Securing the Homeland

TECHNOLOGIES THAT SCAN AT THE SPEED OF COMMERCE IN SUPPORT OF THE PORT OF THE FUTURE

Presentation for Department of Homeland Security / Science & Technology ALERT Conference – June 20, 2018

LEIDOS SECURITY AND TRANSPORTATION TECHNOLOGY

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Managing Threats to Commerce

MULTIFACETED APPROACH TO SECURITY

Land Border

Mail / Parcel / Aviation

Threat Space

Rail

Seaport

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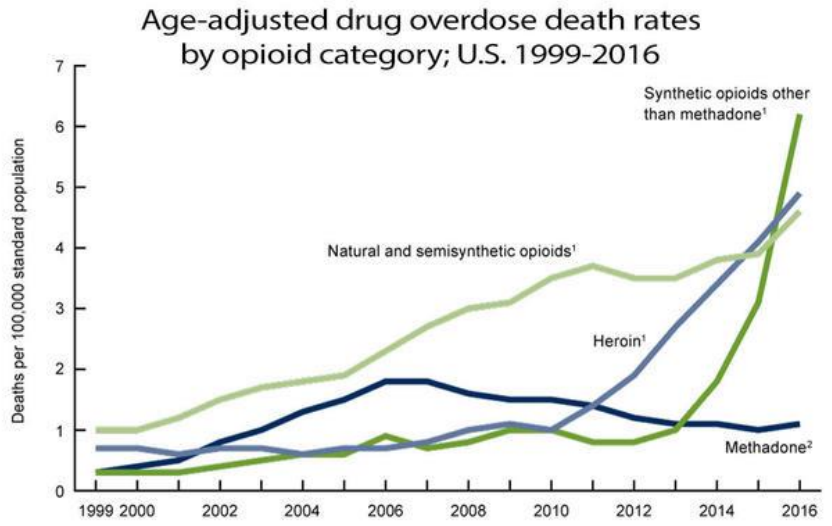
Soaring Opioid Drug Deaths in US
US Congress / Fed Agencies

- 2017: >65,000 Narcotic related deaths in US
  - >43,000 of 65,000 related to illegal opioid
  - Fentanyl, OxyContin etc
- Transportation Vector
  - *Mail, parcel, smuggling*
  - *Aviation, Land Border*
  - *POV, Cargo*
- Problem:
  - *Huge mail / parcel streams*
  - *small quantities lethal difficult to detect with high PD and low PFA*
- Potential Solution
  - Automated CT detection
  - *Handle large volume: approx 2,000/Hr/system*
- TRL: *8 / COTS*
  - Engineered quantity (g), PD & PFA
  - >90% PD
  - Target <10 PFA



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Land Border Crossing – Commercial Cargo

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”

- Commercial Cargo
  - Pre-Primary Integrated NII Solutions
    - 100% Inspection
    - Safe – Efficient – Resource Relocation
    - UVIS / RFID / LPR / RDE
    - Automated Traffic Flow Controls
    - Remote Operation
    - NII Transaction Tied into Shippers’ ACE Data
    - Quicker “Hold / Release” Decisions
    - Command Center Architecture
    - Future: Biometrics, Immigration, CDL, etc.
    - Minimal Civil Works / Minimum Port Reconfiguration

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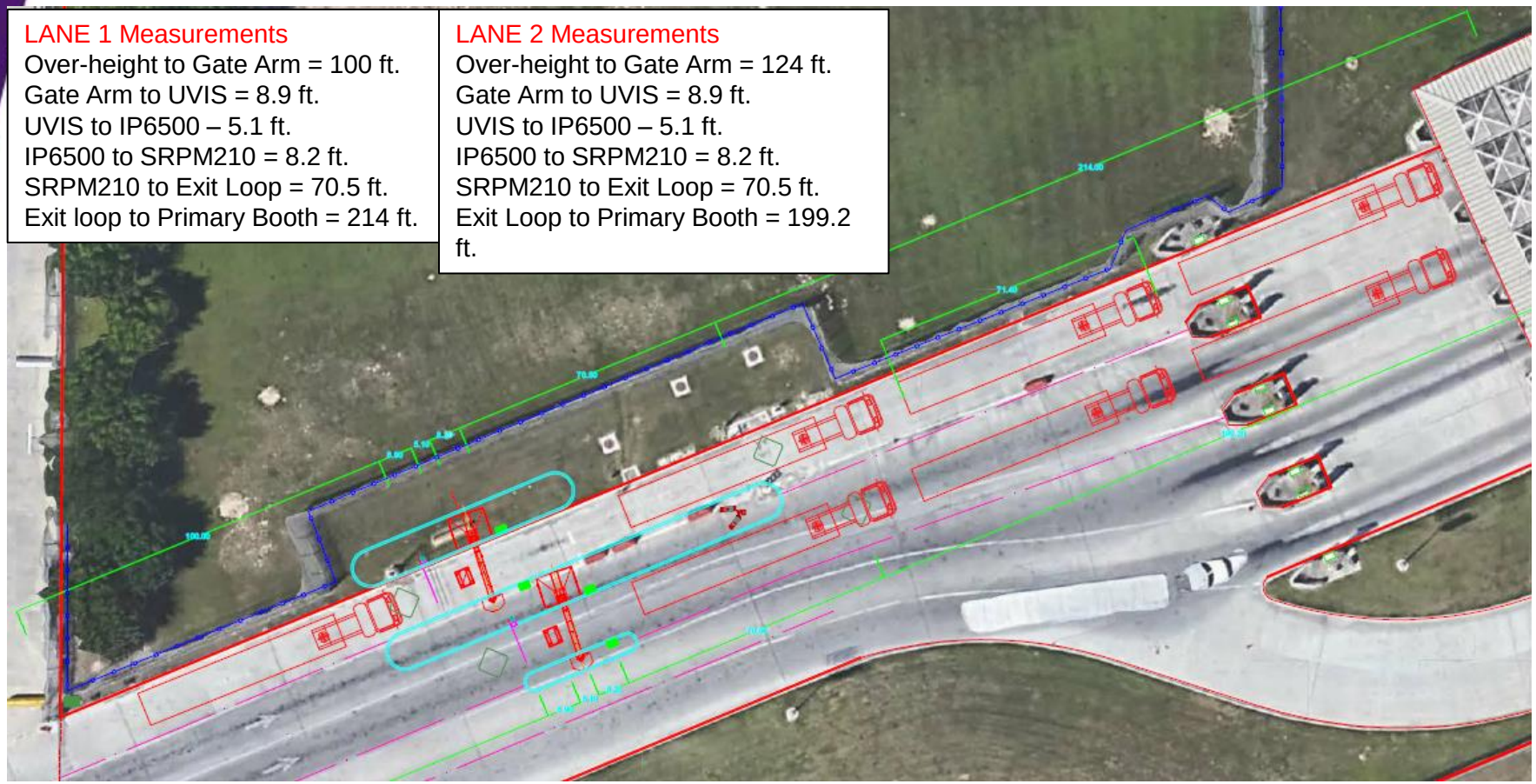
VACIS® IP6500 FullScan System for MEP Program

