Apex: Screening at Speed

Program Planning Overview

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Checkpoint 2014

- Existing Checkpoint
  - Multiple static technologies working independently
  - Limited automated threat detection capability
  - High TSO-to-passenger ratio
  - Slow throughput, long lines
  - Frequent false alarms (pat-downs, bag searches)
  - Significant passenger divestment and re-collection
- Gaps
  - Lower cost (capital investment & operating)
  - Better upgradability (cost and schedule)
  - Improved passenger experience

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Airport Checkpoint Vision

Deployable aviation security checkpoint technology that supports:

- Screening 300+ passengers and their carry-on belongings per lane per hour to TSA Tier IV security standards
- Screening aviation passengers walking at a normal pace through the checkpoint
- No divestiture of clothing or removal of liquids or electronics from carry-on bags
- Adapting dynamically to information provided by Risk-Based Security

Today

Gateway 2020

Artist's concept of future passenger checkpoint

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Enhanced Security and Passenger Experience

Dynamic Aviation Risk Management System (DARMS) Compliant Architecture

- Going beyond TSA Pre ✓
  - Checkpoint adjusts thresholds based on TSA-provided passenger risk profiles
  - Dynamically reconfigurable, driven by national and local threat intelligence

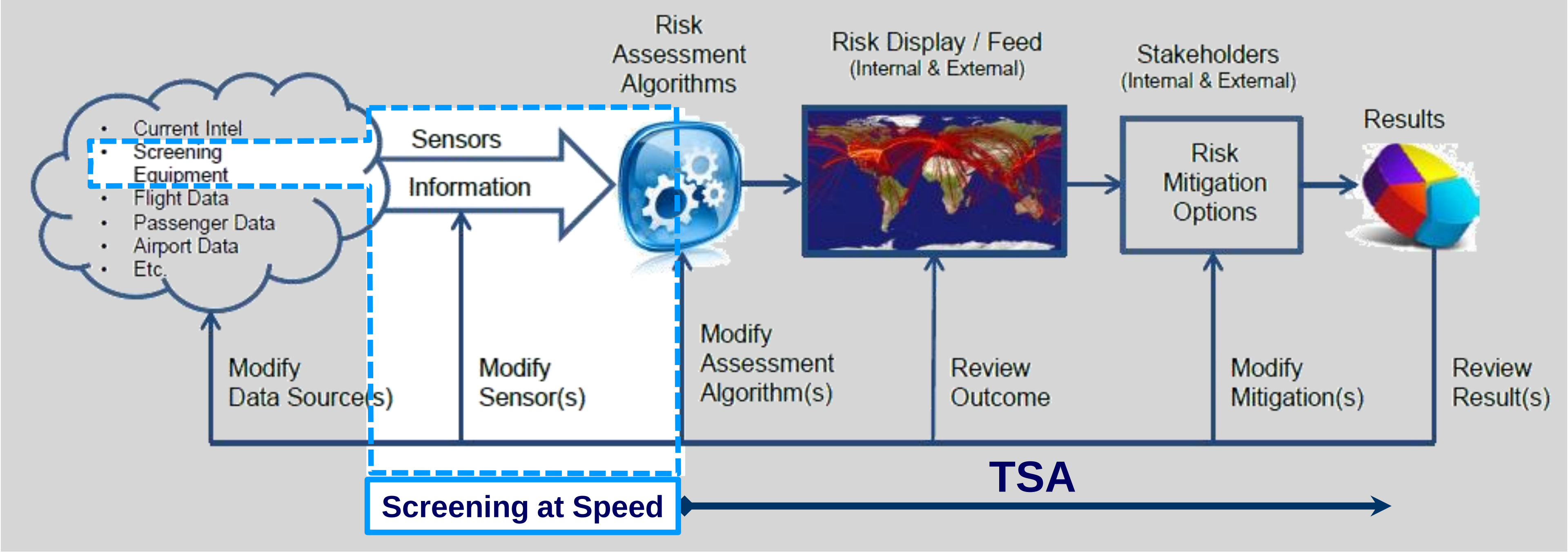

Diagram Source Filename: DARMS Per-Flight Process-Flow Diagram Concept (v1.4) 08.27.14

