SAND2008-5866P

Border Security Technologies & Cooperative Border Monitoring

International Boundaries Research Unit
Strategies & Tools for Effective Border Management

15-17 Sep 2008

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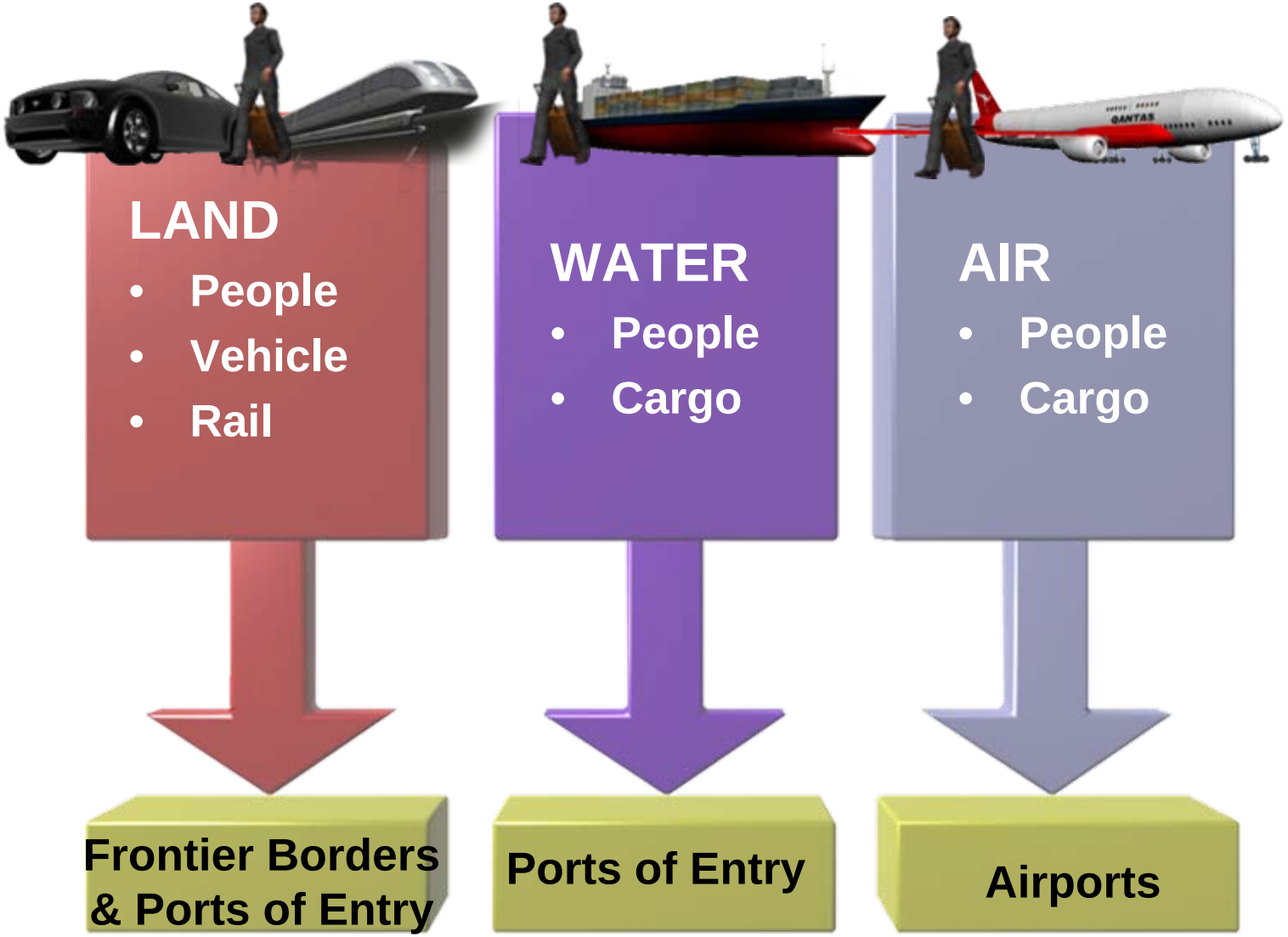
Domains


LAND
• People
• Vehicle
• Rail
WATER
• People
• Cargo
AIR
• People
• Cargo
Frontier Borders & Ports of Entry
Ports of Entry
Airports

Human Challenges

Human challenges to effective border management take many forms:

	Routine	Non-routine
Non-threatening	• **Cross-border nomads and tribal movement** • **Traders** • **Travelers and tourists**	• **Refugees** • **Illegal immigrants**
Threatening	• **Criminal** • **Smugglers and illicit traffickers**	• **Non-state national security threats** • **Terrorists** • **Insurgents**

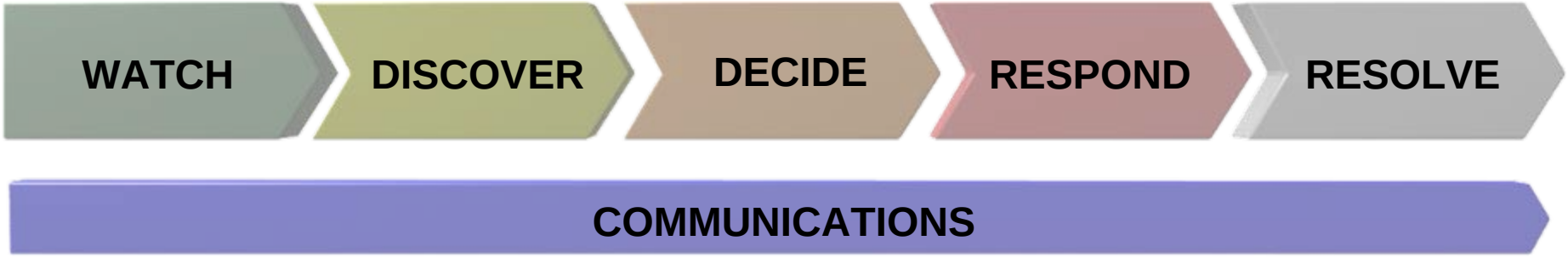
Commodity Challenges

- **Fraudulent documents**
  - **Visas, travel papers, passports**
- **Tariff/license avoidance products**
  - **Cigarettes, autos, counterfeit goods, etc.**
- **Contraband**
  - **Drugs, wildlife, literature, precious gems/metals, stolen goods, etc.**
- **Currency**
  - **Real and counterfeit**
- **Human beings**
  - **Voluntary and non-voluntary, for purposes of immigration, employment, prostitution, etc.**
- **Conventional weapons**
  - **Small arms, heavy weapons, explosives, etc.**
- **Weapons of mass destruction**
  - **Nuclear, biological, chemical, radiological, missile delivery systems**

Model Mission Statement

Strategically deploy a system of personnel, physical elements, and information systems to implement border policies regulating the flow of people and goods across national boundaries, and defending against national security threats.

Anatomy of an Event



Watch

- Surveillance
- Monitoring
- Screening

Discover

- Detection
- Inspection
- Assessment

Decide

- Options
- Chain of Command
- Authorization
- Procedures

Respond

- Engagement
- Arrest
- Confiscation
- Interdiction

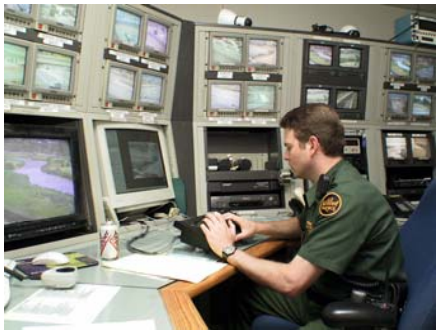
Resolve

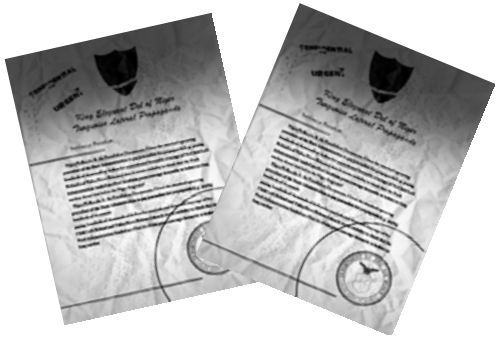
- Prosecution
- Destruction
- Deportation
- Material disposition
- Lessons learned

Watch

Looking for abnormalities or anomalies:

- **Tracks/footprints**
- **Access paths/trails**
- **Cut or damaged fences**
- **Sensor returns**
- **Increased/unusual traffic flows**
- **Nervous behaviors**
- **Space and weight inconsistencies**





Discover

- **Detection of activity, including:**
  - **Unauthorized cross-border movement**
  - **Illegal immigration**
  - **Illicit materials/goods/cargo**
  - **Smuggling/trafficking**
  - **Terrorist/insurgent activity**
  - **Diversions**
  - **Access paths**
  - **Hidden compartments**

Decide

- **Based on degree of assessment certainty**
  - Unconfirmed sensor data, data might be inconclusive or ambiguous
  - Materials discovered through inspection
- **How is the decision made to respond to an event?**
- **What are the options?**
  - Response decision might be based on existing
    - Authorizations
    - Standard Operating Procedures (SOPs)
  - Unique situations might require an adapted or improvised response – who has this authority?
- **Chain of command reporting**
  - Who needs to be notified of, or included in, the decision?

Respond

- Search and seizure
- Detain suspects
- Force-on-force engagement
- Repair/improve technology/infrastructure
- Increase vigilance
- Increase/redeploy forces
- Hand-off to other jurisdictions

Resolve

- Chain of custody—people and evidence
- Prosecution
- Reporting
- Isolation/containment
- Disposition
- Transportation
- Lessons learned

Deterrence

Visible Demonstration of Capability + **Consistently Effective Operations and Event Response** = **Threat Deterrence**

- Effective deterrence can convince a potential threat to reconsider and even decide against action
- Visibility of deterrence must be balanced with need to maintain secrecy of some capabilities
  - For example, visible vs. invisible sensors

Emergency Response

- Not all events conform to standard operating procedures or regular training requirements
  - Environmental disasters
  - Refugee crises
  - WMD events
- Emergency events may require adapted or improvised responses
- Personnel can still be prepared with basic skills
  - “First responder” equipment and training (first aid, medivac)
  - Procedures for handling:
    - Sudden and large flows of people, vehicles, and goods
    - Large-scale medical emergencies
    - Search and Rescue
    - Cross-border communication and coordination

Threats

Two key parameters for evaluating threats are:

(1) the probability that a particular weapon will be used in a terrorist attack, and

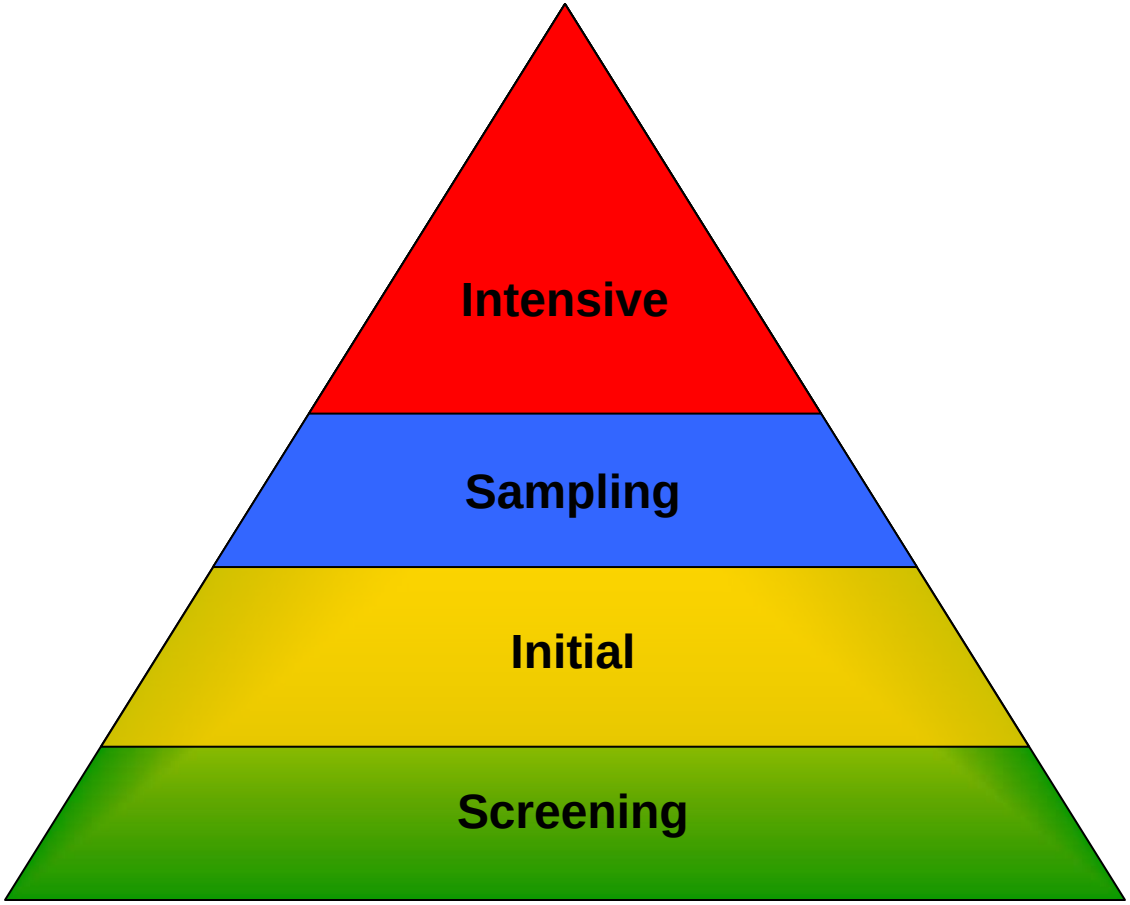
(2) the consequences of the successful use of that particular weapon in a terrorist attack.

