Exceptional service in the national interest

Sandia National Laboratories

DRAFT

Open Threat Assessment Platform

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U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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Context

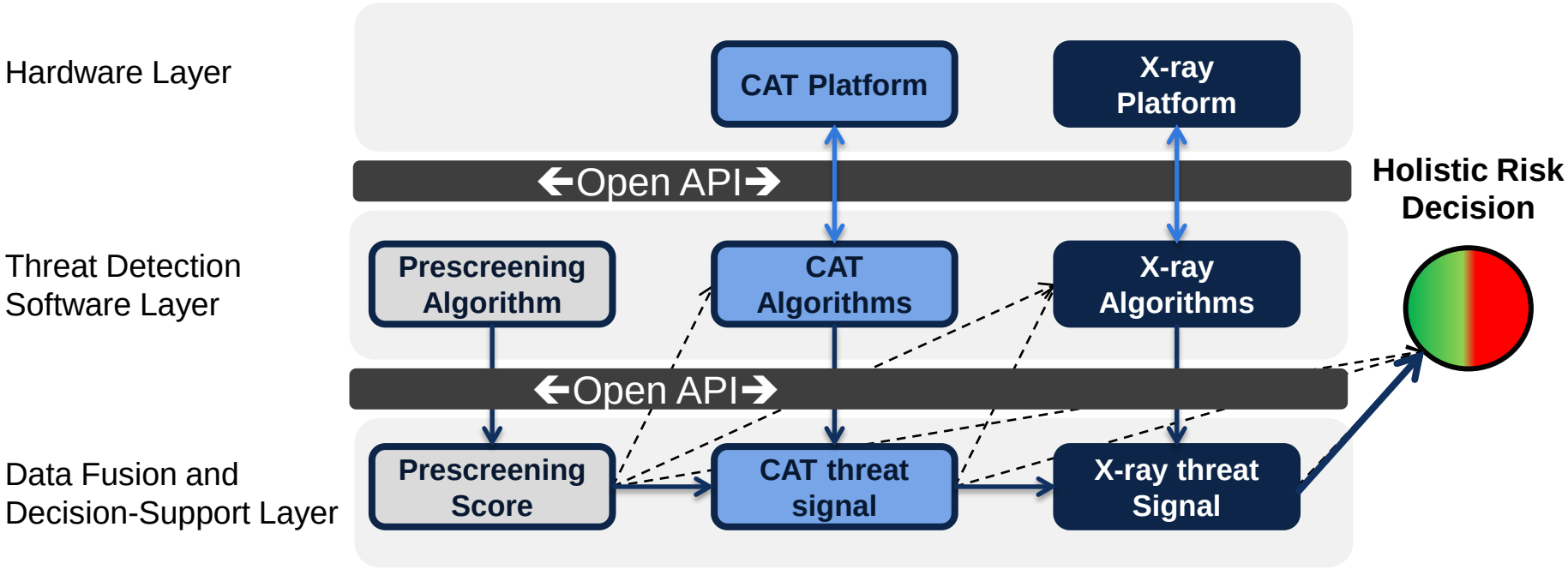
- ***TSA Capability Investment Plan is high-level roadmap we'll follow*** (Candid & Accurate)

- RBS: Moving the security/efficiency frontier
  - Lane configurations and staffing inflexibilities limit efficiencies
  - How good are current detection technologies anyway?

- ISIS and Foreign Fighters
  - How long do we have? What new expertise will they have?

- Industry landscape: Proprietary & Inflexible
  - "Currently capabilities qualify for procurement against a very specific set of threat and operational parameters and are highly proprietary solutions. The static and inflexible nature of these capabilities makes it difficult to adapt to changes in the aviation threat landscape in a timely, cost effective manner..."

Notional Dynamic RBS Screening Concept



The D-RBS architecture utilizes a common API to enable different logical layers of the system to communicate and dynamically screen passengers in real time. Data from multiple sources inform each successive step in the process, as well as the final risk decision.