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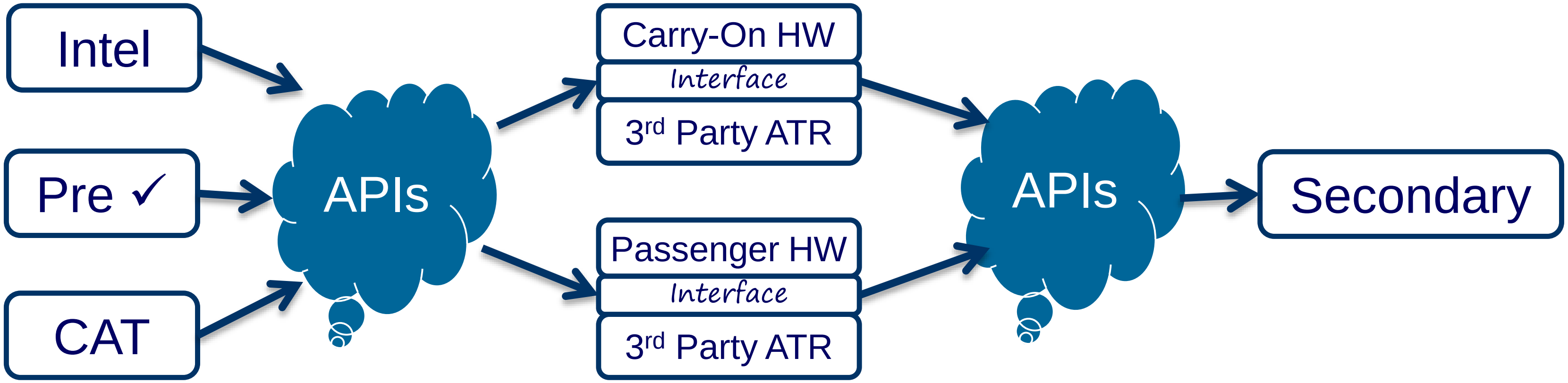
Enterprise-wide adaptability to changing threat environments

APIs and Interface Goals

Open Architecture-based Application Programming Interfaces (APIs) facilitate the development of an integrated and customizable checkpoint with modular hardware and software.

- Components conform to TSA's Security Technology Integrated Program (STIP)
- APIs connect the checkpoint with DARMS
- Inputs accepted from Credential Authentication Technology (CAT)



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Designed for seamless integration with TSA infrastructure

What Does Success Look Like?

A checkpoint lane that is collectively:	Today		FY20
	Standard	Pre ✓	Apex
Fast (Passengers per lane per hour)	135-150	250	300
Effective (TSA standard for bags)	Tier I *	Operator only	Tier IV
Effective (TSA standard for passengers)	Tier II	Metal detector	Tier IV
Efficient (False alarms for passengers; pat-downs)	(SSI)	-	< ½
Efficient (False alarms for baggage; invasive search)	(SSI)	(SSI)	< ½
Respectful (Divest outerwear, footwear, headwear)	Yes	None	None
Convenient (Passenger transit)	Pause & Pose	Walk Through	Walk Through
Convenient (Liquids, Aerosols, and Gels policy)	Divested; 3.4 oz. max.	In bag; 3.4 oz. max.	In bag; Any size
Agile (Timeline for new threat response)	Months	N/A	Days
Secure and Modular	Vulnerabilities known	Vulnerabilities known	STIP/DARMS compliant

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*: Tier II Detection being evaluated at TSL, but current P_{FA} unacceptable to customer

Test & Evaluation Strategy

EXD has an ongoing collaboration and funding agreement for Development Test and Evaluation (DT&E) at the Transportation Security Laboratory (TSL).

T&E Efforts

Initial Lab Testing & Demo	Technology Demonstrator	Performance Evaluation at TSL	Operational Testing	Site Acceptance Testing
• Concept validation • High-level performance assessment • Event-driven • Done at contractor facility	• S&T Program Office validates performance against SOW • Test conducted at contractor facility • Test validated • Performance report to TSL	• P_D, false alarm, throughput and minimal operational tests • Testing at TSL • If unsuccessful, refer back to S&T for more development	• Operational tests conducted • Performance evaluated • Defect remedy cycle • TSA conducts OT&E	• TSA decides who will integrate subsystems, and where it should be done