Technologies

Sensors can play three important and complementary roles in a security system, depending upon the threat used and the locale of the attack:

- Detecting the presence of threat before an attack,
- Detecting an attack while it is taking place
- Measuring and assessing the extent of an attack so that officials can respond and mitigate effects.

Frontier Border - Examination Levels



Screening & Initial

Screening

- As it pertains to alarms or indications of traffic, i.e. footprints
- Use technology
  - Sensor alarms
  - Field Glasses
  - Night Vision
- Look for smuggling indicators:
  - Backpacks
  - Dump areas
  - Items thrown over fence
  - Using animals
  - Tracking “Sign”
- Response to Interdiction

Initial

- Secure site
- Radiation sensors
- Check any documents
- Initial interrogation

Sampling & Intensive

Sampling

- 100% check?

Intensive

- Search any baggage
- Search person
- Use drug field testing kit

Officer Safety Concerns

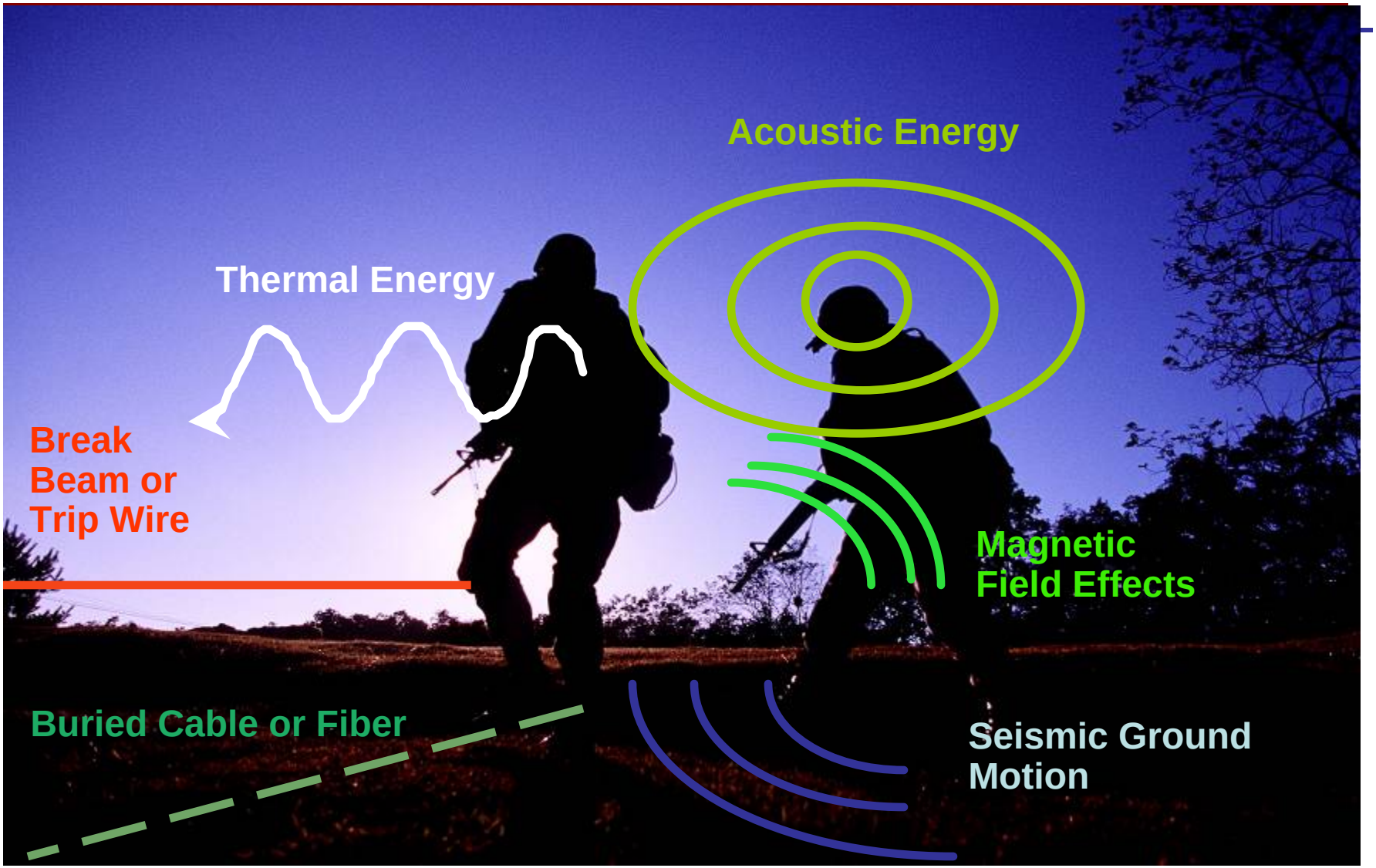
Potential Hazards

- Armed Intruders
- Escalating violence
- Chemicals
- Radioactive Materials
- Isolated Patrol Areas
- Lack of quick medical response

Precautions

- Within Radio communication operating distances
- Properly operating radio / batteries
- Appropriate defensive equipment, i.e. weaponry
- Training for emergency procedures and disposition for dangerous confiscated materials

Example Sensor Measurements



Physical signatures

- Weapons
  - Magnetic
  - Weight
  - High density material
  - Shape and size (could be broken down into pieces)
  - Radiological signature (gamma rays, neutrons, heat)
- Bulk Explosives
  - Weight
  - Chemical emissions
  - Medium density material
  - Mass
- Ammunition
  - Weight
  - Shape
  - Chemical emissions (less than explosives)
  - High density material
- Drugs
  - Weight
  - Chemical emissions
  - Low density material

Appropriate technologies will vary with location

Glaciers

Mountains

Plains

Deserts

Detection Overview

of personnel and explosives, drugs, weapons and radioactive material on personnel

Explosive/drugs sniffer detector

- Seismic (Geophones)
- Magnetic
- Infrared
- Ported Coaxial Cable
- Microwave
- Ground Surveillance Radar
- Acoustic
- Taut Wire
- Fiber Optics

Wireless Seismic

Radar

Passive Infrared

Narcotics Identification Test Kit

Fence Sensors

Magnetic Sensor

Seismic

Metal Detector

Hand-held Radiation Detector

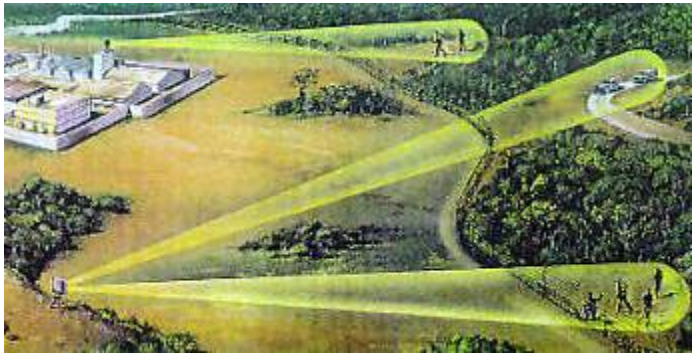
Buried Intrusion Detection Sensors (short range)

- Seismic (Geophones)
  - Detection of vibration created by either vehicle or human movement
  - Has the ability to discriminate between vehicle and human traffic
- Magnetic Line*
  - Detects anything that contains a ferromagnetic object
  - Can distinguish between armed intruders and animals
- Ported Coax
  - Generates an invisible electromagnetic field to detect intruders.
- Advantages
  - Not visible, low false alarm, rugged
  - Not affected by small objects or animals
  - Terrain following installation

**Magnetic can be installed underwater*

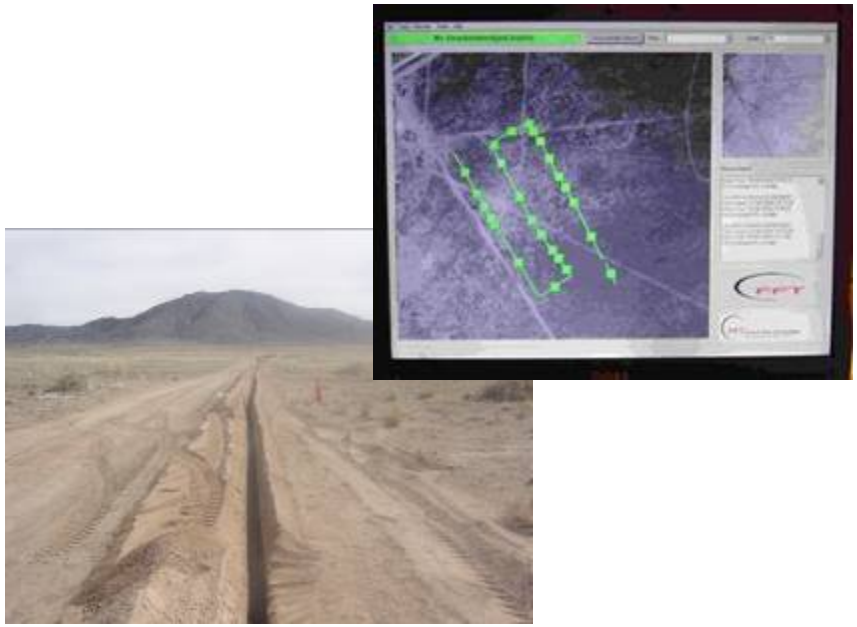
Ground Surveillance Radar (long range)

- Multi-target tracking with up to 360 degree coverage
- Detects: ground vehicles, people, helicopters, low flying aircraft, ships up to 40km



Fiber Optic Sensors
(buried or fence - long range)

- Fiber-Optic Intrusion Detection
  - Laser light is transmitted through optical fiber
  - Detector measures characteristics of light
  - Changes in light transmission due to deflection of the fiber result in an alarm



Fiber Optic

- Long range fiber optic sensor system
  - Fence-line and buried applications
  - Install up to 50 linear kilometers with location capabilities (±50 meters from the actual crossing)

Video is Used to Confirm and Identify Alarms

Sensors usually measure a specific “event” but have trouble assessing what the event means.

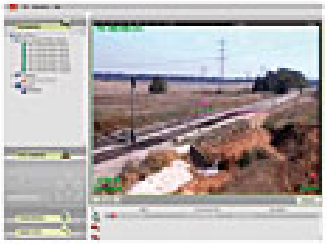
- movement detection: animal, human, vehicle
- alarms caused by environment
- Detection requires assessment

Video camera images provide information for rapid, efficient human assessment of the event.