Broad Vision

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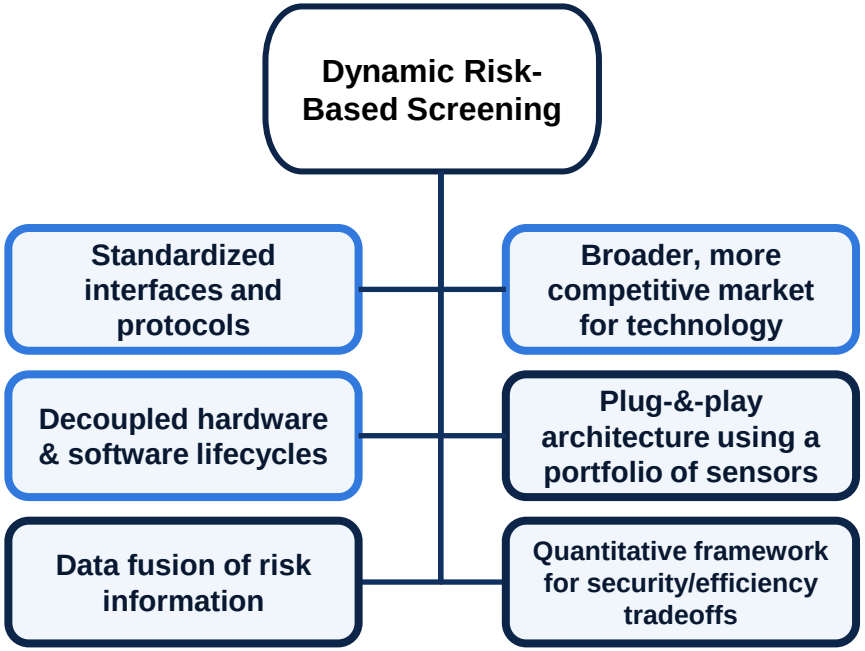
Dynamic Risk-Based Screening (D-RBS)
A system that leverages passenger risk information to dynamically screen each passenger at a level commensurate with that person's risk status and the current operational environment.



- Higher-efficiency screening
- Improved security
- Improved passenger experience
- Leverages expert TSOs
- Flexible screening that can be adjusted on the fly

OTAP Value Proposition

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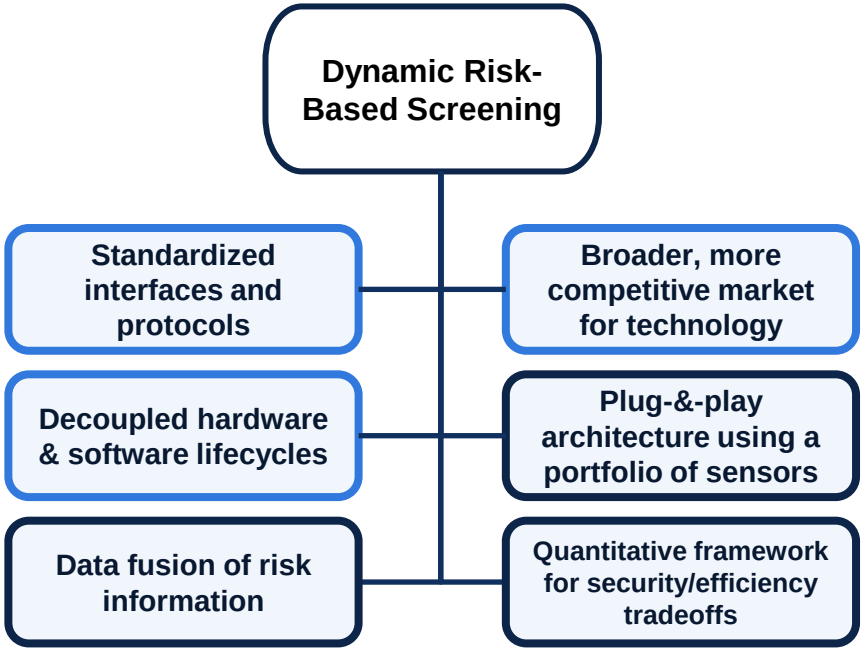
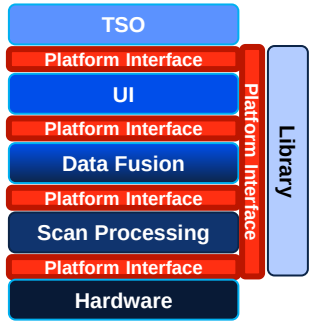
Prototype Value Proposition: A tactical step towards Dynamic Risk-Based Screening that creates a marketplace for software innovation: The prototype is the first step in decoupling the hardware and software innovation lifecycles, which lowers false positive rates and closes the gap between TSA and adversary innovation cycles.