T&E Resource Needs

- Operational Test Assessment Team
- Users/Data Collectors
- Pilot Locations
- Facilities
- Approvals

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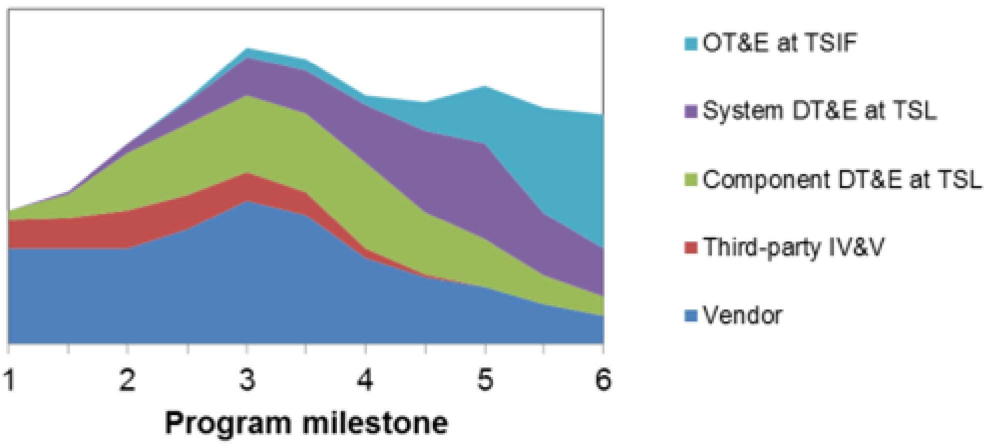
Test and Evaluation Responsibilities

Controlling Government T&E Risk:

- Vendor in-house capabilities used to evaluate early-TRL components and prototypes
- Third-party, independent test facilities used to validate vendor claims
- Proven (TRL 4+) components integrated into systems and tested further
- Formal, rigorous Developmental Test and Evaluation (DT&E) by TSL qualifies systems
- Transition to Operational Test and Evaluation (OT&E), managed by TSA

Notional T&E Budget profile:



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Technology Path: Baggage Screening

Today	SaS Innovation	Technology Outcome	Improves
Transmission data	Transmission and Diffraction Data	Higher precision in effective atomic number	• P_{FA} • Liquid/amorphous P_D • Material discrimination
Single- or dual-energy detectors	Multi-energy detectors	• Direct photon counts • Narrow energy resolution • Spectrum of images at 16-256 energies	• Contrast • P_D • P_{FA} • Material discrimination
Unstructured illumination	Phase Contrast Imaging	• Finer edge segmentation • Real index of refraction to 10^{-7} precision	• P_D • P_{FA} • Material discrimination
Few (~4) views	Thousands of views via Computed Tomography (CT)	More precise effective density and atomic number	• Concealment detection • P_D for sheets • P_{FA}
Conventional reconstruction	Iterative reconstruction	• Improved SNR • Fewer artifacts	• P_D • Throughput

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Technology Path: Passenger Screening

Today	SaS Innovation	Technology Outcome	Improves
Conventional antennas	• Wider bandwidths • Multi - Frequency • Metamaterial-enhanced antennas	• High-definition (few mm) spatial resolution • Improved clothing penetration • High power efficiency • Standoff imaging (~2m)	• P_D • P_{FA} • Smaller anomalies • Reduced divestiture • Throughput • Passenger experience
pause-and-pose	• Video analytics • Compressive sensing algorithms	• Walk-through (~1 m/s) screening • 10-100 Hz video imaging	• Throughput • Defeats concealment
Single perspective	Multi-panel, multi-view arrays	Data fusion of scans from many angles	• Concealment detection • P_{FA}
Single-band RF sources	Multi-band screening	• Attenuation data • Penetrates thin objects • Spectrum of reflectivity	• Reduced divestiture • P_D
		• Higher-frequency 'spotlight' re-scans suspect regions	• P_{FA}

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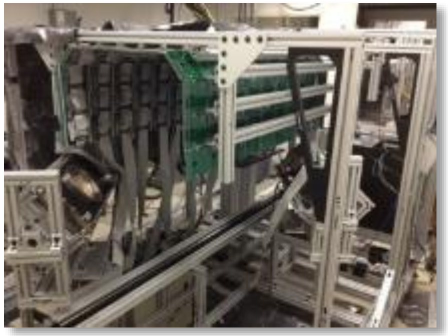
Potential Technology Components