- routine surveillance
- video motion detection
- intruder triggered
- night vision

Video Motion Detection Technology

- Intrusion Detection
- Unattended Item Detection
- Object Removal Detection
- Autonomous PTZ Tracking



Night Vision Technologies

- Infrared Illuminator
  - Illuminate location with infrared light
- Image Intensifier
  - Amplify available visible light
- Infrared thermal imager
  - Displays infrared radiation (heat) from objects

Thermal Images

Infrared Image

Image Intensifier

Mobile Monitoring Systems

- Establish temporary observation posts
- Move mobile monitoring station to areas of concern
  - Increasing activity level
  - Reports of pending infiltration

US Border Patrol “Sky Watch” mobile observation post

Day / night cameras with high intensity spot light

Unmanned Aerial Vehicles (UAVs)

Advantages

- Many countries build UAVs
- Low altitude - able to see small vehicles, people
- Loiter time – hours to days
- Generally quiet, hard to see
- Operate day or night – depending on sensor

Disadvantages

- Narrow field of view
- Needs ground support
- Weather and altitude limitations
- Line of sight operation

Dragon Drone

Fire Scout

Hand Launched

Tethered Balloons

Unmanned Aerial Vehicle - UAV

Commercial Satellite Imagery can Support Border Security Operations

(A Quickbird commercial satellite image of the Pakistan-Afghanistan border near Chaman, Pakistan – October 6, 2003)

Vehicle Barriers & Fences

VehcicleBarrier_1.WMV

Chemical / Biological / Explosives Sensors

- Specific Characteristics
  - The characteristics of sensors for chemical agents, biological agents, and explosives are affected by two key types of attributes:
    - performance-related
    - threat agent-related.

- The key performance-related characteristics for chemical, biological and explosive sensors include:
  1. **Breadth of use**: does the sensor only work on a single threat agent, or across a range of potential weapons?
  2. **Range**: how far away does the threat agent need to be in order to be detected by the sensor? Does it work both indoors and outdoors?
  3. **Speed**: what is the time lag between when the sensor gets a reading and resulting information can be acted upon?
  4. **Sensitivity**: how sensitive is the sensor to a true positive result?
  5. **False positive rate**: conversely, to what extent does the sensor generate false positives? What secondary means can be utilized to test and verify a positive result?
  6. **Mobility**: can the sensor be moved easily? Does movement hinder its effects?
  7. **Base cost**: how much does the sensor cost?
  8. **Maintenance cost**: does the sensor need to be frequently replaced? How labor-intensive is this maintenance?
  9. **Integration**: how easy is it to integrate the sensor into an existing surveillance and detection system?

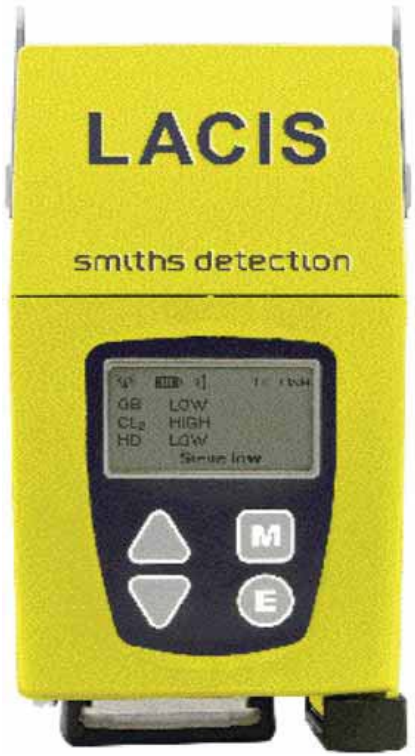
Chemical Sensors: Explosives & Drugs

Hound II with ITI's Vapor Tracer

Smiths Detection Sabre 2000

- **Detectors use gaseous samples**
- **Samples can be from people, cargo, or the vehicle itself**
- **Current gaseous detectors are hand-held**
- **Gaseous sampling of entire vehicles is not currently available but is under development**

Trace Detection
Using Swipe Technology



Lightweight Autonomous Chemical Identification System (LACIS)

Narcotics Identification Kit

Using Canines for Explosives and Drug Detection

Pros:
- May be quickest and most reliable
- Works for any explosive (in principle)
- Low purchase cost

Cons:
- Extensive initial training, continual training
- Short effective working time (no 24 hr/day operation
- Labor intensive
- Day to day performance varies

Radiological / Nuclear

Sensors: Specific Characteristics – Radiological / Nuclear

The key functional attributes and technical requirements for radiological and nuclear sensors include:

1. **Range of Detection**: How far away can the sensor detect the presence of radiation? Can it detect radioactive materials with long half-lives and weak radioactivity? To what extent does shielding hinder the detection process?

2. **Scope of Detection**: What types of radiation can the sensor detect (alpha, beta, gamma)?

3. **Tracking / Time Required to Detect**: Can the sensor detect and pinpoint objects, or is it only effective on relatively stationary objects?

4. **Signal-to-Noise Ratio**: Can the sensor distinguish between radiation coming from a potentially malicious source and background / normal-use radiation?

5. **Mobility**: How easy is it to transport the sensor? Can it be used by front-line officials on an everyday basis?

6. **Safety**: Does the sensor itself pose a health risk either to its users or those who are targeted?

Radiological / Nuclear Sensor Types

The two main types of sensor technologies for radiological and nuclear materials are passive detection systems and active detection systems.

- Passive detection systems rely on detecting trace signs that radioactive isotopes are present.

- Active detection systems create radiation or other effects intended to alter or affect the radioactive isotopes, in a way that creates a signature that can be detected.

Radiological / Nuclear Sensor Types

Key equipment building blocks of a radiological/nuclear sensor system are:

- **Small handheld devices**: at a size that can fit into a shirt pocket and be worn in the normal course of business. Their current range and effectiveness is limited, but if used widely this creates a network effect that provides security at a facility or gateway with a high law enforcement presence.

- **Large worn devices**: not worn in the normal course of day-to-day business, but only while on the hunt for potential radiological or nuclear materials – perhaps on a ship, in a building, or on the land side of a port. These have higher capabilities but are limited in their applicability by cost and ease of use.

- **Fixed portals**: drive-through or drive-between devices that can detect radiological or nuclear materials in a car or a truck, perhaps at the exit point from a port, or at an unobtrusive point along a highway.

- **Large, mobile devices**: large sensor systems that can be deployed on a vehicle and rapidly transported to areas of high risk depending upon evolving threat conditions.

Sensor networks: a collection of sensors on a city-wide or region-wide basis, tied into each other in a way that goes beyond simple notification, but uses sophisticated algorithms and other analytical tools to isolate abnormalities and potentially interdict terrorist activity.

Personal Radiation Detection (PRD) Sensors

- Requires minimum training for operations
- Indicators vary from simple lights and beeps to actual levels i.e. 10uR/h
- Some detect just gamma
- Some detect gamma and neutron
- But what do you do if it does alarm?
- What if it is a False Alarm?

Radtronics
MGP PDS-100 Radiation Detector

Thermo Scientific
RadEye Personal Radiation Detector

Hand-held Radiation Monitors

Radioactive Isotope Identification Devices (RIIDs)

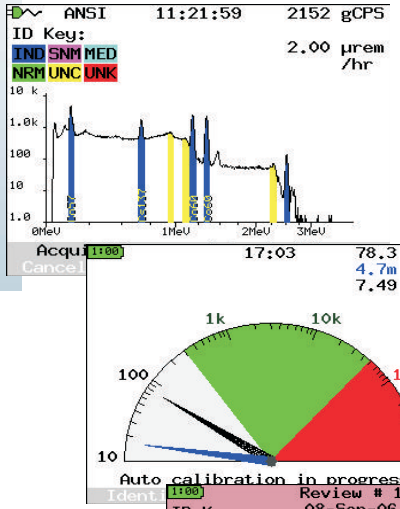
- Use is time consuming
- Operator must be trained
- Useful for follow-up:
  - Localize the source
  - Identify isotopes

Interceptor

TSA PRM-470A

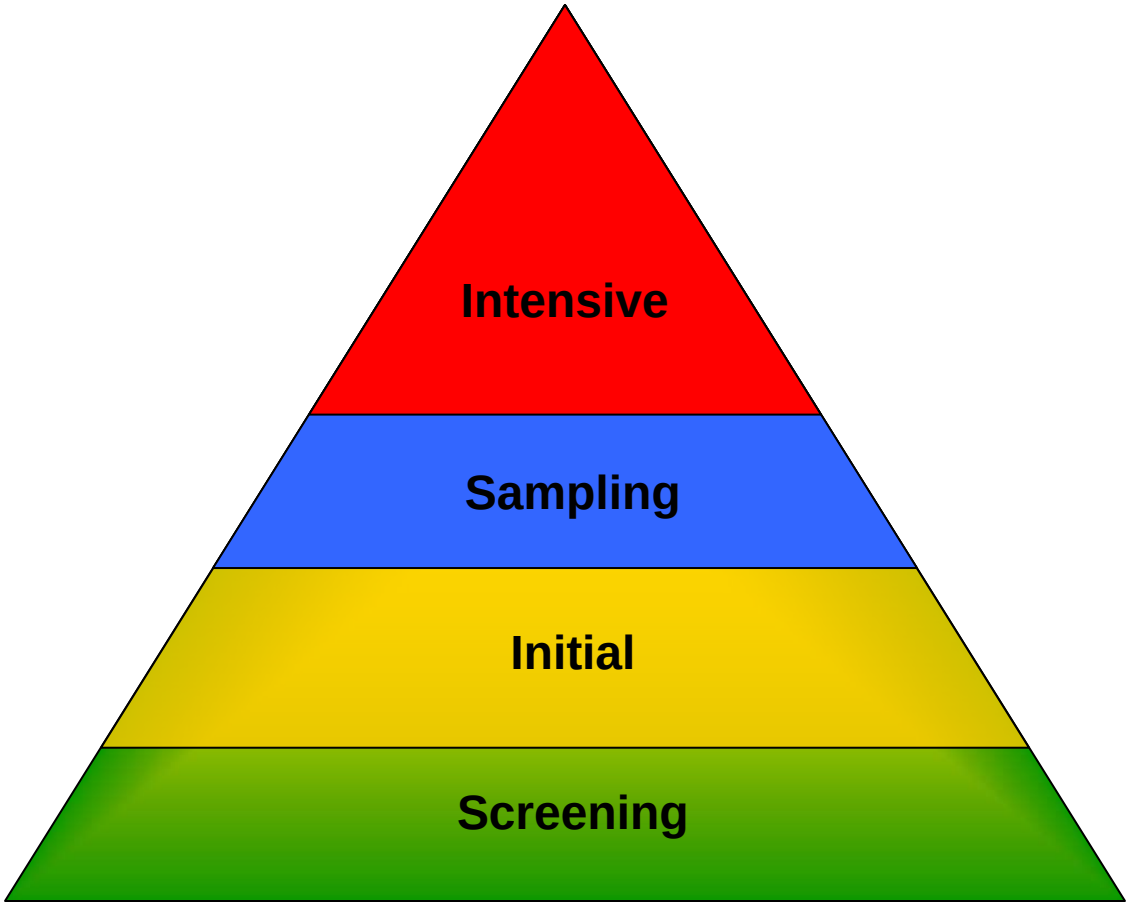
SAIC GR-135

BNC-SAM-940



FieldSPEC
Spectrometer-Isotope Identifier

Port of Entry - Examination Levels



Screening and Initial

Screening

- Review Cargo Document
- Check registration numbers
- Use technology
  - X-ray
  - XRF
  - VACIS
  - PRD
- Continue to examine if warranted

Initial

- Check security seal
- Verify load weights
- Use radiation pager
- Open doors and visually inspect contents
- Continue to exam if warranted