SYSTEM LAYOUT AT BROWNSVILLE, TEXAS BORDER CROSSING (CONTINUED)

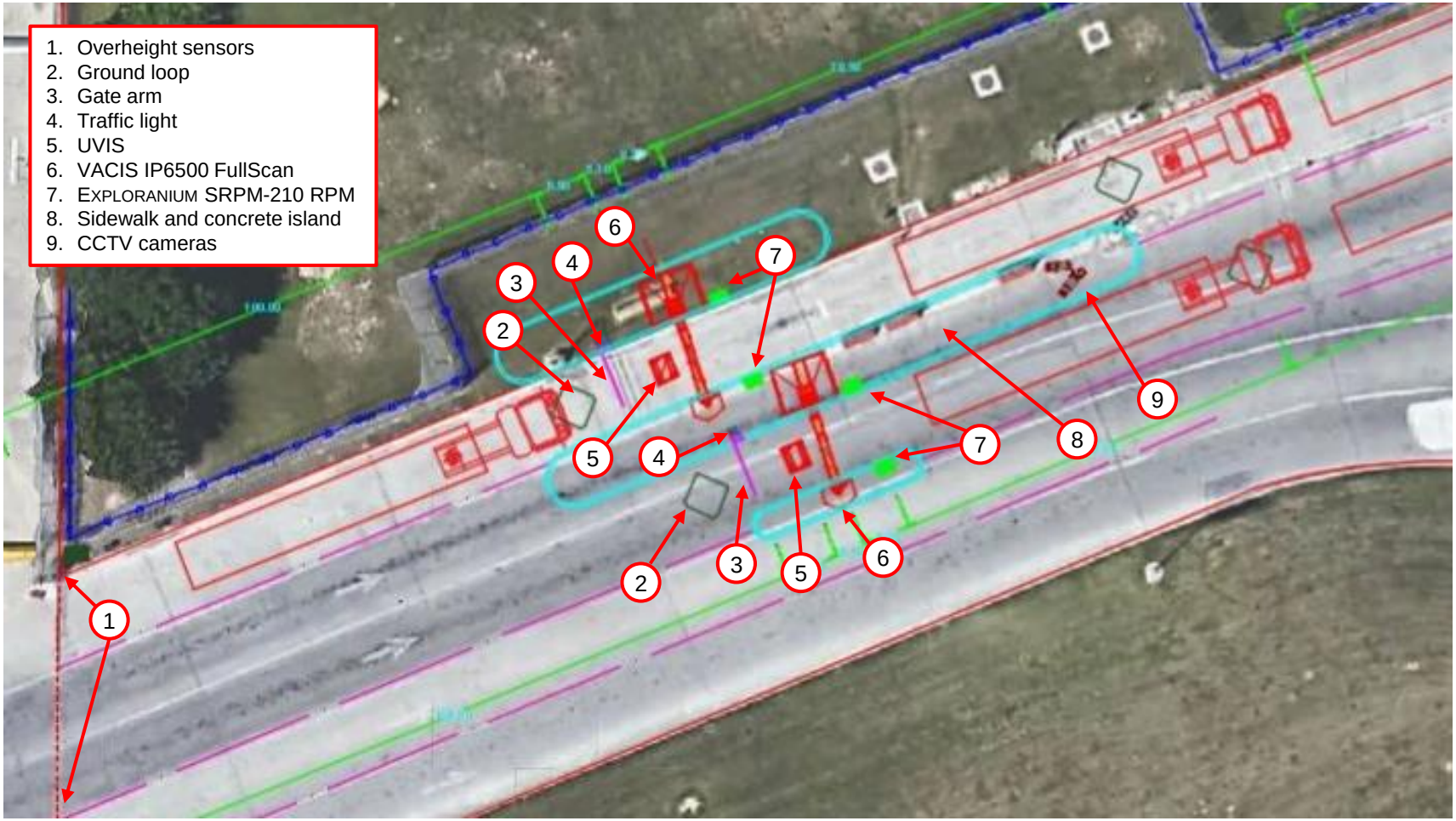
LANE 1 Measurements
Over-height to Gate Arm = 100 ft.
Gate Arm to UVIS = 8.9 ft.
UVIS to IP6500 – 5.1 ft.
IP6500 to SRPM210 = 8.2 ft.
SRPM210 to Exit Loop = 70.5 ft.
Exit loop to Primary Booth = 214 ft.

