sensor response due to inherent characteristics which are independent of the measurement
- Clutter
  - Sensor response to all factors associated with the measurement environment other than the agent
- Signal
  - Sensor response to the agent



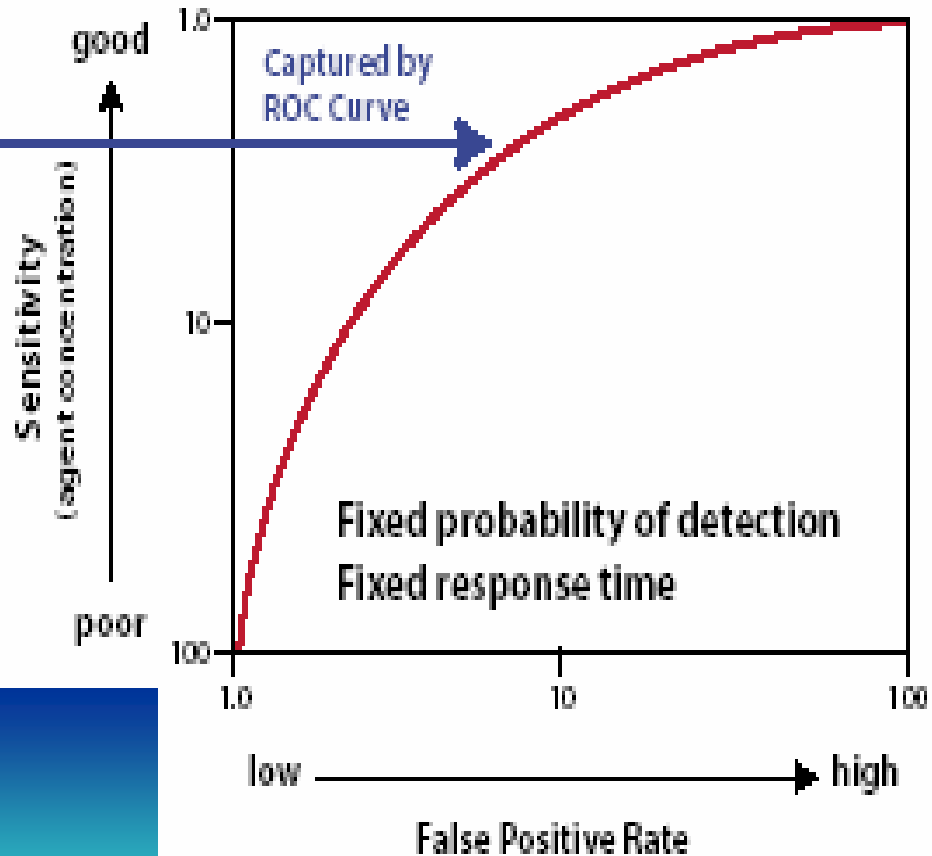
# Receiver Operating Characteristic Curve