Sampling and Intensive

Sampling

- Select 20% of the cargo by “tunneling”
- Examine selective cargo thoroughly

Intensive

- Unload cargo
- Examine all cargo
- Examine conveyance

Safety Concerns

Potential Hazards

- Unstable loads
- Chemicals
- Toxins
- Radioactive Materials

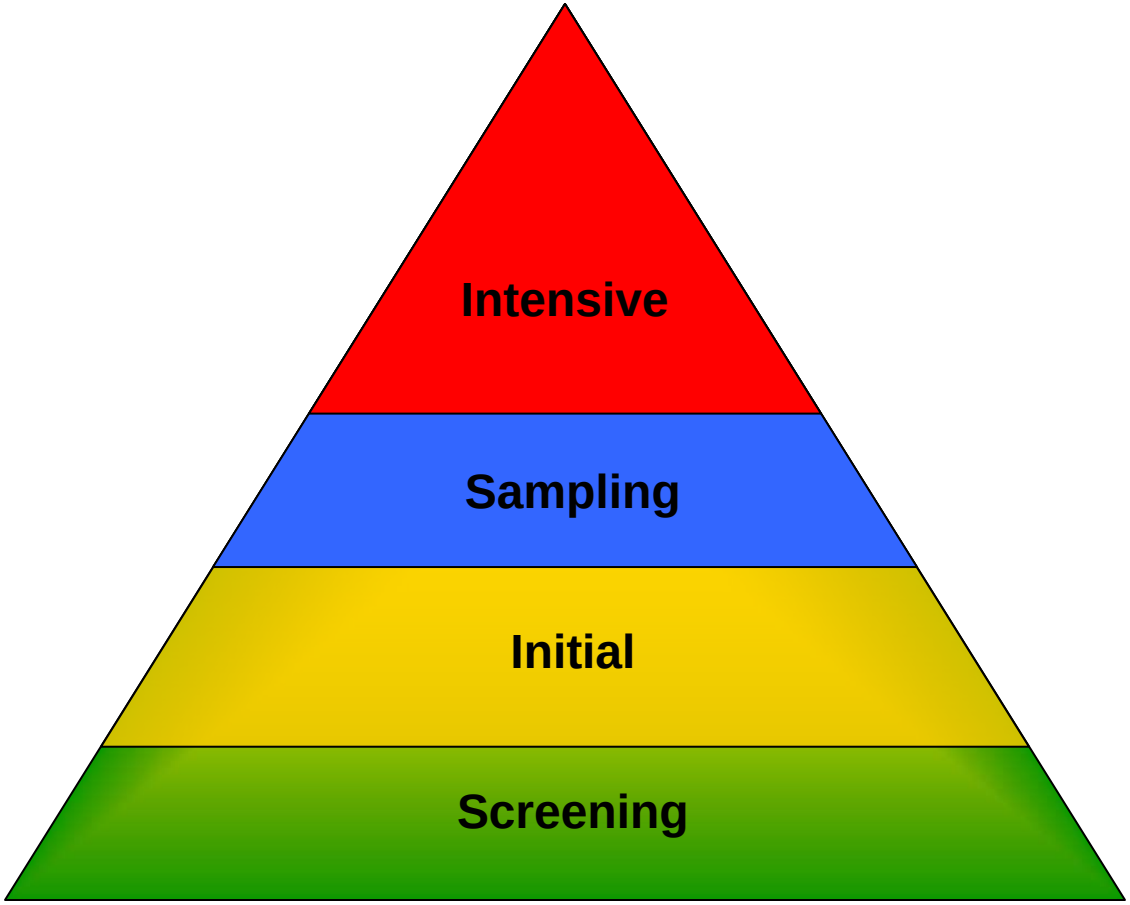
Precautions

- Wear protective equipment
- Ensure ventilation
- Use proper lifting techniques
- Know the contents for drilling or opening packages
- Look for warning labels and placards
- Work in teams

Other Techniques

- Be systematic
- Look for smuggling indicators:
  - Tampering on containers/boxes
  - Fresh or unusual tape
  - Cargo that does not match other items
  - Cargo in unusual places
  - Cargo without normal shipping marks
  - Concealment in packages

Maritime - Examination Levels



Screening and Initial

Screening

- Review Cargo Document
- Check registration numbers
- Use technology
  - X-ray
  - XRF
  - VACIS
  - PRD
- Continue to examine if warranted

Initial

- Check Manifest
- Check security seals
- Verify load weights
- Use radiation portals
- Secondary inspection for further examination
- Open doors and visually inspect contents
- Continue to exam if warranted

Sampling and Intensive

Sampling

- Select 20% of the cargo by “tunneling”
- Examine selective cargo thoroughly

Intensive

- Unload cargo
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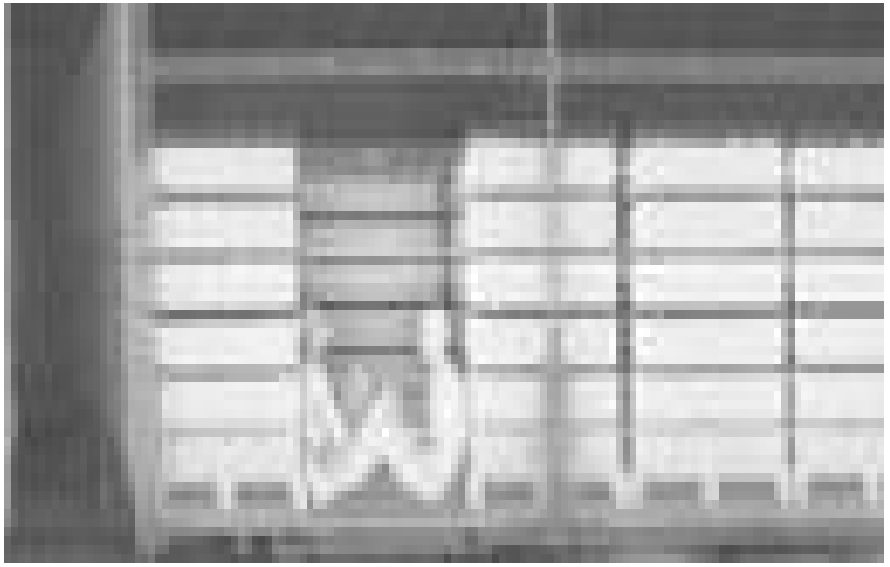

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Detecting Explosives, Drugs, Weapons, and Radioactive Material on Pedestrians

Explosive/drugs sniffer detector

Container Scanner

Radiation Detection Portal

Narcotics Identification Test Kit

Swipe for explosive and drug residue

Pedestrian Scanners

Hand-held Radiation Detector

Detection

of explosives, drugs, weapons and radioactive material on pedestrians

Explosive/drugs sniffer detector

Explosive/Drug Detection Portal

Package Scanner

Radiation Detection Portal

Narcotics Identification Test Kit

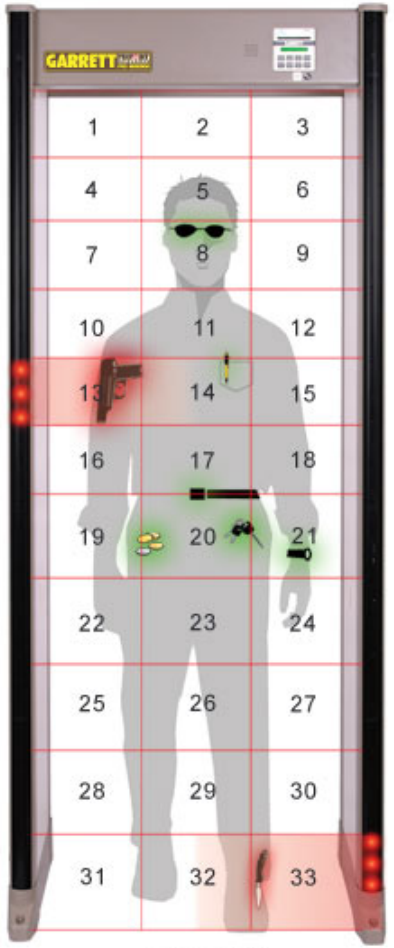
Swipe for explosive and drug residue

Metal Detector

Hand-held Radiation Detector

Metal Detectors

- Portals
  - Quick and effective
  - Does not detect all weapons

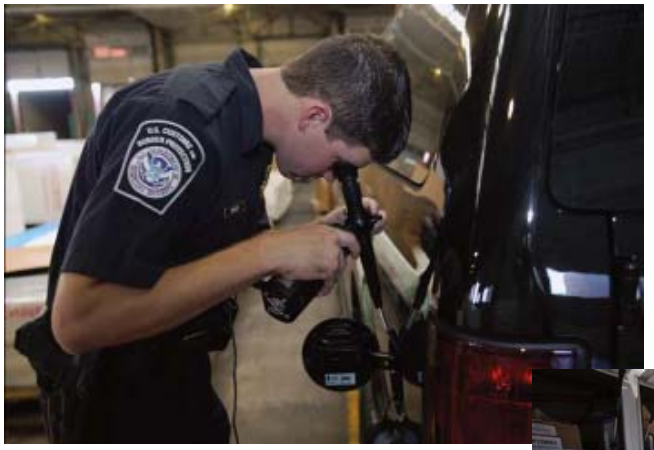


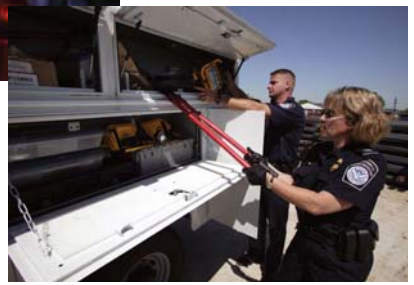
PD 6500*i*™

- Handheld
  - Scan any given area, anytime
  - Inexpensive
  - Time-intensive
  - May be considered invasive

Metal detector for personnel or small package inspections

Inspection Tools





Fiber-optic tool to look inside enclosed spaces

Inspection Mirrors

Inspection Dogs

Hand Inspection

Trace Detection
Using Swipe Technology

Sample collection from people or containers for explosive and drug residue

Smiths Detection IONScan 400 B

Narcotics identification

Chemical Sensors: Explosives and Drugs

Hound II with ITI Vapor Tracer

Smiths Detection Sabre 2000

- Detectors use gaseous samples
- Samples can be from people, cargo, or the vehicle itself
- Current gaseous detectors are hand-held
- Gaseous sampling of entire vehicles is not currently available but is under development

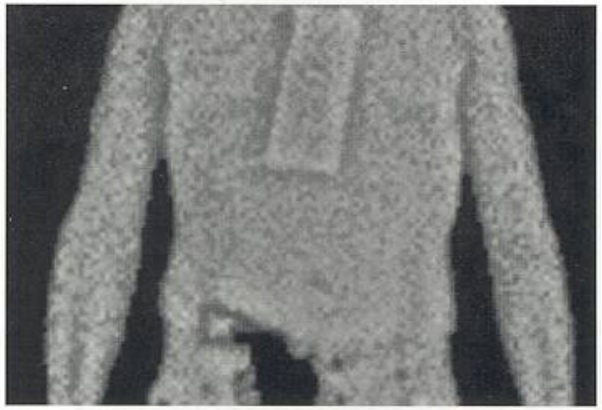
Trace Detection:
Explosives Detection Portals

Sandia Vehicle Portal Prototype

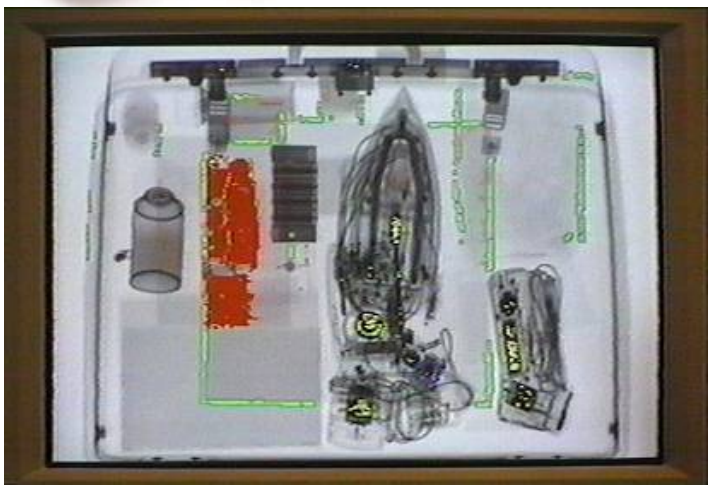
Smiths Detection Sentinel

X-ray Imaging

Soft X-ray Systems
For Human Screening



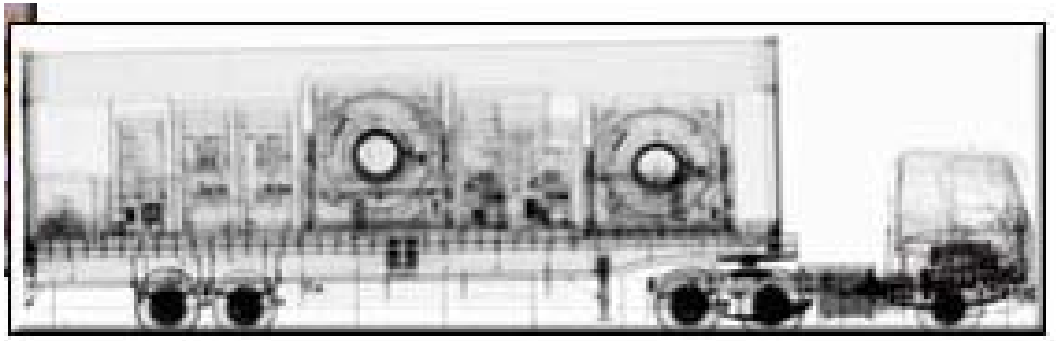
Dual Energy Transmission Device
for Packages