The Open Platform is…

- **Plug-and-play**
- **Extensible**
- ***Technology-agnostic*** **(CT, x-ray, etc.)**



Feasible, Limited-Scope Prototype

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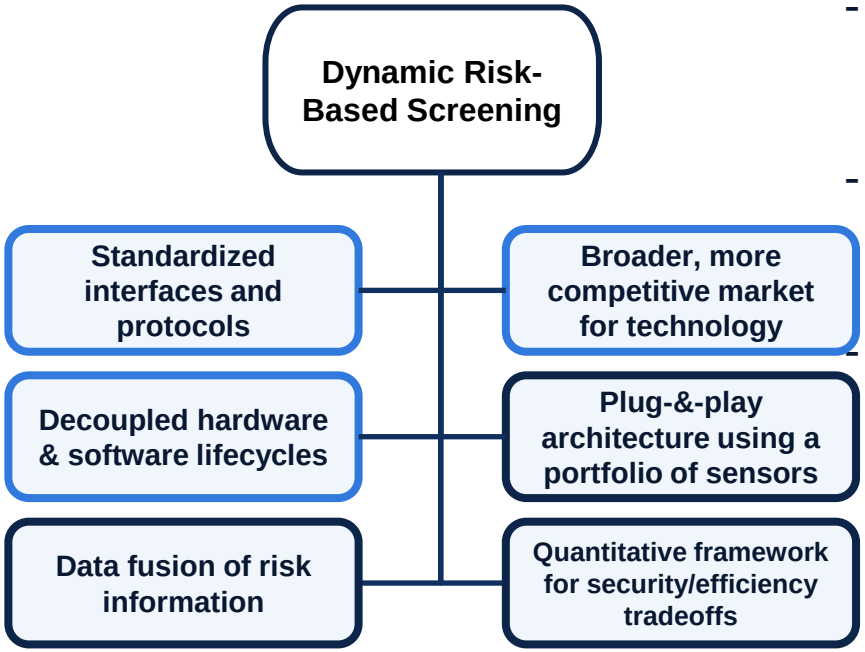
Open Threat Assessment Platform (O-TAP): An X-ray detection platform that utilizes an open API, standard data formats, and human-annotated images, to aid machine learning and human factors experts in developing algorithms that assist TSOs.



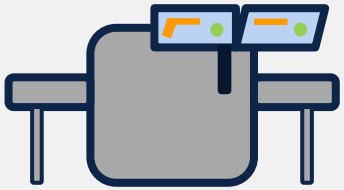
- Sets the foundational requirements for development of a D-RBS system
- Is a tangible deliverable that will clarify operational requirements

Utilizes an “accessible” X-ray sensor, which may be procured via:

- Vendors currently used by TSA
- Vendors not currently used by TSA
- In-house development
- Adjustments to existing equipment

Prototype Concept

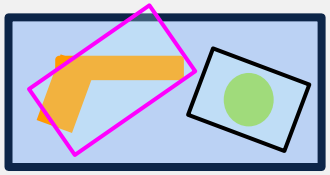
Develop API to a non-proprietary X-ray to decouple the hardware sensor and detection algorithm.



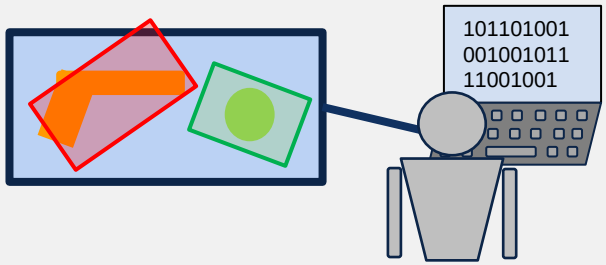
API

- Get_image()
- Get_data()
- Move_belt()
- Stop_belt()
- Annotate_image()
- …

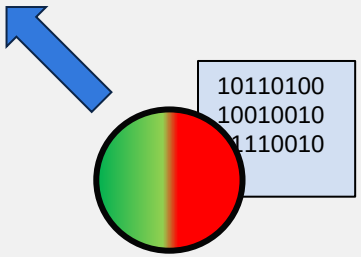
Detection algorithms annotate the X-ray image. Human factors metrics track TSO search performance.