LANE 2 Measurements
Over-height to Gate Arm = 124 ft.
Gate Arm to UVIS = 8.9 ft.
UVIS to IP6500 – 5.1 ft.
IP6500 to SRPM210 = 8.2 ft.
SRPM210 to Exit Loop = 70.5 ft.
Exit Loop to Primary Booth = 199.2 ft.



VACIS® IP6500 FullScan System for MEP Program

SYSTEM LAYOUT AT BROWNSVILLE, TEXAS BORDER CROSSING (CONTINUED)



VACIS® IP6500 and IP6500 FullScan Inspection Systems

OVERVIEW

Performance

Penetration through steel:	305 mm (12 in) or more
Throughput:	150+ vehicles per hour[1]
Minimum scan height:	As low as 0.2 m (8 in)
Typical dose per scan (cargo):	No more than 2.7 µSv (273 µrem)
Typical dose per scan (occupants):	No more than 0.25 µSv (25 µrem)[2]
Scanning speed:	Up to 16 km/h (10 mph)

[1]300 or more vehicles per hour achievable by extending the controlled-access area and/or adding equipment
[2]VACIS IP6500 FullScan system only

Features

- Automated drive-through operation
- Modular design for quick installation
- Imaging systems: X-ray source, Leidos's patented detector array
- Full-time dual-energy material discrimination
- Powerful image-analysis tools
- Optional integrated radiation scanning and OCR-based equipment identification

Benefits

- Drive-through operation enables high throughput
- Installs quickly and easily on any existing concrete or asphalt pad with no required civil works
- VACIS IP6500 automatically scans only cargo – never drivers
- VACIS IP6500 FullScan automatically scans entire vehicles, including occupants
- Very low radiation dose to vehicle occupants and bystanders
- Very small operating footprint—barely larger that the system itself

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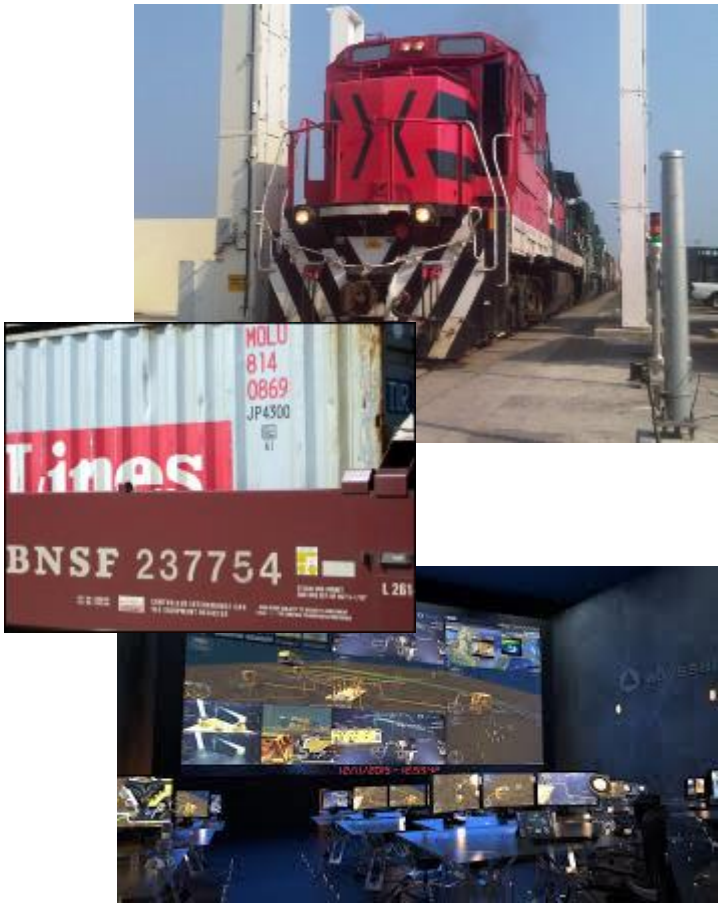
Land Border Crossing – Rail

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”

- Commercial Cargo
  - Pre-Primary Integrated NII Solutions
    - 100% Inspection
    - Safe – Efficient – Resource Relocation
    - UVIS / RFID / LPR / RDE
    - Container OCR
    - Remote Operation
    - NII Transaction Tied into Shippers’ Data
    - Quicker “Hold / Release” Decisions
    - Command Center Architecture
    - Minimal Civil Works / Minimum Port Reconfiguration



VACIS® IR6500 Integrated Rail Inspection System

OVERVIEW

Performance

Penetration through steel:	254 mm (10.0 in) with combined radiation detection
Penetration through steel:	318 mm (12.5 in) without combined radiation detection
Throughput:	Two 1.6-km (1-mi) trains per hour
Typical dose per scan:	No more than 2 µSv (200 µrem)
Resolution:	15 mm (0.6 in) or better
Contrast sensitivity:	2.5% or better