Using a Millimeter Wave Detection

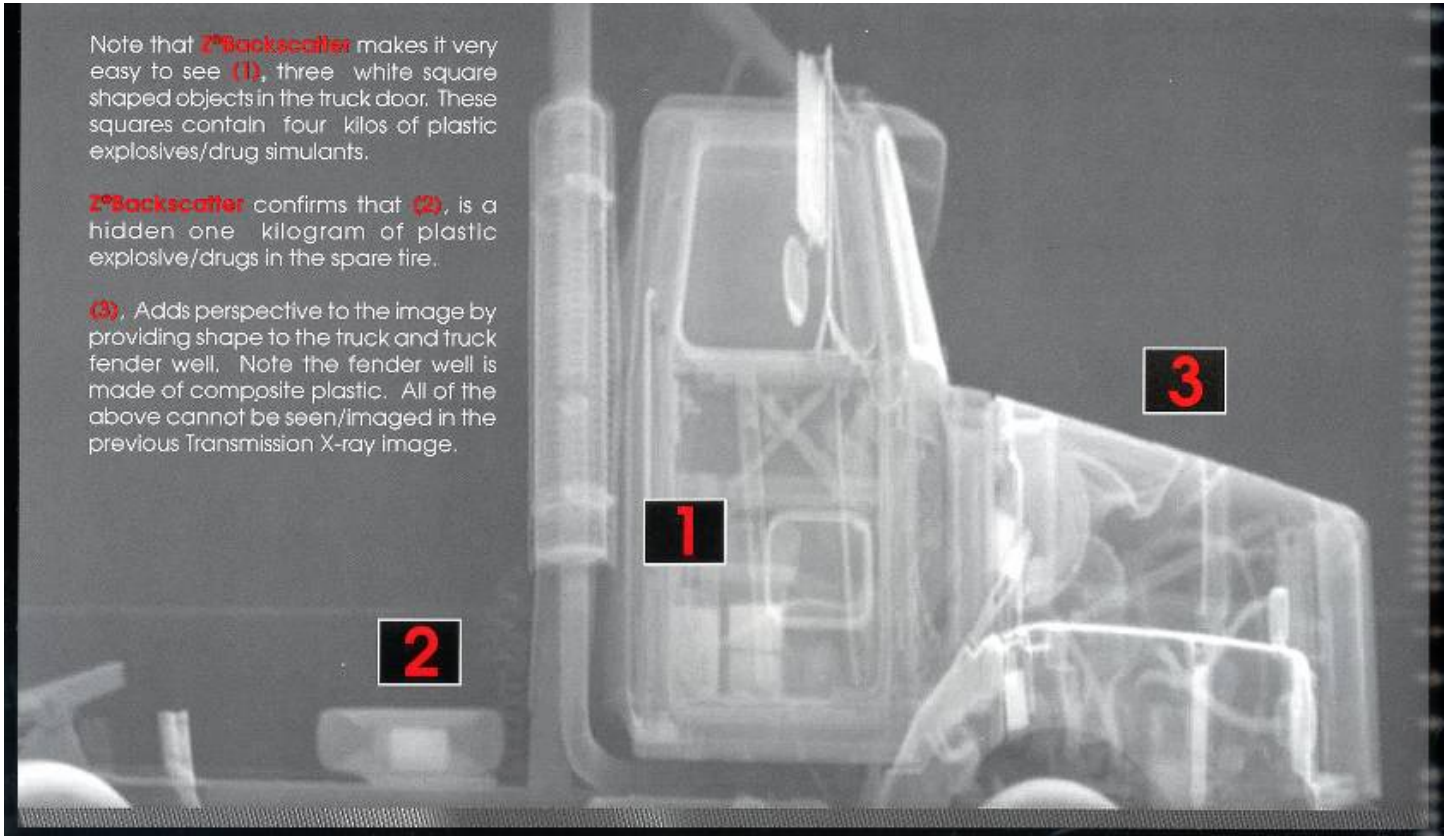
Sensitive Images are not available to guard force

X-Ray Imaging



Note: Radioactive source requires security protection

Example of a Vehicle X-ray Image



Bulk Detection: Neutron-based analysis

- Cargo Inspector (Stationary)
  - Throughput rate of 20 trucks per hour
  - Does not require unloading of cargo, but people must exit

Review of Explosive Detection Screening Methods

	Pros	Cons
Canine	• May be quickest and most reliable now available • Works for any explosive (in principle) • Low purchase cost	• No 24 hr/day operation; poor for busy checkpoints • Labor intensive • Day-to-day performance varies
Physical Search	• Low equipment costs • Low-tech; only need guards • Fewer technical problems than with other techniques	• Very slow • Superficial, unless you really tear items apart • High labor costs
X-ray	• Gives image • Can be automated (CT) • 24 hr/day operation	• Expensive (up to $1M) • Radiation hazard • Rather slow (5-10 sec/item) • Conventional x-ray not specific
Trace	• Moderate ($50-100k) cost; detects trace amounts • 24 hr/day operation	• Fairly slow (sample collection) • No automation
Nuclear	• Now becoming available • Cost is less than x-ray (but still high - $750k) • Some material specificity	• Speed, cost not what we'd like • Still in development • Some materials (e.g., fertilizers) may give false alarm • Radiation hazard

Radiation Detection Sensors

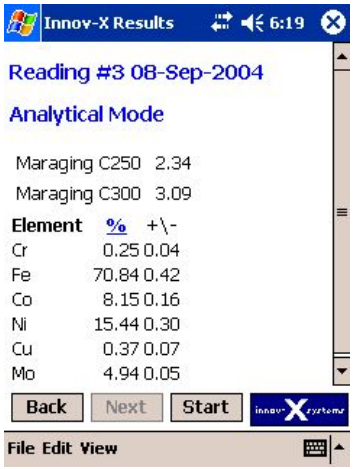
- Enlist complementary measures
  - Look for evidence of potential radiation shielding by using weight sensors
  - Use both gamma and neutron detection

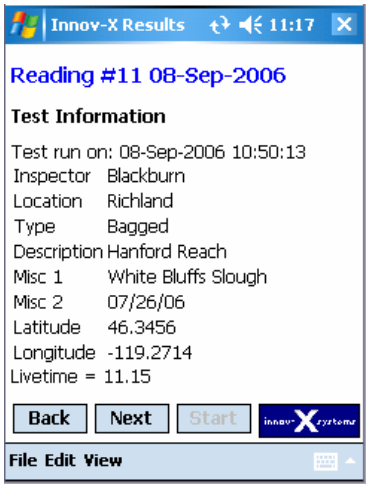
Hand-held Radiation Monitors

- Use is time-consuming
- Operator must be trained
- Useful for follow-up:
  - Localize the source
  - Identify isotopes

Strategic Metals and Alloys

Portable Metal Analyzer XRF and Output





Bluetooth GPS Receiver for added geo-tagging capability

- Commercially available, portable X-ray fluorescence spectroscopy (XRF) instruments can nondestructively and rapidly (10–30 seconds) identify elements and alloys such as those controlled by international export control agreements
- Enhanced version also allows identification of:
  - Trace elements in non-metallic materials including powders, organics, plastics, and other materials
  - Precious metals

Fraudulent Documents

Not everything is a forgery, but suspicious documents coupled with other anomalies is an indicator.

- Differences between letterhead and body
- Print quality, especially smudges
- Ink – flat and blurry (inkjet/bubblejet) or sharp, raised, & reflective (laser printer)
- Illegible signatures
- Inconsistent language/grammar/fonts
- Subtle areas of difference around graphic elements.
- Copies versus originals
- Diversion tactics to reduce close inspection

Fraudulent Documents (con't)

Understand what you are looking for:

- List general security features that can be used to identify documents as being either valid or fraudulent.
- Define holograms, ghost images and micro-printing.
- Identify the differences in the legal status of Permanent Resident Aliens, Non-Immigrant Aliens, and Undocumented Aliens.
- Identify employment authorization documents and travel documents that aliens may possess.
- List general security features that can be used to identify passports as valid or fraudulent.
- List general security features found in national identify cards.
- Identify countries from which foreign citizens may enter your country without a visa.
- Identify and apply basic fraud detection techniques to distinguish past and current immigration documents.
- List the elements or segments of the face used to detect the validity of a photo compared to an actual person.
- List the methods of photo comparison

Document Scanners

Ultraviolet Security Feature Documents

- Passports & Visa's
- Immigration Cards
- Naturalization Papers
- Birth Certificates

Retro-Reflective Security Feature Documents

- Passports
- Driver's Licenses

Co-axial lighting

Summary

- There are many types of monitoring sensors
- The best one to use depends on
  - Type of activity you are trying to detect
  - The operating environment
- A systematic design process can select the best types and configuration of sensors for a specific mission compatible with existing systems

Why Do Field Testing?

- Have you ever purchased an item only to find out it didn't do what the manufacturer said it would?
- Who makes sure what you buy is good quality, won't harm you and does what it says it does?

- How will you assure yourself that the technologies that you choose to secure your border will do the job and are cost effective?

Testing Methodology

- Evaluation Categories
  - Ease of installation
  - Adequacy of documentation
  - Detection capability
  - Nuisance and false alarms
  - Vulnerability to defeat
  - Adaptability
  - Maintenance required
  - Special requirements
  - Manufacture’s support
  - Suggesting changes is appropriate

Functional Testing Methodology

- Functional Type Test (FTT)
  - Evaluate “as built” specifications
  - Conduct bench tests to verify nominal performance
  - Use National Standards as applicable
  - Explore environmental limitations using laboratory facilities
  - Evaluate ease of installation/use
  - Examine documentation sufficiency
  - Produce preliminary gap analysis
    - What is the system missing to meet requirements?

Performance Testing Methodology

- Performance Type Test (PTT)
  - FTT completed
  - Use national Standards and system performance requirements
  - Test in representative operational environment such as Outside Test Facility
  - Determine performance such as
    - Probability of Detection (P_D)
    - Nuisance Alarm and False Alarm (NAR/FAR)
    - Degradation factors
    - Operational environmental effects
  - Test and assess defeat mechanisms
  - Amend gap analysis as appropriate
    - Again, what is the system missing to meet requirements?

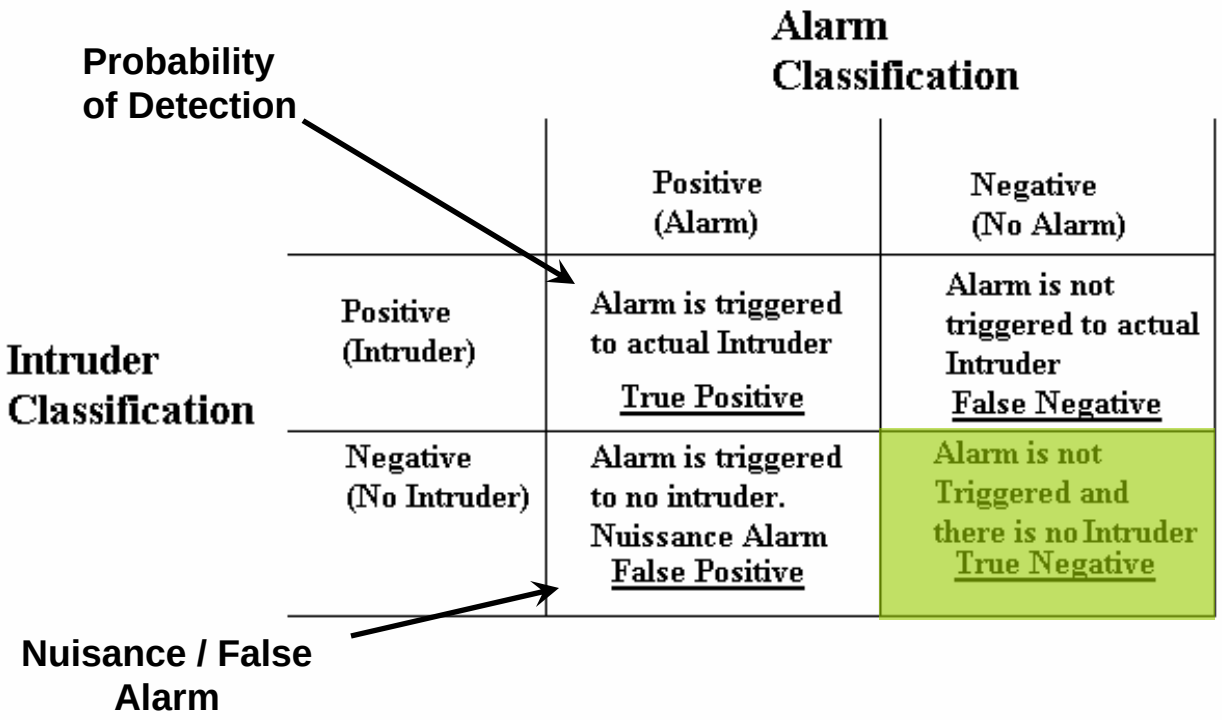
Performance Testing Methodology (continued)

- Performance Testing
  - *Probability of Detection* (Pd)
    - Provides an indication of sensor performance in detecting intruder within sensor coverage
    - Involves characteristics of the sensor, environment, method of installation and the assumed behavior of an intruder
  - *Nuisance / False Alarm Rate* (*NAR/FAR)*
    - Indicates the expected rate of occurrence of alarms which are not attributable to intrusion
    - A *nuisance alarm* is an alarm event which is not caused by an intruder. Alarm is triggered by both natural and industrial environments
    - A *false alarm* is a nuisance alarm that is generated by the equipment itself (poor design, inadequate maintenance, or component failure)
  - *Vulnerability to Defeat*
    - Bypass – all sensors have a limited detection zone, any sensor can be defeated by going around its detection volume
    - Spoofing – any technique that allows the intruder to pass through the detection zone without generating an alarm.