Rapiscan 620DV checkpoint screening system



Interior of Coded Aperture X-Ray Imaging prototype

L3 ProVision 2 AIT (fielded)

Metamaterials flat-panel AIT prototype (left)

IDSS Detect 1000 checkpoint CT screening system

Design: CAMMS Miniaturized mass spectrometer

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Stakeholders

Stakeholder	Role and Responsibilities
Congress & GAO	Resourcing, Oversight
TSA	MNS, AoA, CONOPS, Acquisitions Plan, Training, Logistics
S&T EXD	Technology Development, Prototypes (Hardware And Software)
S&T Other	T&E, Systems Integration
USSS, FPS, CBP	Provide And Defend Other Agency Requirements For System Components
ECAC	European Harmonization
Pass Rights/Privacy Advocates	Articulate And Defend Passenger/Privacy Rights
Airport Authorities	Facilities Planning And Preparation
Airlines (IATA)	Articulate And Defend Airline Industry Interests
Security Industry	Commercialization Of System Components
Universities and Labs	Technology Development And Optimization
Medical Consultants	Ensure Health And Safety To Passengers And Operators
Human Factors Experts	Passenger Experience, Operator Effectiveness, Training
Media	Accurately And Responsibly Informing The Public

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Transition

- Leverage the TSA-S&T RDT&E Program Coordination Steering Group for joint planning, coordination and oversight
- Balance TSA's need for enhancing currently fielded technologies with the development of next-generation screening technologies
- Align with TSA lifecycle replacement /recapitalization plans to support TSA's Full Operational Capability (FOC) acquisition goals

		Useful Life	FOC	FY16	FY17	FY18	FY19	FY20
PSP	AIT	10 years	870	------	------	------	Recap 43 Units	Recap 202 Units
PSP	AT-2	10 years	2,030	------	Recap 246 Units	Recap 246 Units	Recap 247 Units	Recap 247 Units
PSP	BLS	10 years	1,530	------	------	------	Recap 382 Units	Recap 383 Units
PSP	CAT	10 years	1,520	------	------	------	------	------
PSP	EMD	10 years	1,460	Recap 897 Units	Recap 70 Units	Recap 72 Units	Recap 28 Units	Recap 6 Units
PSP	ETD	10 years	5,115[1]	------	------	Recap 297 Units	Recap 298 Units	Recap 298 Units
EBSP	EDS	15 years	------[2]	Recap 53 Units[3]	Recap 15 Units[4]	Recap 15 Units[4]	Recap 15 Units[4]	Recap 15 Units[4]

Table from "Approved Recapitalization Figures", presented by TSA at their Industry Forum Kickoff, 2/5/15