Features

- X-ray system: high-energy X-ray source, Leidos's patented detector technology
- Operating personnel required: 1
- Open interface software design: SQL database, Windows® operating system
- Powerful image-analysis tools

Benefits

- Low radiation dose — System's access-controlled area is very small, just 18 m (59 ft) x 3.7 m (12 ft), about the same size as the system's physical footprint
- Optional integrated radiation detection — Helps operators detect and locate radioactive sources
- Integrated display — X-ray scan image and radiation profile integrated into one transaction
- World-class support – Training and 24/7 maintenance programs available worldwide

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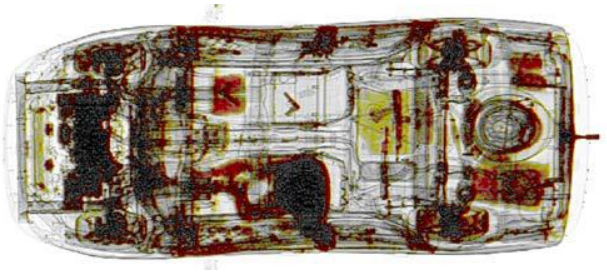
Land Border Crossing – Privately Owned Vehicles

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”

- Privately Owned Vehicles (POVs)
  - Pre-Primary Integrated NII Solutions
    - 100% Inspection
    - Safe – Efficient – Resource Relocation
    - UVIS / RFID / LPR / RDE
    - Remote Operation
    - Quicker “Hold / Release” Decisions
    - Command Center Architecture
    - Multi-Lane / Relocatable Configuration



VACIS® XPL Passenger Vehicle Inspection System

OVERVIEW

Performance

Throughput:	150+ vehicles per hour[1]
Resolution:	7 mm (0.3 in) or better
Portal dimensions:	3.8 m (12.3 ft) W x 3.2 m (10.5 ft) H x 3.7 m (12.1 ft) L
Portal weight:	1,072 kg (2,363 lb)
Tunnel dimensions:	2.8 m (9.2 ft) W x 2.5 m (8.2 ft) H
Typical dose per scan:	0.05 µSv (5 µrem)

[1]300 or more vehicles per hour achievable by extending the access controlled area and/or adding equipment

Features

- X-ray system – compact X-ray source featuring switched-energy material discrimination technology
- Personnel – one operator
- Windows® operating system
- Powerful image-analysis tools
- Optional remote operations capability
- Optional VACIS XPL Mobile configuration

Benefits

- Non-stop scanning of the entire vehicle – including occupants
- Low radiation dose per scan – complies with ANSI N43.17-2009
- High throughput – scans hundreds of vehicles per hour
- Compact physical footprint
- Quick relocation with VACIS XPL Mobile configuration
- Supports remote, centralized image analysis
- World-class training and 24/7 technical support

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Mail / Parcel / Aviation

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”

- Contraband / Opioid / Currency Detection
  - Automated Detection Technology that Integrates into Parcel Handling System
  - > 1M / Parcels Per Day Freight Forwarder
  - High-Speed Screening
  - Customs International Mail Facilities
  - Efficiently and Safely Increase Number Of Parcels Scanned
  - Automated Secondary Screening
  - Manageable “False Alarm”

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Contraband Detection Using CT Scanners

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INTRODUCTION

Various contraband categories of interest were collected using a Reveal CT scanner not used before for contraband detection. Since exact detection and false alarm rates could not be calculated until a suitable contraband algorithm was developed, data were collected, and detection performance was estimated from offline analysis. Further, dependence of the PFA on the contraband mass was estimated for each contraband category under assumption of zero false negative errors, *i.e.* detection (PD) is at 100%.

EVALUATING METHOLOGY

The following evaluation technique was used for analysis of contraband detection capabilities:

- Density, Z effective images and histograms were analyzed for regions in reconstructed slices corresponding to each substance of interest.
- Potential increase in PFA for detecting a specified contraband mass of each category was estimated by comparing estimations of *density* and *Z effective* (for Zeff estimation methods, see [1-2]) for contraband items and objects in real bags in the database of international baggage.
- PFA numbers are estimations, actual numbers could be smaller due to FA reduction techniques in Reveal detection algorithm not covered in this work
- Calculation of potential PFA increase for detecting each contraband category was repeated for several values of contraband mass in the range of 10 – 1000 g.

CONTRABAND CATEGORIES

The following contraband categories were studied: *MDMA*, *Amphetamine*, *Cocaine*, *Hashish*, *Currency*. The data subcategories we considered: no clutter (*bare*), in clutter with electronic devises (electronic clutter, *EC*), in clutter with organic (food) items (non-electronic, *NEC*).

RESULTS

Results presented used data from a Reveal CT80DR scanner for all contraband categories, except for CURRENCY, the later analysis used data collected on a high-speed CT120 system. Blue dots in the plots represent objects in typical (contraband free) airport bags.

A. MDMA

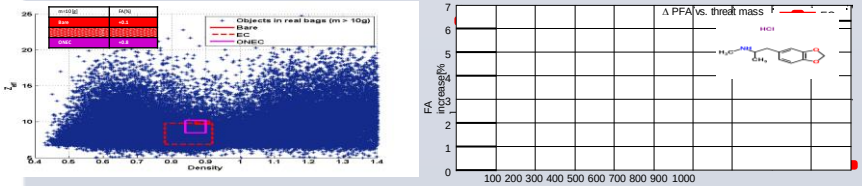

Fig. 1. (Left) Estimated signatures of MDMA subcategories (density, Zeff) and potential PFA implications to detect m=10[g]. (Right) Estimated dependence of PFA on the contraband mass for the hardest category.