Testing Methodology

- System Type Test (STT)
  - FTT/PTT complete
  - Place in system suite for full scale tests
    - Fit and form
    - Interoperability
    - Compatibility
    - Usability by border security personnel at operational locations
  - Evaluate for conformance to overall system design

Data Analysis & Probability of Detection



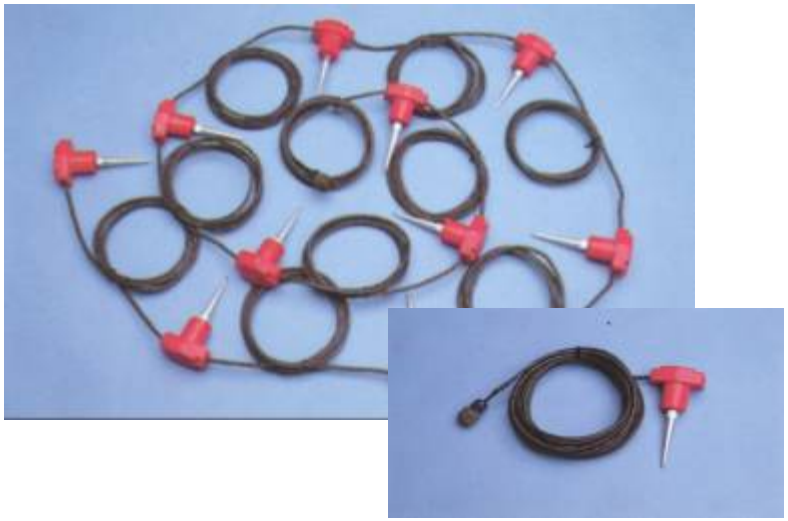
Probability of Detection (Pd) = [True Positive] / [True Positive + False Negative]

True Positive: Amount of actual alarms activated
False Negative: Amount of alarms that did not activate when there was an intruder

Completed Test
Seismic Sensor System

Statistical data on Seismic Sensors:	
Total Test run on Seismic Sensors:	**260**
Probability of Detection ($P_{d\text{-}Ideal}$):	**85.34%**

Average Circle of Detection:	
Human Walking:	**6.14 meters**
Human Running:	**14.14 meters**
All Terrain Vehicles:	**19.25 meters**
Truck:	**22.67 meters**

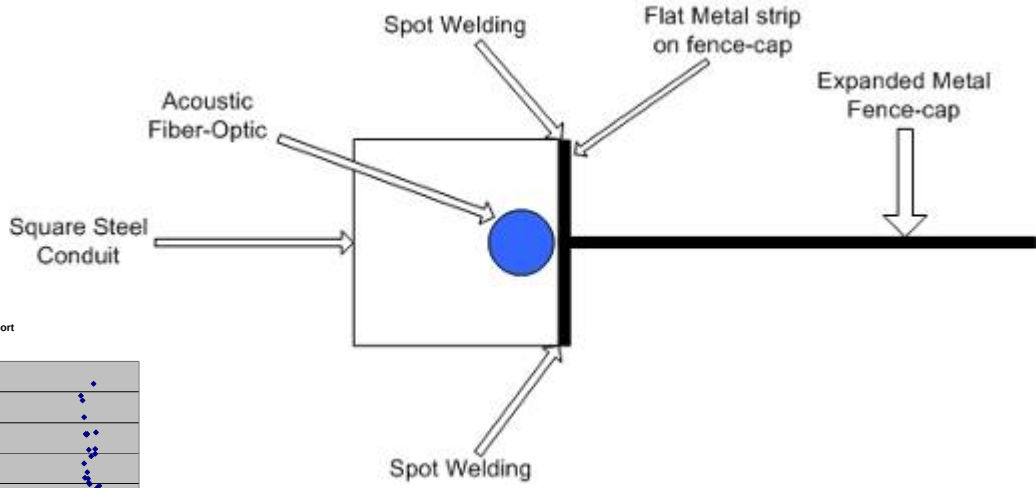


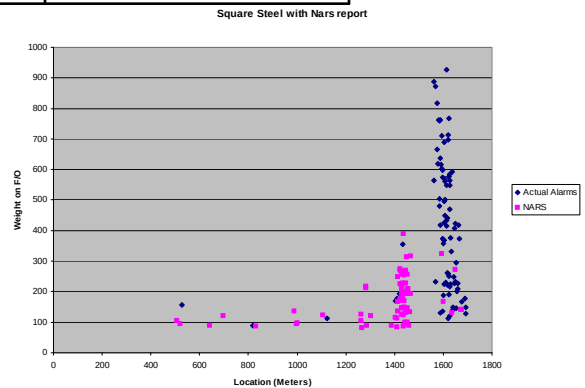
Completed Test
Acoustic Fiber-optic Sensor on Fence-Line

Statistical data on Chain-Link Fence Configuration:	
Total Test run:	**120**
Probability of Detection ($P_{d\text{-}Ideal}$):	**92.31%**
Average Nuisance Alarm Rate	**44%**

Location capability:	
Location for Alarm	**1579 Meters**
Standard deviation from Actual Alarm	**162 meters**

Steel Conduit on Border Fence:





System Compatibility

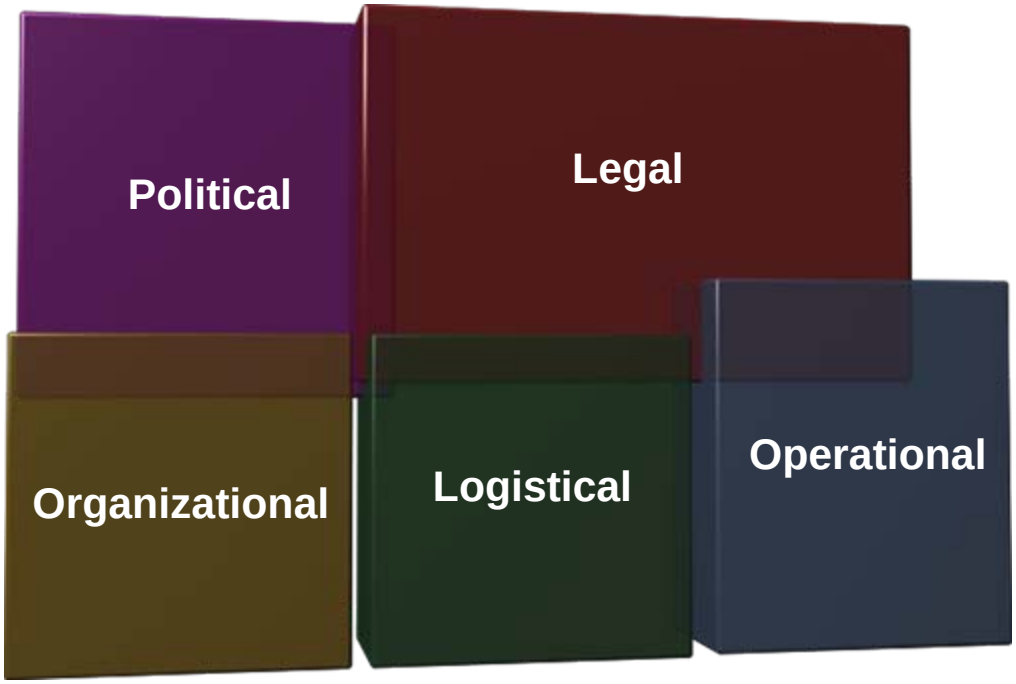
- Meet national communication requirements and compatibility
- Survive and work in various environmental conditions
  - Temperature ranges
  - Humidity
  - Rain
  - Snow
  - Elevation
  - Wind
  - Blowing sand
- Survive and work after transport
  - Ground, rail, air
  - Vibration, mechanical shock, acceleration,
- Security of the equipment / sensors
  - Covert installation
  - Protective measures to delay intruder from stealing or destroying before response force arrives
- System Reliability, Availability, Maintainability (RAM)
  - What is the Reliability of the system
  - Availability
    - Are there readily available spares
  - Maintainability
    - Mean Time Between Failures (MTBF)
    - Mean Time To Repair (MTTR)
- Life Cycle costs
  - How often need to replace system components

Cooperative Approaches

Sandia is a multiprogram laboratory operated by Sandia Corporation
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000.

Constraints

Every country's border management system is subject to a variety of constraints, internal and external, potentially limiting freedom of action. These include:

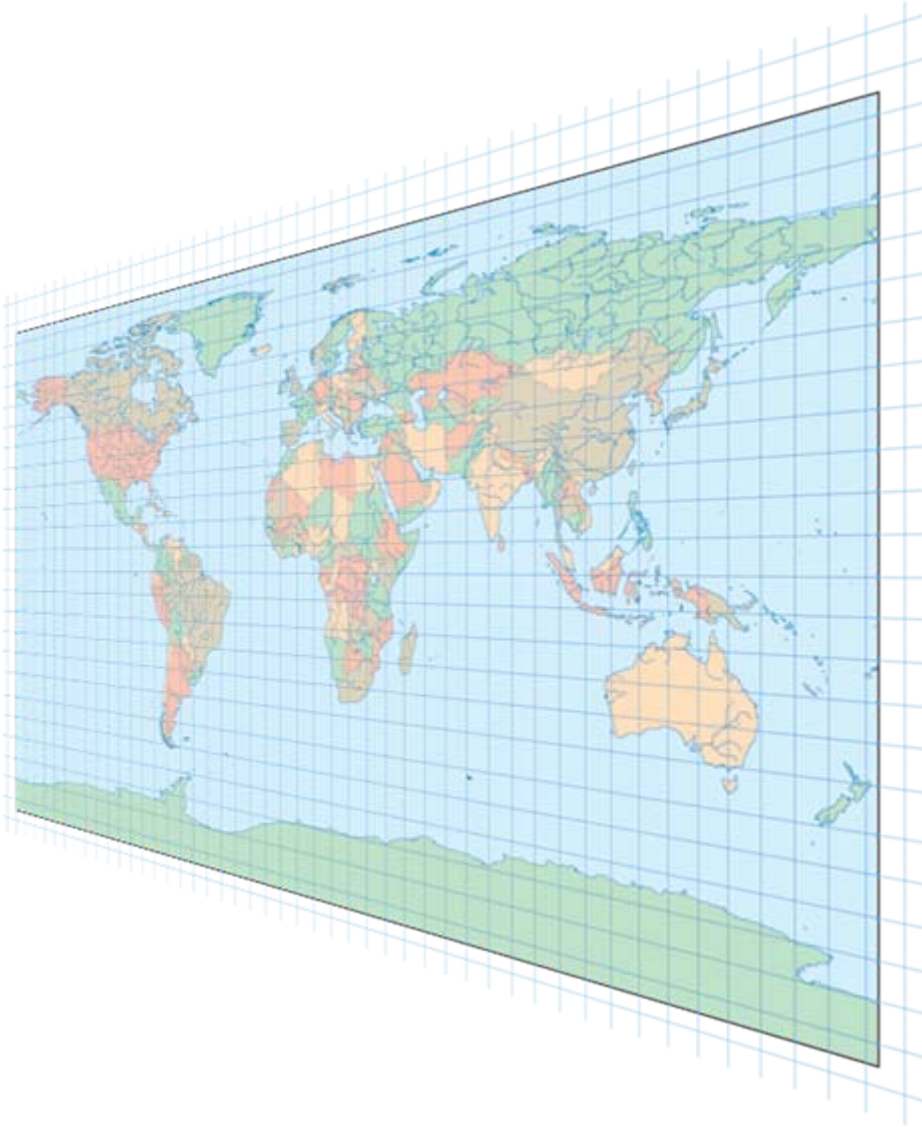


Constraints

Border management systems face many constraints

Geopolitical Challenges

- Differing, and possibly opposing, country border management policies and postures
- Militarized tensions between countries
  - Ongoing hostilities
  - Disputed boundaries
  - Opposing forces
  - Demilitarized zones
- Unstable and/or uncooperative neighbors



What is Cooperative Monitoring?