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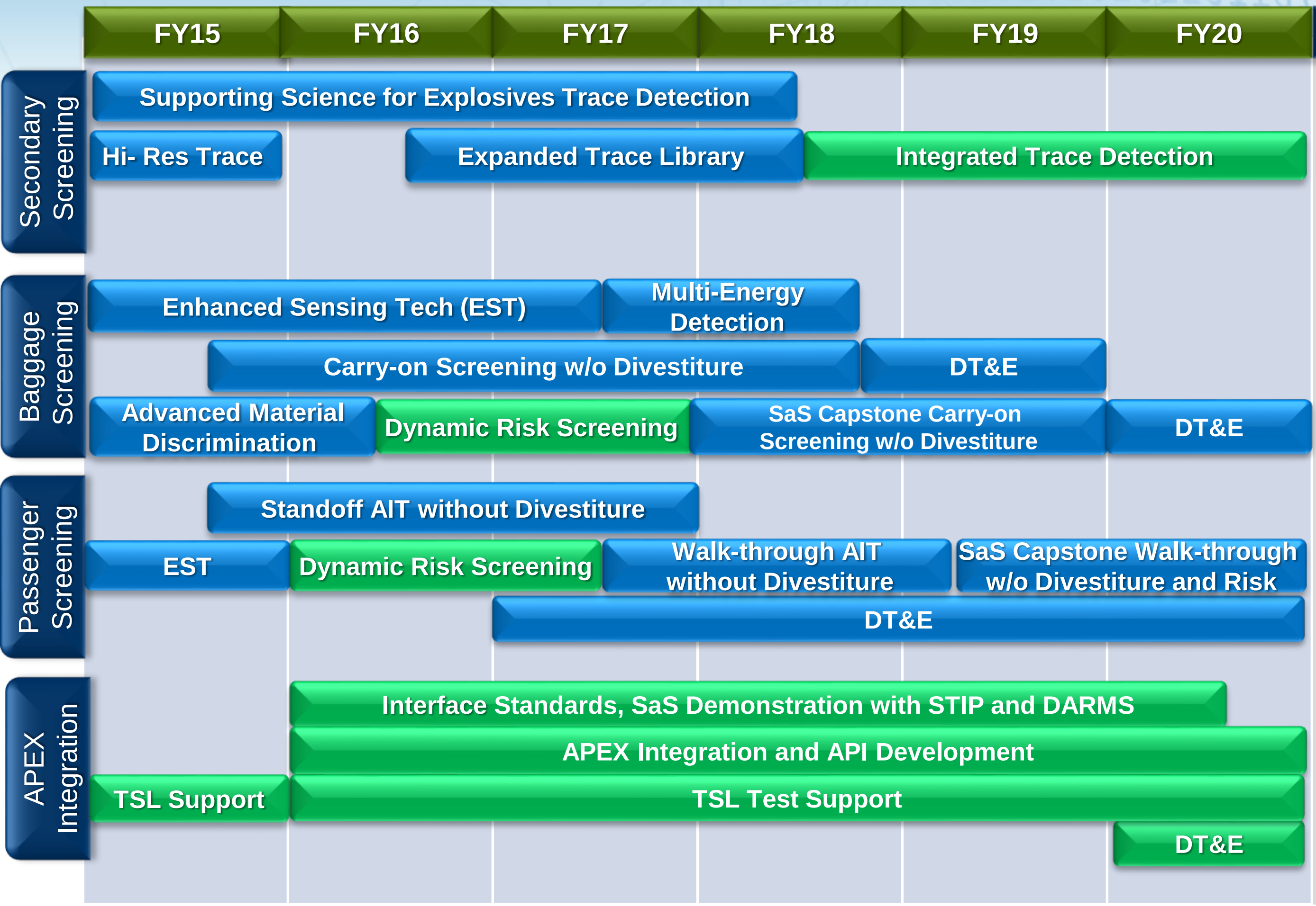
SaS will field solutions for TSA's capability gaps

Program Plan



Notes

- IPSS and Next-Generation Checkpoint budgets are transitioning in their entirety to Apex: Screening at Speed
- Technologies derived from High-Resolution Trace and Advanced Material Discrimination will support Apex: Screening at Speed
- Architecture components primarily implemented by TSA
- Synchronized with the TSA's Recapitalization Plan

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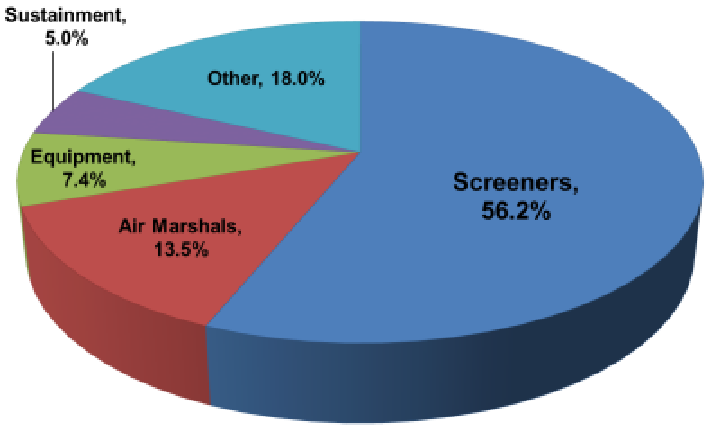
Legacy Projects & Follow-on

APEX SaS & New Starts

Return on Investment

- TSA spends a majority of Aviation Security funds on staffing
  - TSA's Aviation Security budget for FY15: $5.68B [1]
  - Staffing driven by frequent false alarms and checkpoint complexity
- Apex SaS: Fewer false alarms, reduced 'coaching' for divestiture
  - 2,200 lanes are currently needed to achieve desired throughput [2]
  - Faster throughput could reduce the number of lanes (equipment/sustainment costs)
  - Significant reduction in divestiture and false alarms will allow some checkpoint staff at standard lanes to be redeployed to support other critical tasks
- Air travel volume is projected to grow 2.2%/year [3]
  - Apex SaS technology will increase TSA's efficiency even as more passengers need screening