MDMA detection had insignificant PFA implications in bare and non-electronic clutter categories. Electronic clutter was the hardest category, see Fig.1.

B. AMPHETAMINE

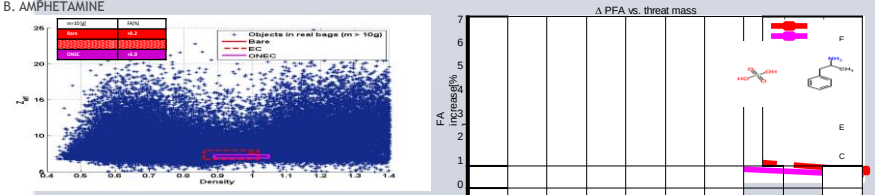

Fig. 2. (Left) Estimated signatures of AMPHETAMINE subcategories (density, Zeff) and potential PFA implications to detect m=10[g]. (Right) Estimated dependence of PFA on the contraband mass for the hardest categories.

AMPHETAMINE detection had insignificant PFA implications in bare category. Electronic clutter was the hardest category, see Fig.2.

C. COCAINE

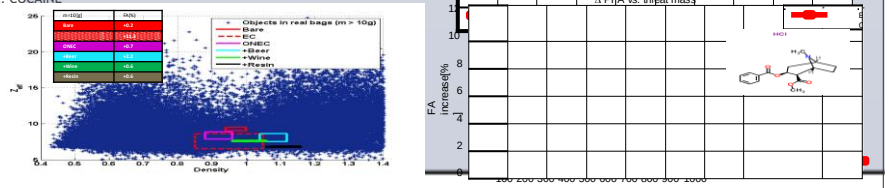

Fig. 3. (Left) Estimated signatures of COCAINE subcategories (density, Zeff) and potential PFA implications to detect m=10[g]. (Right) Estimated dependence of PFA on the contraband mass for the hardest category.

COCAINE detection had low PFA implications in bare category and non-electronic clutter. Electronic clutter was the hardest category, see Fig.3.

D. HASHISH

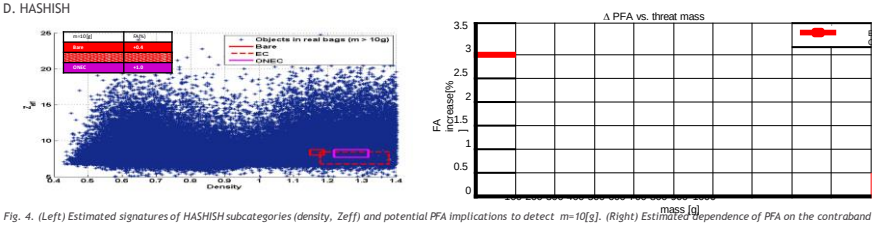

Fig. 4. (Left) Estimated signatures of HASHISH subcategories (density, Zeff) and potential PFA implications to detect m=10[g]. (Right) Estimated dependence of PFA on the contraband mass for the hardest categories.

HASHISH detection had insignificant PFA implications in bare category. Electronic clutter was the hardest category, see Fig.4.

E. CURRENCY

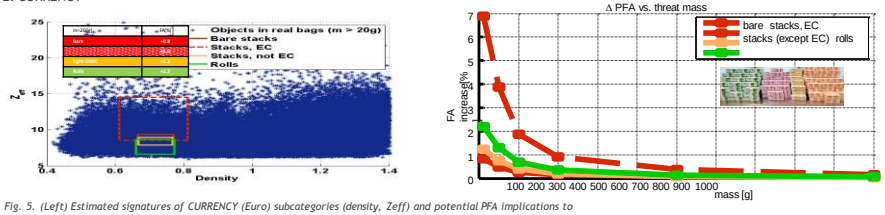

Fig. 5. (Left) Estimated signatures of CURRENCY (Euro) subcategories (density, Zeff) and potential PFA implications to detect m=20[g]. (Right) Estimated dependence of PFA on the contraband mass for the hardest categories.

CURRENCY (Euro) detection had insignificant PFA implications in bare category. Electronic clutter was the hardest category, see Fig.5. Other currencies studied included US dollars and Mexican pesos. Detecting 20[g] of currencies corresponds to detecting:

- over €10,000, (20 x €500)
- over $2,000 (20 x $100)
- over 20,000 Mexican peso, about $1,500 (20 x 1,000 pesos)

CONCLUSIONS

1. Signatures of various contraband categories were analyzed.
2. Analysis of detection clearly shows the benefits of using dual energy CT (CT80DR, or CT120).
3. We have shown that all bags containing contraband were correctly identified. The small number of clear bags that were incorrectly labeled as containing contraband greatly decreases as the sensitivity of the detection decreases.
4. We found that the *bare* subcategory was the easiest for both CT80DR and CT120 systems providing reliable detection with insignificant PFA implications for most contraband categories.
5. The hardest subcategory for most substances was *electronic clutter*.