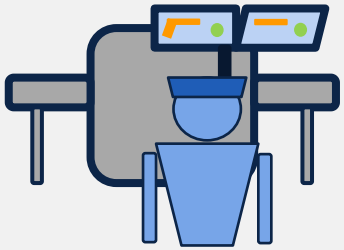
TSO provides ground-truth information to the image.



Developers use the ground-truth data sets and human factors research to improve the threat-detect assist algorithms.



Improved algorithm is deployed to the X-ray.



Open Platform System Architecture

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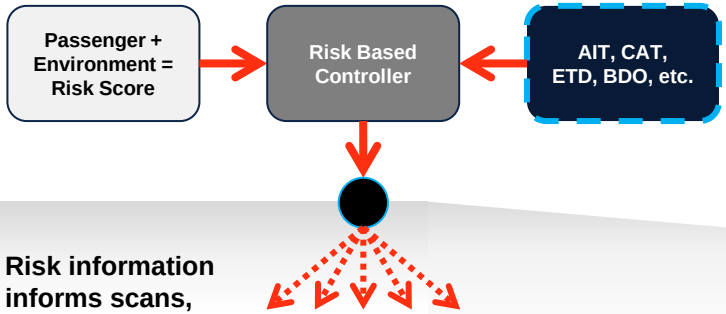

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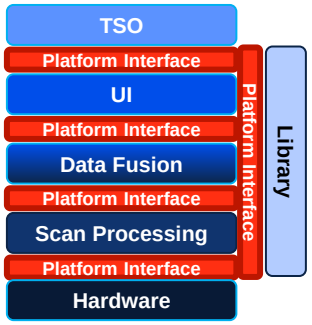
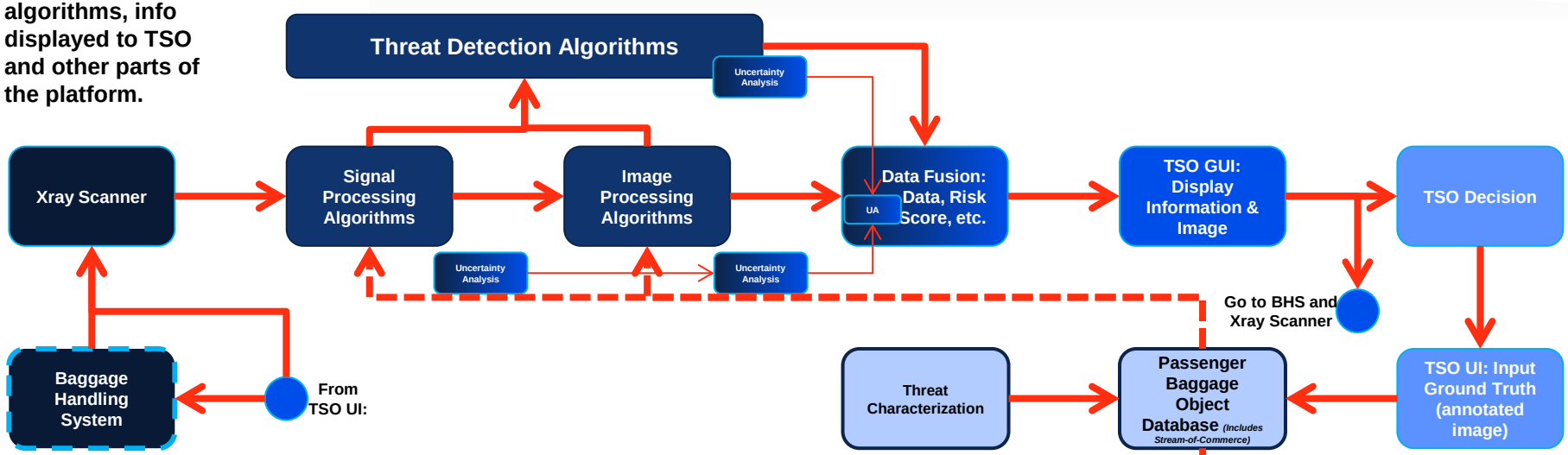


Risk information informs scans, algorithms, info displayed to TSO and other parts of the platform.