## Key Metrics

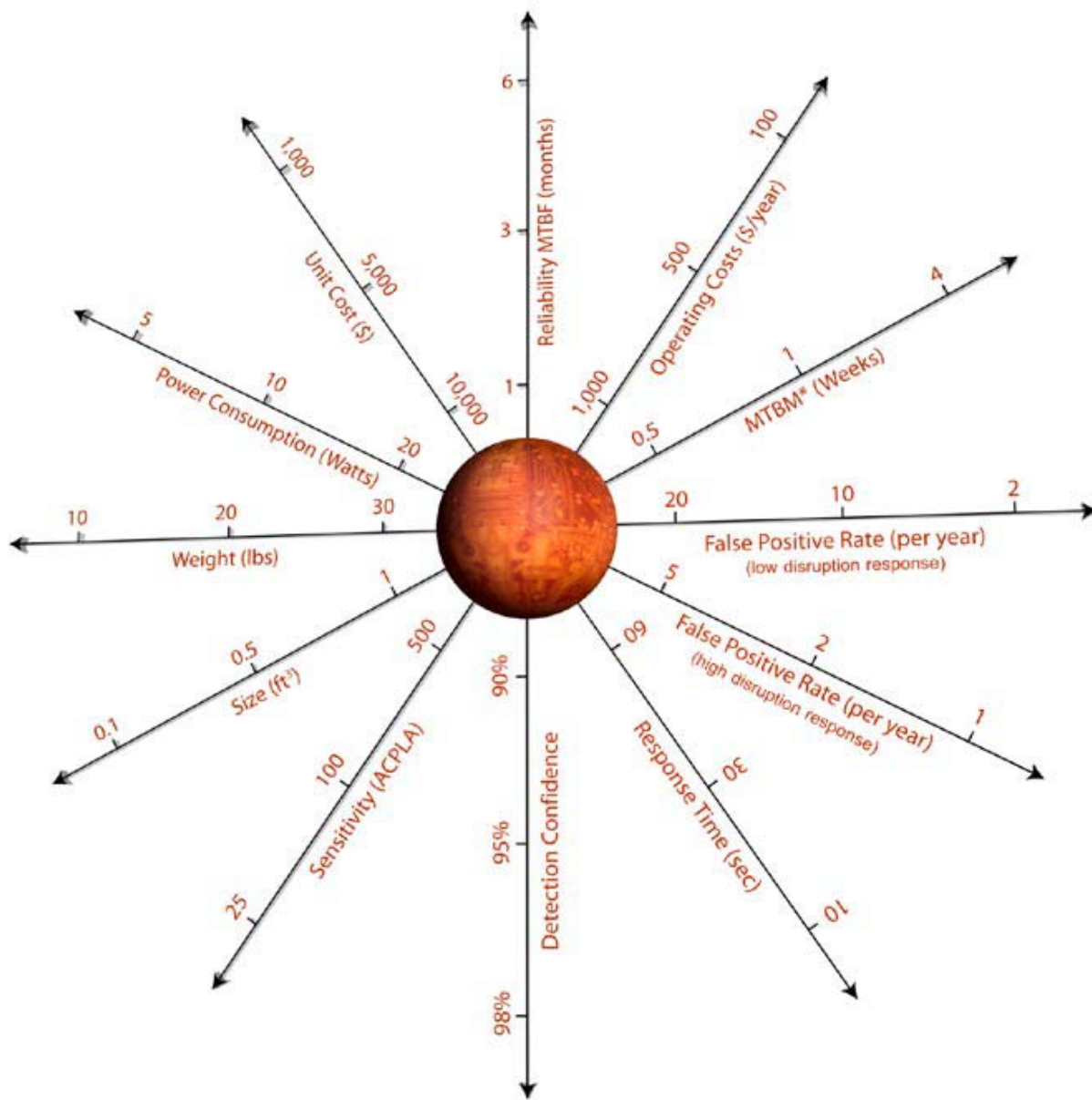
- Sensitivity
- Probability of detection
- False positive rate
- Response time

## Other Attributes

- Cost
- Power consumption
- Reliability
- Maintenance/Logistics
- Size and weight