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2Manohara, S.R., et al. 2008. "On the effective atomic number and electron density: A comprehensive set of formulas for all types of materials and energies above 1 keV", *Nucl. Instrum., Methods Phys. Res. B*, 266, 3906-12

ACKNOWLEDGEMENTS

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BIOGRAPHY

rge Soloviev received the M.S. degree in Applied Mathematics and Physics from the Moscow Institute of Physics and Technology, Moscow, Russia in 1991, and the S. degree in Computer Science from the Weizmann Institute of Science, Rehovot, Israel in 1997 for his work on Modeling of the Shift Invariant Recognition.

om 1999 to 2005, he was with the Department of Biomedical Engineering, Boston University, where he was involved in research on modeling of visual perception d a team lead in a number of fMRI imaging studies. In 2005, he joined Reveal Imaging (now a division of Leidos) as a Senior Algorithm Engineer.

He invented and implemented image-based solutions to explosive detection problems for EDS to inspect baggage for airport security. He designed and implemented RayTracer, a polychromatic x-ray system simulator that was successfully used in the design and engineering validation of several X-ray security systems. Currently, as a Principal Scientist, he is responsible for image quality analysis, design of new image processing algorithms and simulations of x-ray security systems.

He is an author of a number of publications in Computational Mathematics, Modeling, and in Biomedical Engineering.

Seaport Container Screening

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”

- Contraband in Sea Cargo Containers
- Mobile or Fixed-Portal NII Configurations
- Automated Drive Through / Remote Operations
- Safe / Minimal Civil Works
- Multi-lane
- Integrated Technologies: RDE, OCR, etc.

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VACIS® M6500 Mobile Inspection System

OVERVIEW

Performance*

Penetration through steel:	203 mm (8 in)
Resolution:	9 mm (0.35 in)
Contrast sensitivity:	3%
Throughput:	150 vehicles per hour
Typical dose per scan (cargo):	≤1.0 µSv (100 µrem)
Typical dose per scan (occupants):	≤0.25 µSv (25 µrem)

* All specifications at 5.6 km/h (3.5 mph) scan speed in stationary mode

Features

- High-throughput stationary or flexible mobile operation
- Dual-energy material discrimination
- Scans bumper to bumper or cargo only
- Very low radiation dose to vehicle occupants and bystanders
- Small operating footprint

Benefits

- Supports a wide range of scanning scenarios
- Low scan height ensures that the entire vehicle is scanned
- Commercial or special driver's license generally not required for operation
- Complies with ANSI and IEC dose limits for scanning people in security operations
- Can be deployed in 10 minutes
- Operates on internal generator or shore power

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QUESTIONS / COMMENTS

Backup Sides

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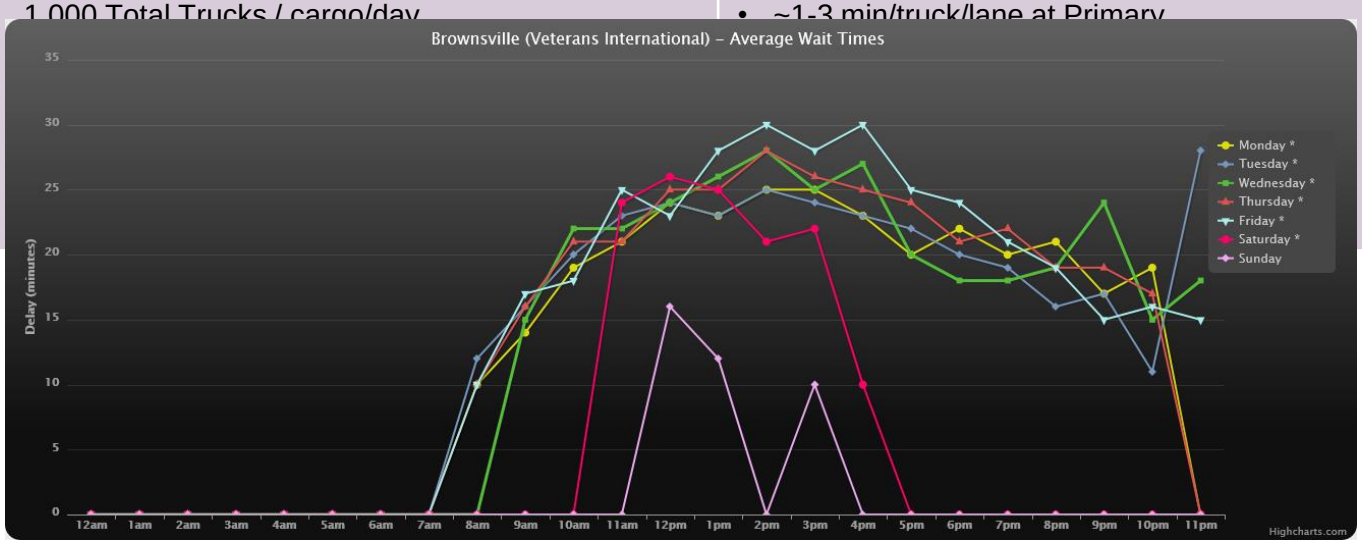
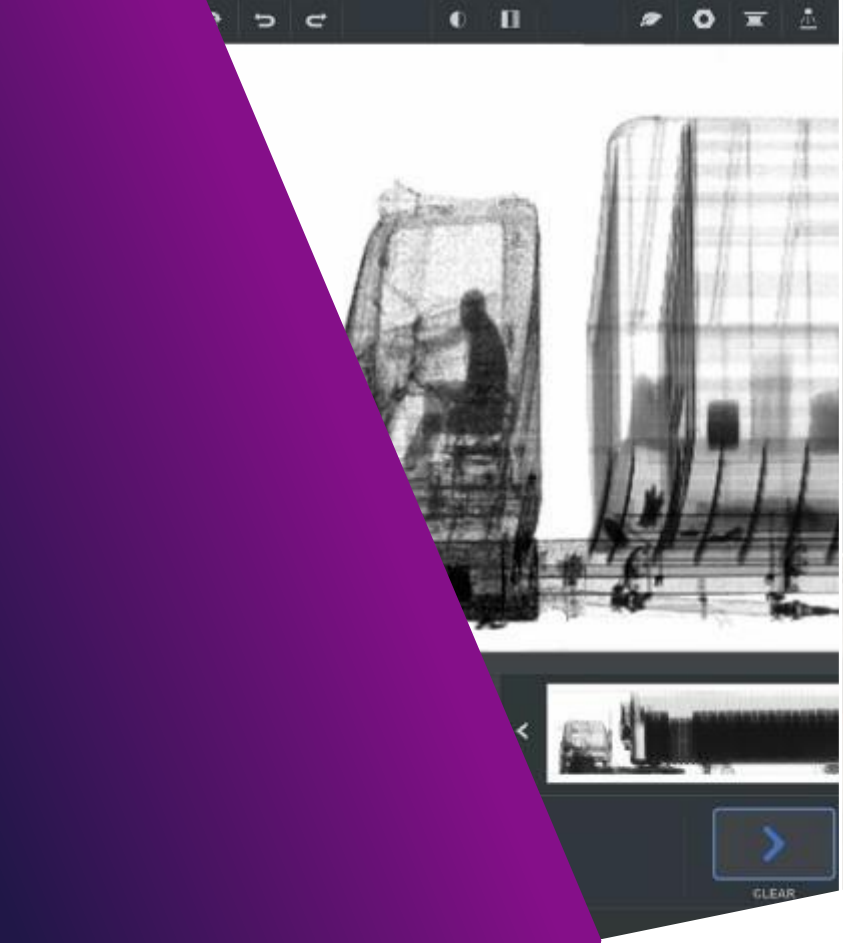
Veterans International Bridge – MEP Project (Cargo)