- The process of obtaining and sharing agreed information among parties
  - Uses sharable technologies and data information gathering methods
    - Treaty verification
    - Confidence-building
  - assures equal access to results
  - stipulates procedures for dealing with anomalies

Cooperative monitoring complements, but does not replace national capabilities.

Advantages of Cooperative Approaches

- Again, frontier border regulation is often a unilateral national activity

- Cooperative approaches offer advantages, however, including:
  - Reaching understanding regarding common issues and concerns
  - Reaching understanding regarding common policies and standards
  - Building confidence and transparency
  - Pooling and leveraging of resources and capabilities
  - Synergy and integration of capabilities

Disadvantages and Obstacles

- Cooperative approaches are not always feasible or preferable
- Obstacles include:
  - Differing national priorities
  - Differing perceptions of threats and challenges
  - Histories of conflict and confrontation
  - Differences in capabilities
  - Resource constraints
  - Security constraints
- Obstacles may be overcome through:
  - Incremental approaches
  - Third-party facilitation

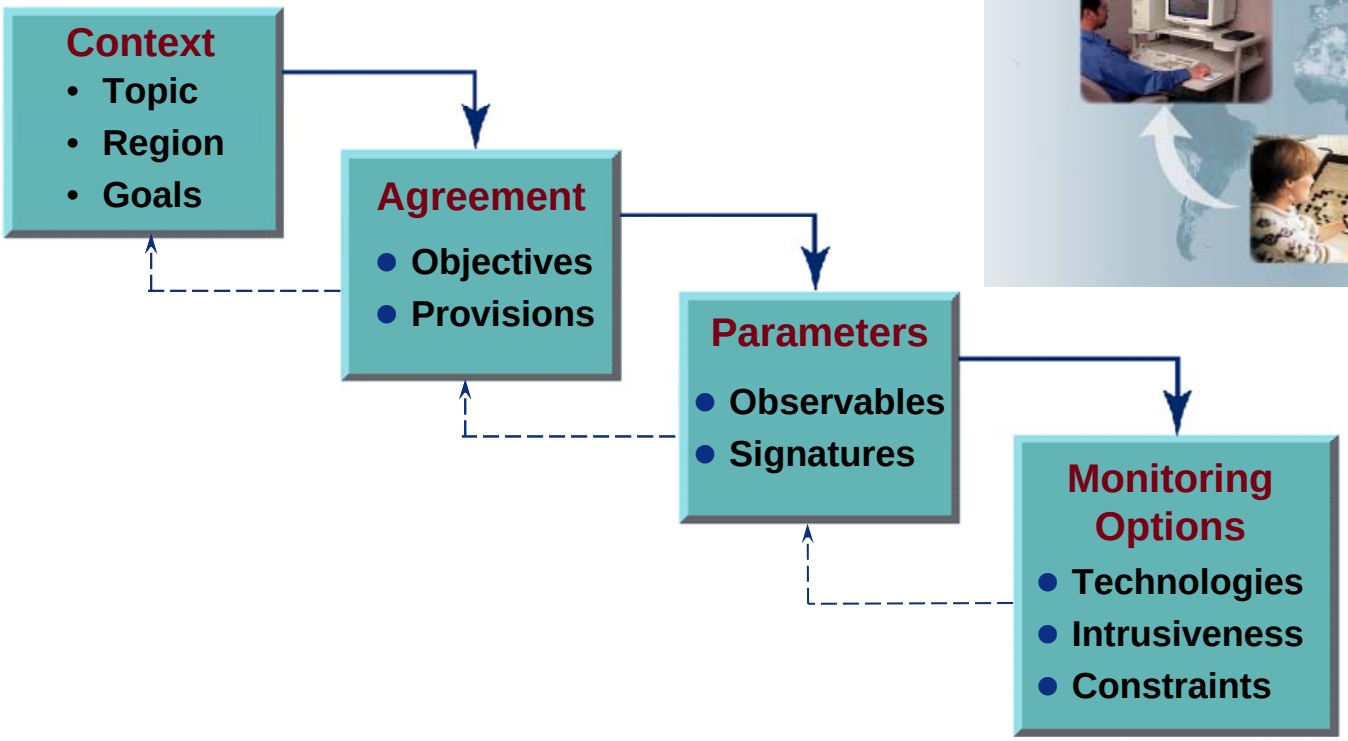
Cooperative Approaches

The basis for cooperation can take many forms:

- Bilateral agreements
- Regional agreements
- International agreements
- Treaties
- Confidence building measures (CBMs)
- Cooperative Monitoring
  - Process of obtaining and sharing agreed information among parties
  - Assures equal access to data/results
  - Stipulates procedures for dealing with anomalies

Cooperative Monitoring Framework

- **Cooperative monitoring complements, but does not replace, national capabilities**

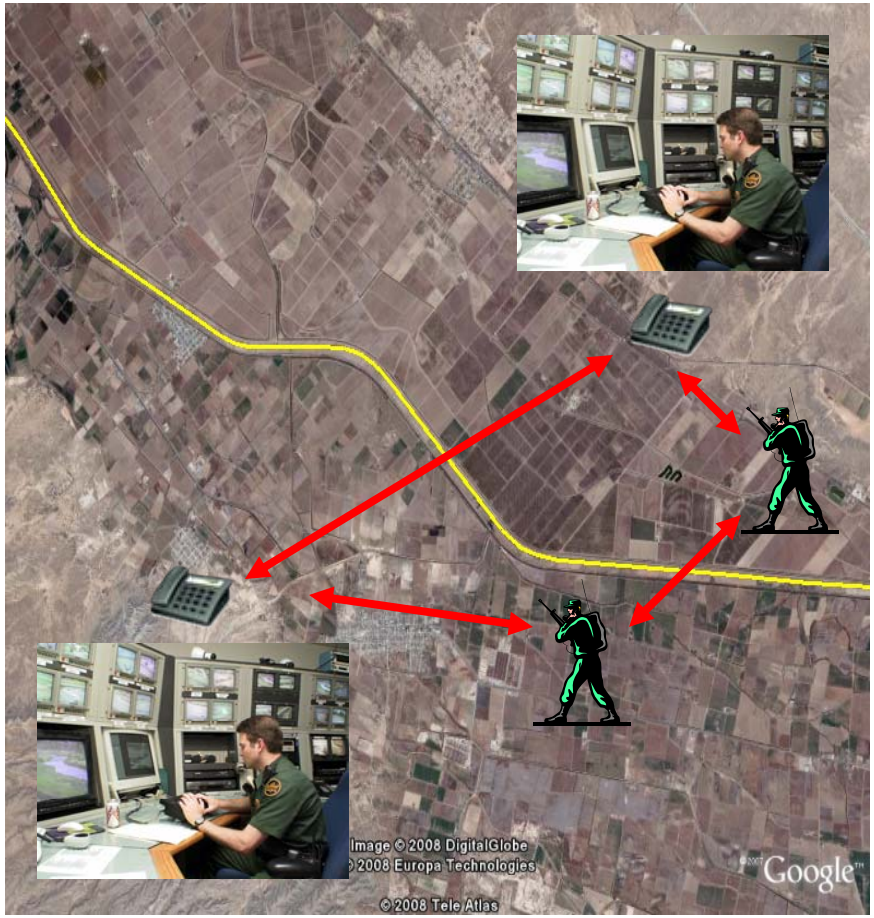


Regional/Bilateral and Unilateral Initiatives

- Lacking international guidance, borders are sometimes subject to regional agreements
- Regional/bilateral examples include:
  - European Union “Integrated Border Management”
    - Schengen
    - European Border Agency – FRONTEX
  - United States/Mexico
    - 2002 U.S./Mexico 22-Point “Smart Border” Agreement
    - Merida Initiative
  - United States/Canada
    - 2001 “Smart Border Accord”
    - Integrated Border Enforcement Teams (IBETS)
- For the most part, borders worldwide continue to be unilaterally regulated

Frontier Border Applications: Informational

- Common data bases for information management
- Sharing non-sensitive capabilities information
- Cross-border communications networks
  - HQ level
  - Field level
- Notification of operations and exercises
- Incident notification
- Intelligence sharing



Frontier Border Applications: Technical

- Joint test and evaluation
- Sharing technical test and evaluation data
- Developing common technical standards
- Integrating technical capabilities
- Technical training exchanges
- Coordinated procurement decisions

Frontier Border Applications: Operational

- Common procedures
- Training exchanges
- Cooperative/joint operations
- Division of labor
- Border demarcation
- Posting liaison officers
- Joint refugee management
- Joint exercises
- Cooperative infrastructure development
- Open skies agreements

Frontier Border Cooperation: Real-World Examples

- United States/Canada Integrated Border Enforcement Teams (IBETs)
  - Partner agencies include:
    - Royal Canadian Mounted Police
    - Canada Border Services Association
    - US Customs and Border Protection
    - US Bureau of Immigration and Customs Enforcement
    - US Coast Guard
  - Primarily an intelligence-sharing arrangement, supporting border-related investigation, enforcement, and interdiction
  - Information is collected from and shared with local community law enforcement organizations
    - State/provincial and municipal police
    - Tribal police
  - Focus on areas “between the Ports of Entry”
  - 24 teams spread across 15 regions
  - Includes informational, technical, and operational cooperation

Frontier Border Cooperation: Real-World Examples

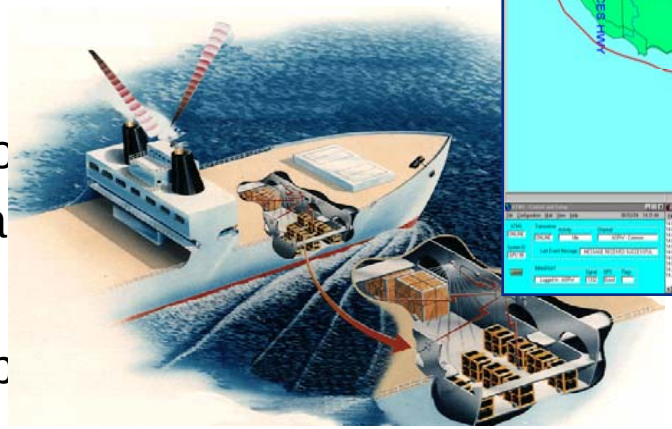
- European Union Rapid Border Intervention Teams (RABITs)
  - Multinational teams of border guards and other border security personnel
    - Personnel drawn from member state “expert pools”
    - Personnel trained according to EU standards
  - Called upon in times of border-related crisis
    - Refugee situations
    - Mass migration
  - Deployed at the request of EU member states
  - Intended to supplement existing member state capabilities
  - Teams are commanded by an officer from the member state, operating under the state’s mandate
  - Operational