Simulator ***Human Factors Research***

Platform interfaces integrate each module, enabling an open architecture

Open Platform Interfaces (e.g. APIs)

The Open Platform: Technology Agnostic

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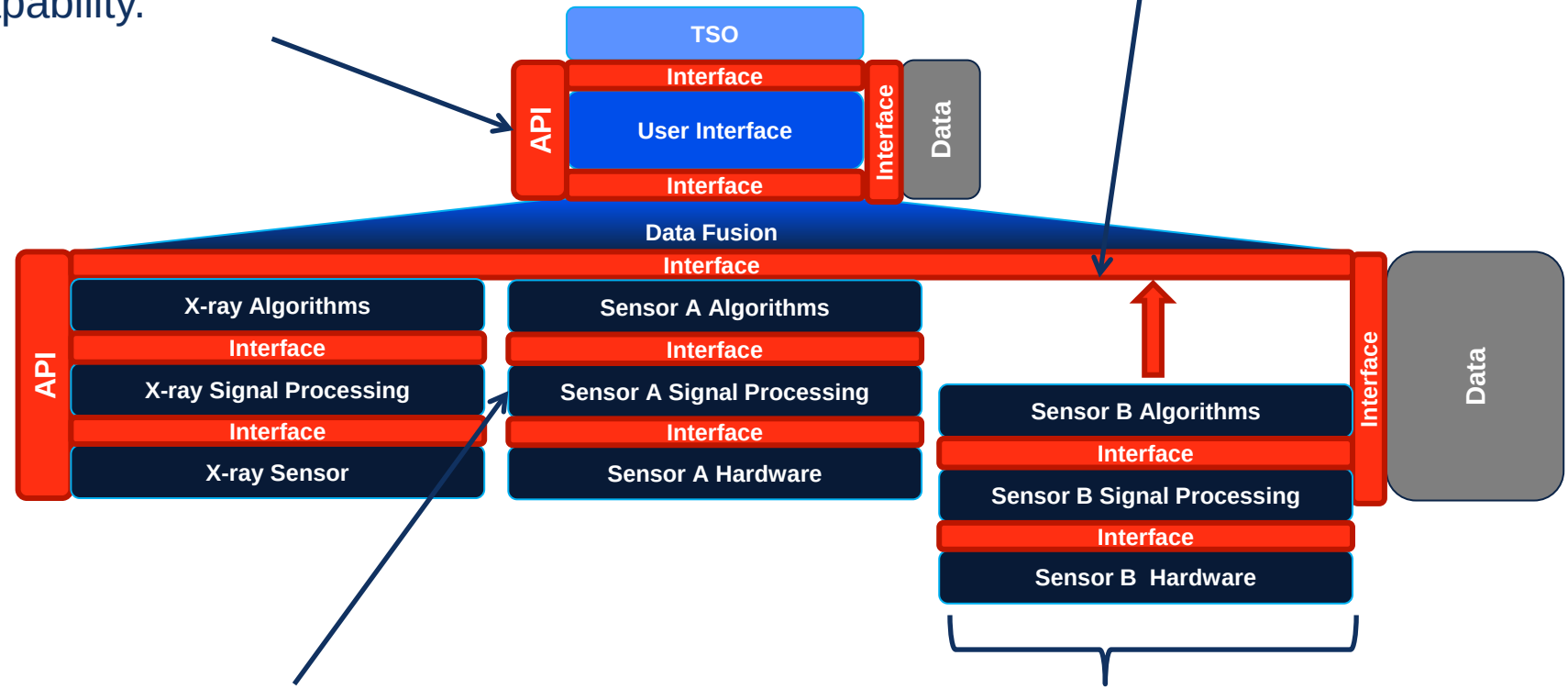
A common API and data formats make it easy for 3rd party developers to contribute capability.

The Platform's interfaces enable modules to communicate with each other. Modules can be swapped in & out.



The Platform's extensibility simplifies adding in new functionality.

Any sensor using the specified interfaces can be integrated into the Platform.