Veterans Bridge WTB Statistics

• POE Operates M-F 6am-12AM • Sun, Sat: 8AM-4PM • Weekday: 18 Hrs, 6AM-10AM – Empty's & Infernal	Wait times: • M-F 10AM-11PM 20-30mins • M-F Before 10AM Empty's No NII • Sat-Sun: 8AM-4PM: 5-15 mins
• 1 FAST lane: Over height & FAST • 3 Standard lanes • Primary 4 lanes	Secondary Inspections • Based on ACE Transaction • ~160 NII Inspections over 2 shifts • Sat: ~300 • Sun: ~50-60
• ~ 13,000 trucks / month ~220,000/yr • 1,000 Total Trucks / cargo/day • [illegible] • [illegible]	• Lane is 3-10AM – 12AM: ~70-80 trucks / Hr • ~1-3 min/truck/lane at Primary

Current "Commercial Standard" Northbound Wait Times





VACIS® IP6500 and IP6500 FullScan

INTEGRATED CARGO INSPECTION SYSTEMS

Product Presentation

SECURITY AND TRANSPORTATION TECHNOLOGY

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VACIS® IR6500

INTEGRATED RAIL INSPECTION SYSTEM

Product Presentation

SECURITY AND TRANSPORTATION TECHNOLOGY

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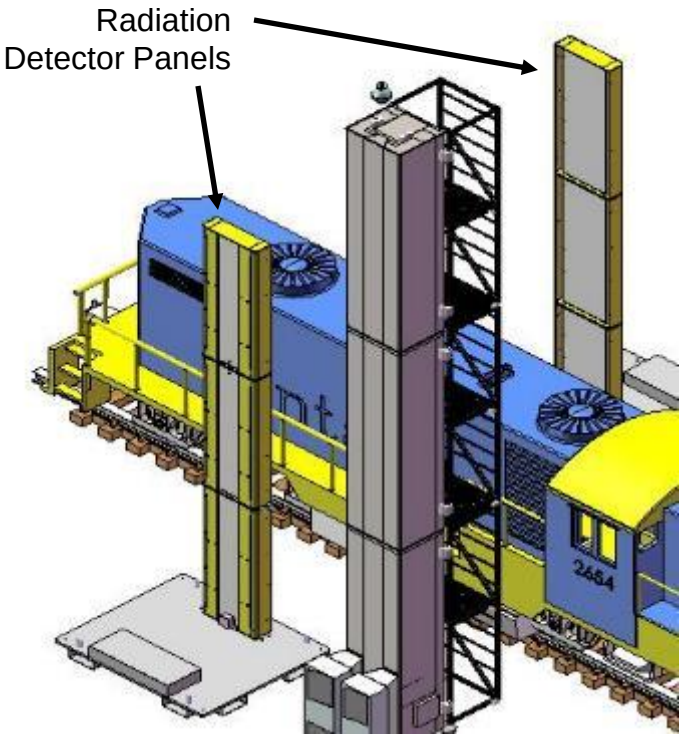
VACIS® IR6500 Integrated Rail Inspection System