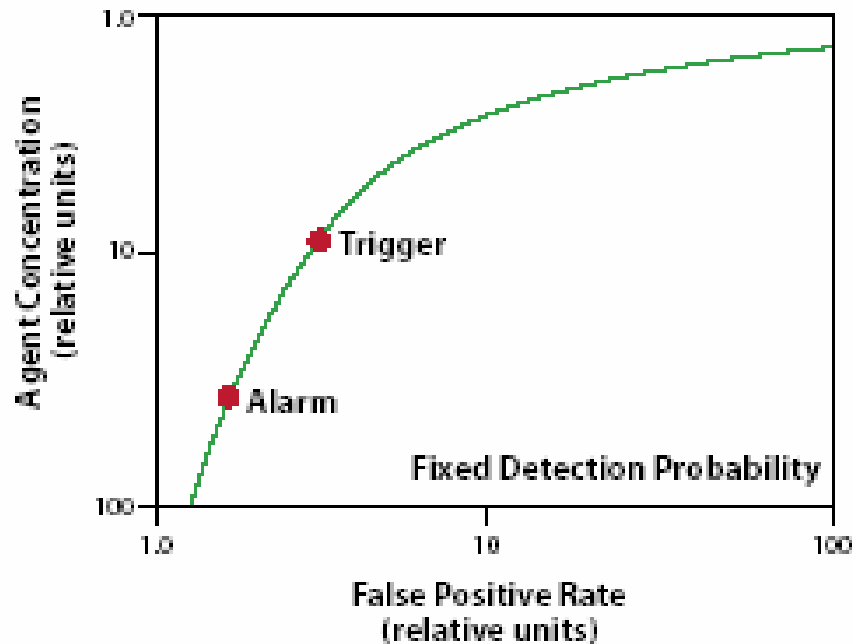


# Spider Chart for Sensor Evaluation

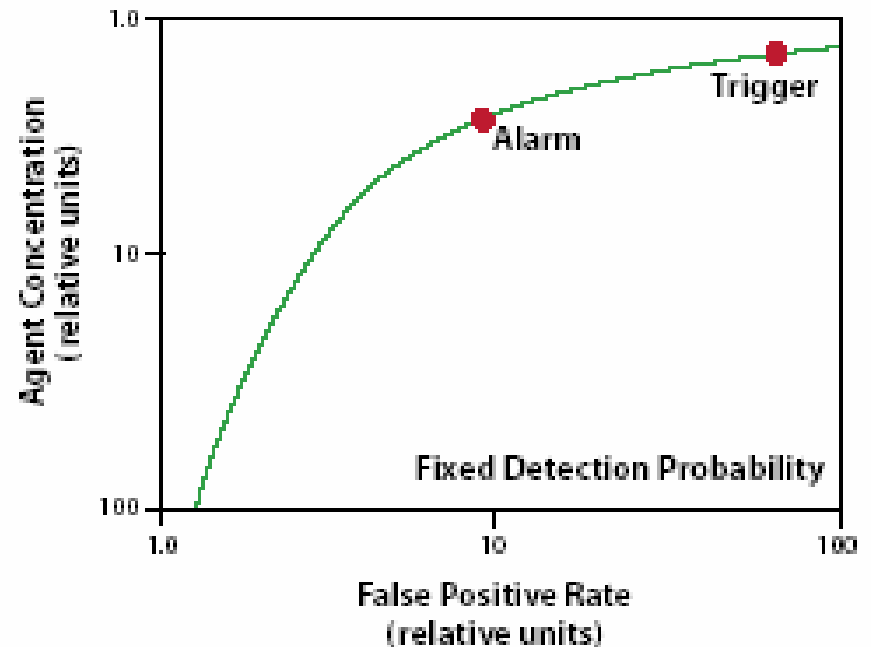


# Thresholds Vary With Scenario

## Low Threat Condition



## High Threat Condition



# First Responder Requirements

- On-scene Detection and Identification
  - Accurate
  - Reliable
  - Affordable
  - Minimal logistics support
- Remote Detection and Identification
  - Cloud assessment and identification
  - One kilometer range desired



# U.S. National Academy Study “Sensor Systems for Biological Agent Attacks: Protecting Buildings and Military Bases”

## **Phase 1: Reduce Vulnerabilities and Install Baseline Detect to-Warn System**

- Balance HVAC systems, install new filters and continue to monitor and maintain the performance of these systems
- Bioaerosol monitoring in HVAC ducts to characterize and reduce ambient aerosol backgrounds
- Sample air to support lab confirmation and identification to treat exposed individuals

U.S. National Academy Study  
“Sensor Systems for Biological Agent Attacks:  
Protecting Buildings and Military Bases”

**Phase 2: Add On-Site PCR for Attack  
Confirmation**

- Develop 15-30 minute PCR technology with automated sample collection and preparation



U.S. National Academy Study  
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**Phase 3: Upgrade System to Protect  
Against Low-Level Attacks**

Add sensors in HVAC ducts:

- Rapid (2 minute or less) structure-based identification
- About 5 minute PCR for confirmation of low-level attacks



U.S. National Academy Study  
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**Possible Phase 4: Improve Response  
Times by Use of Distributed Low-Cost  
Sensors**

- Bio “smoke alarms” in each room provide earlier warning than centralized in-duct sensors, reducing casualties



# One Size Does Not Fit All

- Cost
- False positive rate
- Speed
- Logistical Support
- Accuracy
- Requirements will drive the development of new chemical and biological sensors
- The need is now