SaS Outcome	SaS Impact
Fewer new lanes needed	Fewer systems and screeners
Improved P_D	Improved security
Improved P_{FA}	Fewer searches/searchers, Less secondary screening
Walk-through screening	Shorter lines, fewer complaints



TSA FY15 Aviation Security Budget ($5.68B)

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[1]: DHS Congressional Budget Justification FY15, http://www.dhs.gov/dhs-budget
[2]: TSA Full Operational Capacity, 2014
[3]: FAA Aerospace Forecast, Fiscal Years 2014-2034

Checkpoint Industry Day: June 15, 2015

(visit Fed Biz Opps for details – May 8 posting)

Questions?

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Carry-on Baggage Screening Comparison

	Current Screening	Current Pre ✓	Screening at Speed
Performance	• 445 to 495 items per hour (~3.3 items/passenger) • Liquids and laptops must be removed • "3-1-1" rule applies	• 450 to 540 items per hour (~1.8 items/passenger) • Liquids and laptops remain in bag • "3-1-1" rule applies	• Over 540 items per hour (~1.8 items/passenger) • Liquids and laptops remain in bag • No liquid size restrictions

Technology	• Few X-Ray views
	  • Less reliable automated threat recognition
	  • High false alarm rate slows throughput
	• Cannot respond to evolving threats
	• Must divest items from bag
		• Voluntary risk-based screening allows TSA to separate high-risk and low-risk passengers
		• Static capability
		• Accepting risk of limited divestiture from bags
			• Many X-Ray views
			• Use of orthogonal technologies (e.g. diffraction) improve ATD
			• Improved imaging and detection algorithms
			  • 50% fewer false alarms
			  • Higher throughput
			• Detects concealed threats

Challenges and Strategy	• Automated threat detection • "Few-view" reconstruction is impractical (~45 min)	• Less stringent security posture	• CT/Enhanced X-Ray and X-Ray diffraction performs automated threat detection • Compressive sensing and computation supports real-time implementations

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Everything stays in the carry-on bag = screening is faster

Passenger Screening Comparison

	Current Screening	Current Pre ✓	Screening at Speed
Performance	• 135-150 passengers/hour • Limited by frequent false alarms	• 250 passengers/hour • Only superficial screening (metal detectors)	• 300+ passengers/hour • Full screening and fewer false alarms

Technology	• Metal detectors
	• Millimeter wave and backscatter for anomaly detection
	  • Posing and 2-5s scan
	  • Full divestiture
		• Metal detectors
		  • Limited divestiture
			• Multi-band millimeter wave and terahertz technology for threat material identification
			  • Walk through at pace
			  • No divestiture

Challenges and Strategy	• Metamaterials transceivers are in their infancy • Poor image quality	• Less stringent security posture	• Multiband transceivers embedded in metamaterials provide enhanced detection capability

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No posing, No pausing

Secondary Screening Comparison

	Current Screening	Screening at Speed
Performance	• Threat detection requirements are not in agreement with primary screening capabilities • Trace uses a large number of consumables	• Align threat detection requirements with primary screening capabilities • Reduce consumables requirement for trace equipment
Technology	• Ion mobility spectrometry-based explosive trace detectors (ETDs) with direct contact sampling • Bottled liquid scanners (BLS) have bottle size and material limitations	• More chemically-selective ETDs (*e.g.*, mass spectrometers) with non-contact sampling • BLS handles multiple bottles at once, and wider variety of bottle materials
Challenges and Strategy	• Trace non-contact technologies are inefficient • Ion mobility spectrometers can support only limited libraries • BLS challenged by opaque bottles • BLS only scans one bottle at a time	• Non-contact trace collection technologies (*e.g.* vortex samplers) • Systems with 2x-3x threat library sizes (*e.g.*, mass spectrometers) • Robust X-Ray and optical techniques handle a wider array of bottle opacities • Algorithms for multi-bottle scanning

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Faster, more accurate response to a wider variety of threats