OPTIONAL GAMMA AND NEUTRON RADIATION DETECTION

- Optional radiation detection technology helps operators detect and locate gamma ray and neutron sources in cargo
- Continuous 24/7 operation
- High throughput – scans railcars moving at 3-16 km/h (2-10 mph), sufficient to scan two 1.6-km (1-mi) long trains per hour
- Offers advanced technology capable of reducing false alarm rate
- Displays live and stored radiation profiles on graphic consoles
- Proven solution – similar technology installed for thousands of government and commercial clients in the U.S. and other countries



VACIS® XPL

PASSENGER VEHICLE SCANNING SYSTEM

Product Presentation

SECURITY AND TRANSPORTATION TECHNOLOGY

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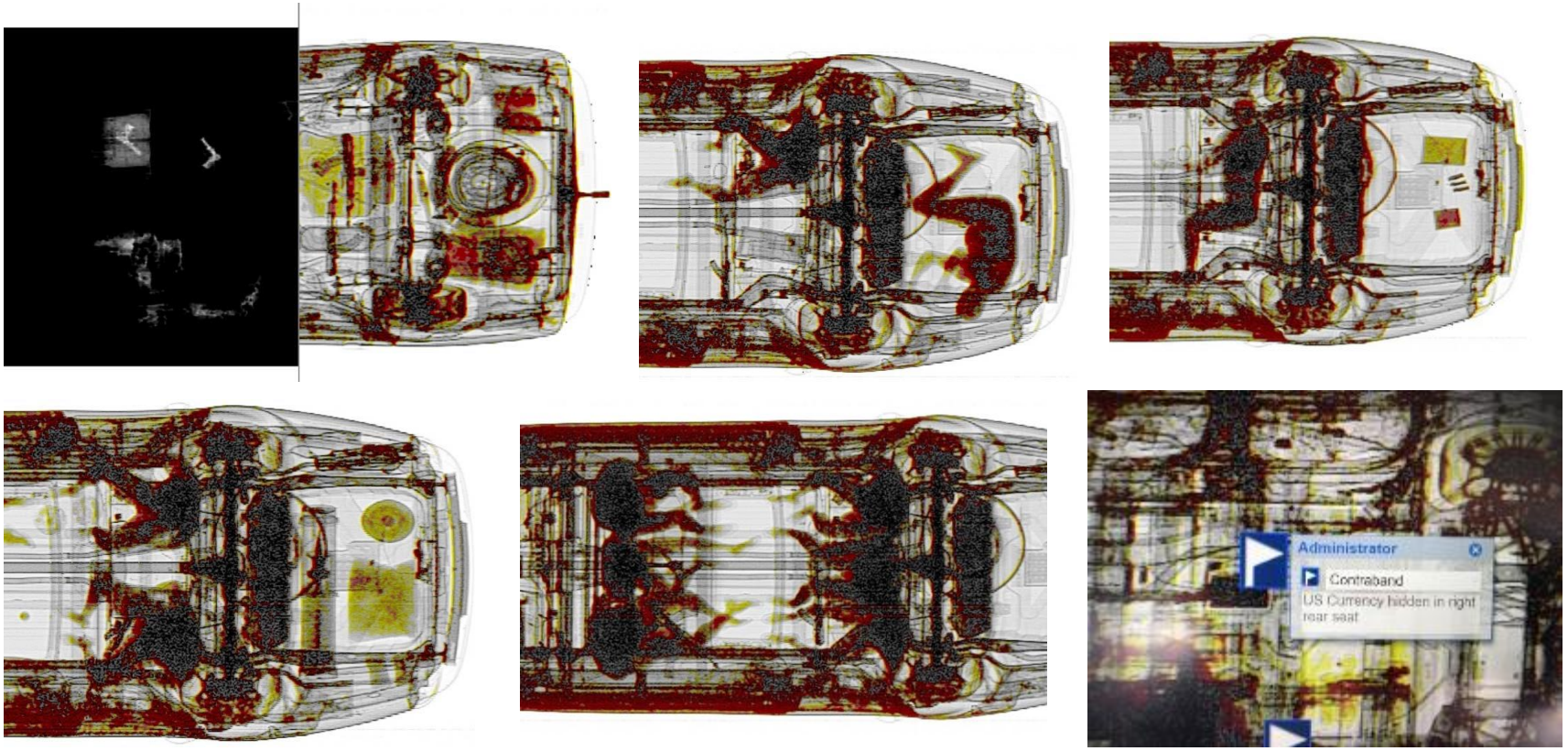
Land Border Crossing – Personal Occupied Vehicles

ACCELERATING THE SCREENING PROCESS – “SCAN MORE – SEIZE MORE...”



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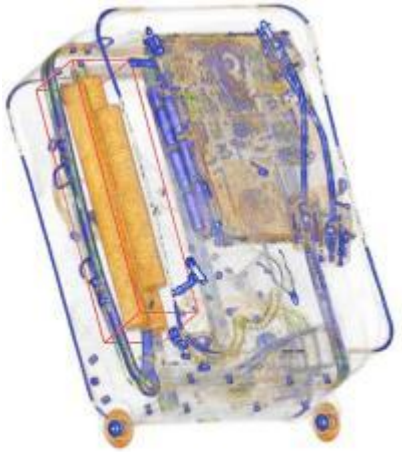

Reveal CT-120HS

EXPLOSIVES & Contraband DETECTION SYSTEM

Product Presentation

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VACIS® M6500

MOBILE INSPECTION SYSTEM

Product Presentation

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