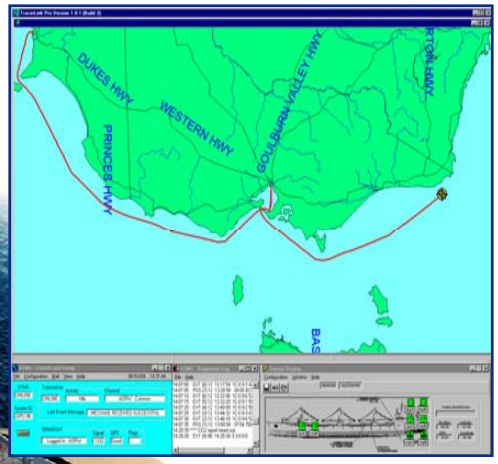
Port of Entry Applications

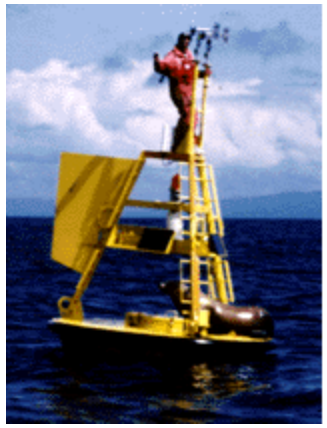
- Shared Port of Entry Facilities
- Common data bases for information management
- Common procedures
- Detection and assessment systems test and evaluation data
- Training exchanges
- Drug and smuggling interdiction
- Refugee management
- Joint exercises

Maritime Applications

- Objectives
  - Useful to avoid accidental border crossings
  - Useful for search and rescue
  - May avoid military confrontatic
  - Scientific cooperation potentia
- Technical Options
  - Global positioning system ship tracking
  - Moored buoys for data collection or boundary demarcation







Maritime Operational Examples

- Operation Active Endeavor
  - Mediterranean Sea
  - Network headquartered in Naples
  - Includes: Russia, Ukraine, Israel, Albania, Croatia, Algeria, Morocco, Georgia, Finland, Sweden
  - Blue denotes those countries that have exchanged MOUs and are participating in information exchange
- ICC-International Maritime Bureau
  - Piracy Reporting Centre—focuses on reducing attacks in piracy hotspots
  - Commercial based on pressuring States that fail to act against piracy
  - Sends daily status reports to ships regarding locations and types of recent attacks, and sends quarterly and annual reports to States
- Joint GCC Remote-Sensing Satellite
  - Management of Natural Disasters
  - Accurate Mapping

Potential Opportunities

- Global intelligence network—Development of a mutually supporting information and intelligence sharing network
- Domain Awareness—Development of enhanced capabilities for early threat identification shall be accomplished through an integrated common operating picture accessible to all stakeholders
- Cooperative monitoring of territorial seas and contiguous zones for
  - Smuggling
  - Piracy
  - Radioactive materials
  - Fishing violations
- Standards and Policies—Development of policies, programs, and initiatives that facilitate implementation of a regional maritime and coastal area security framework
- Joint Training and Exercises
  - Emergency response
  - Detection Technologies
  - Interdiction Techniques

An Example

- Proliferation Security Initiative
  - Global effort to stop shipments of WMD, their delivery systems, and related materials
  - Statement of Interdiction Principles
    - Undertake effective interdiction measures
    - Adopt streamlined procedures for rapid exchange of suspected proliferation activity information
    - Strengthen legal authorities
  - 11 member countries with 73 countries publicly committed

Australia, the U.S., Japan, and France take part in "Exercise Pacific Protector." *(AP)*

An Italian Air Force F-16 intercepts a U.S. Navy P-3C during "Exercise Air Brake 04," a multi-lateral aviation interdiction training exercise in the Mediterranean Sea.

Other Maritime Applications

Natural Resources

- **Water**
- **Wildlife migration**

Pollution

- **Air**
- **Rivers**
- **Oceans**

Energy

- **Fossil**
- **Hydroelectric**
- **Nuclear**
- **Renewables**

Emergency Planning and Response

- **Tsunamis**
- **Cyclones**
- **Oil spills**
- **Volcanoes**

Cooperative Monitoring

- Bilateral and regional agreements are possible
- Can supplement existing agreements and efforts
- Incremental approach is possible
- Initial role exists for establishing training on cooperative monitoring concepts and technologies

Discussion

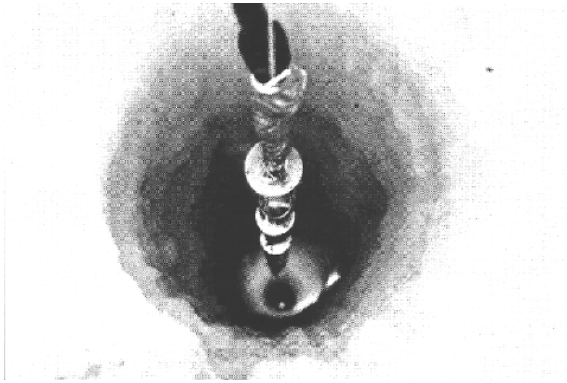
- **In your opinion, how can cooperative approaches assist in border management for your country?**
- **Are there potential obstacles to such an approach?**
- **What advantages can you imagine to an more regional approach?**

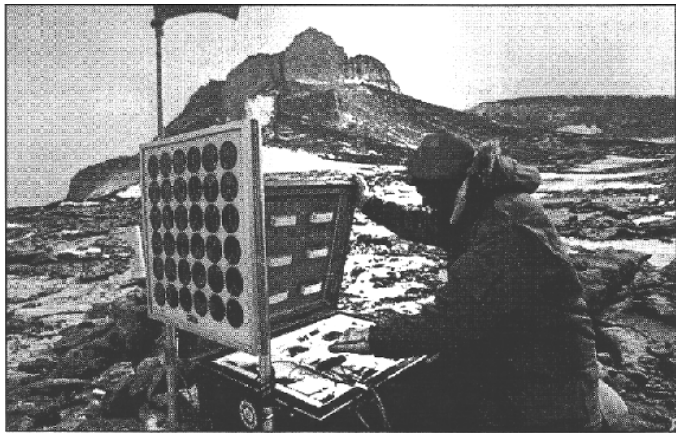
The Siachen Glacier: The Highest Battlefield in the World

- **History**
  - The 1949 cease-fire line between Pakistan and India failed to clearly demarcate the Siachen Glacier.
  - In 1984 Indian and Pakistani troops occupied the glacier. Both states have maintained a continuous presence.
  - The combined death toll is estimated at 3000-5000 lives, mostly due to the inhospitable climate.
- **Current Status**
  - Since 2003 India and Pakistan have maintained an informal cease-fire.
  - Formal attempts at demilitarization of the Siachen Glacier have not been successful.

Siachen Scientific Peace Park

- In 1994 Aamir Ali, an Indian mountaineer, first proposed the idea of a Siachen Peace Park with the goal of stopping the environmental damage being done by both militaries as well as open the glacier to mountaineering and tourism.
- In 1998 Kent Biringer proposed the development of a Siachen Science Center. Such a concept would allow for demilitarization as well as introduce opportunities for unique scientific study.
  - Astronomy, geology, atmospheric sciences, glaciology, life sciences, physiology, psychology and behavioral sciences
- Cooperative monitoring efforts to ease the demilitarization of the glacier would be a crucial component of any peace park proposal.





A Siachen Scientific Peace Park still faces significant political challenges

- Challenges
  - Disagreements concerning the strategic value of the Siachen as well as its ties to the larger Kashmir conflict has made progress towards demilitarization of the glacier difficult.
  - A 2006 conference set to address the Karakoram range was cancelled at the 11th hour by the Pakistani government.
- Positive Signs
  - In 2005, Indian P.M. Singh visited Siachen saying, “it was time to make Siachen a symbol of peace.”
  - Further negotiations (as recent as July 2008) have not made any concrete advances, yet both governments have at least indicated their willingness to resolve the Siachen conflict.
  - Growing support from both inside and outside India and Pakistan for a Siachen Peace Park.

Desertification of Arid Lands in the Middle East

- Desertification is a land degradation problem of major importance in the arid regions of the world. Deterioration in soil and plant cover have adversely affected nearly 50 percent of the land areas as the result of human mismanagement of cultivated and range lands.

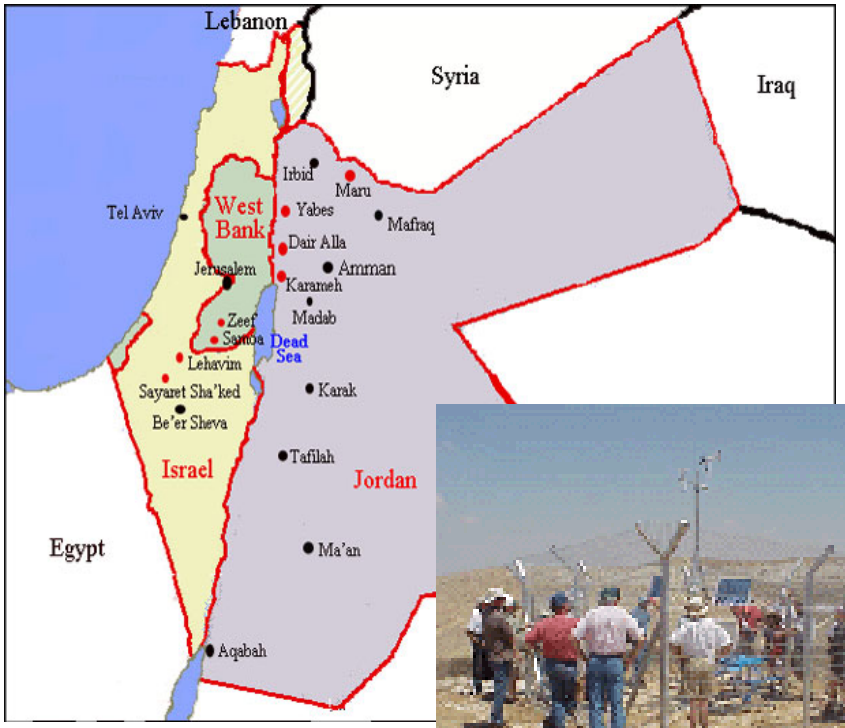
- Improper water management leading to salinization is the cause of the deterioration of irrigated lands. In addition to vegetation deterioration, erosion, and salinization, desertification effects can be seen in loss of soil fertility, soil compaction, and soil crusting.

- Combating desertification can be done successfully using techniques already known if financial resources are available and the political will to act is present.

- Almost everyone possessed meteorological stations in the region except for the Palestinians but no one was sharing data.

Middle East Meteorological System (MEMS) Formerly the Sustainable Land Use (SLU) Project

- In 1999 the Cooperative Monitoring Center (Albuquerque, NM) launched an effort to minimize the effects of desertification in Israel and Palestine. In addition, the SLU project sought to promote further interaction and confidence building among the participants.
- Sustainable Land Use Project
  - **A collaborative project between Israel and Palestinian Authority scientific organizations and universities**
  - **Four automated monitoring stations in Israel and the West Bank to measure weather and soil conditions**
  - **Project website is forum to exchange data and ideas**



MEMS Future

- The overall vision of the project is to build a regional network of MET stations that will be coordinated through CMC-Amman.
- Four Meteorological stations in Jordan have been integrated into the system.
- Project envisions expansion to other countries in the region (Egypt, Saudi Arabia, Iraq, Iran, …etc.).

Additional Cooperative Monitoring Efforts

- Red Sea Marine Peace Park
  - As part of the 1994 Trilateral Peace Negotiation Process Israel and Jordan agreed to form a binational peace park in the Gulf of Aqaba to protect the coral reef ecosystem of the Gulf.
  - USAID funding coordinated through NOAA from 1999-2003.
  - Program sought to develop a coordinated management and educational research program as well as a long-term monitoring and research program.
- Hungary and Romania Open Skies Treaty
  - A bilateral Open Skies treaty designed to reduce tensions and provide transparency between Hungary and Romania.
- Sino-Indian Confidence Building Measure Agreements
  - 1993 and 1996 CBM agreements attempted to reduce tensions along the Line of Actual Control (LAC) through reductions in forces and through limits on military activities.
  - Agreements contained few verification provisions, yet are seen as positive steps in the normalization of relations between China and India.

Event Discussion

- **Scenario: 1) Terrorists cross your frontier border with a radiological source, 2) a land-based port of entry with a radiological source in a hidden compartment, 3) a fishing boat is carrying a radioactive source, 4) a cargo container contains threatening radioactive material.**

- **Key Questions:**
  - **How would they be detected?**
  - **How would they be delayed until response could arrive or be enacted?**
  - **What happens to operations during the event?**
  - **Was response force able to interdict/neutralize the adversary?**
  - **What was the final disposition of the adversary? Of the materials?**
  - **After the initial event takes place, who would be notified, and how would the information flow up the chain of command?**
  - **What steps would be taken in regards to the event "anatomy" – watch, discover, decide, respond, resolve?**