Value Chain

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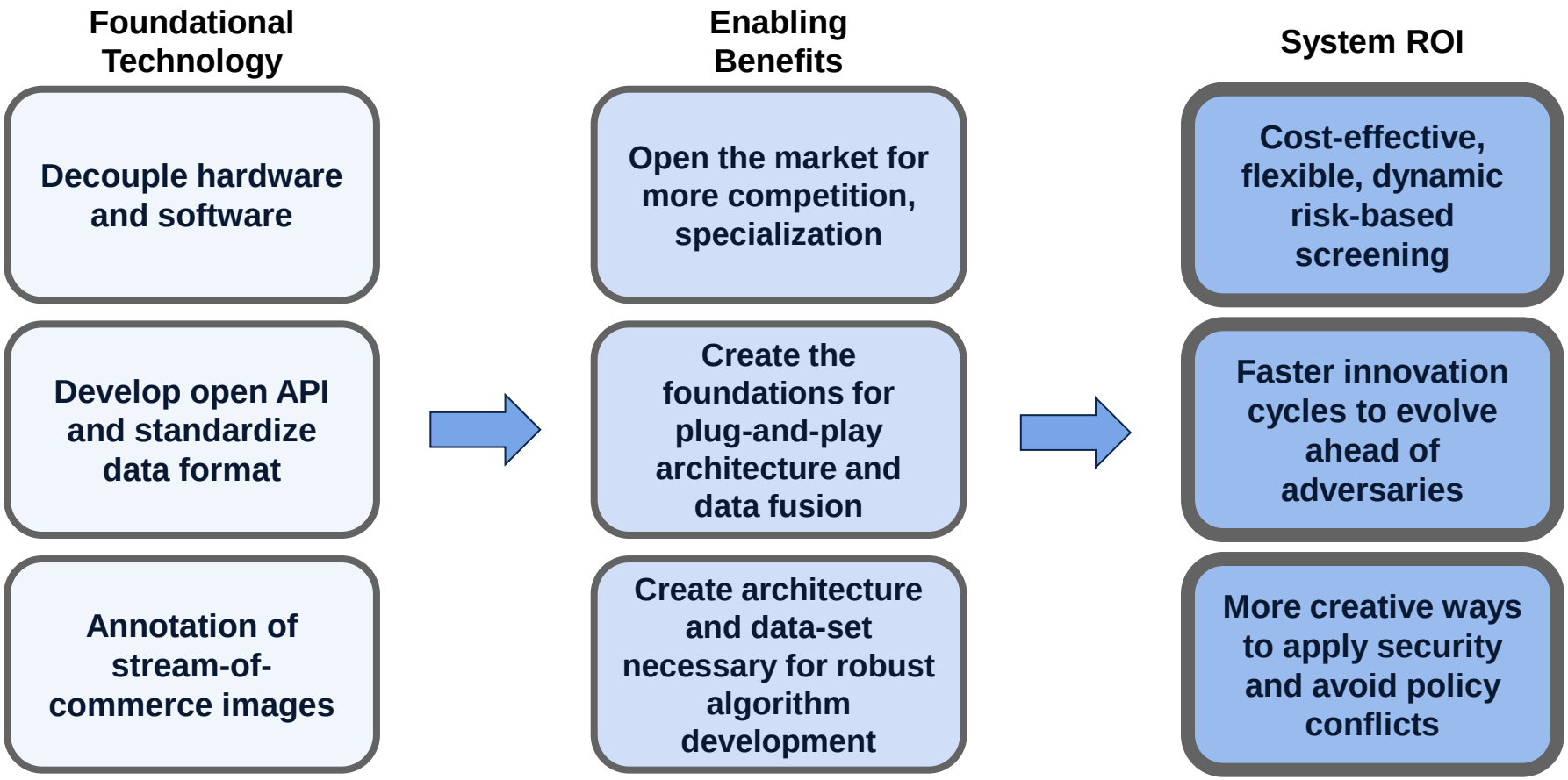

A dynamic risk-based screening (D-RBS) vision requires foundational changes in technology and architecture to drive changes in the market and ultimately changes in how a screening system can be assembled. Once achieved, better security, efficiency, passenger experience, lifecycle costs, and industry vitality are possible.

Strategy

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i. **Bring to bear existing private sector technologies and other lab expertise in a *systems integration* effort that produces a working prototype passenger baggage screening Xray**

ii. **No bi-lateral partnerships, no/few CRADAs; predominantly sub-contracts**
➔ **ensure accountability and reduce politics**

iii. **Modularize components of the Xray architecture to develop on parallel but coordinated paths; (but need strong systems integration and requirements to ensure they come back together)**

iv. **Expose developing modules to end-user interaction very early in TRL evolution**

v. **Partner with operators early in the process to validate requirements and test potential CONOPs**

Strategy

vi. **Sandia personnel mirror development for certain modules (ATR) to build formal and tacit knowledge that allows Sandia to be credible expert**

vii. **Ensure key components (esp. API, Data-sets) are open-source or freely available to restructure the marketplace**

viii. **Retain, build, and attract human capital within Sandia for this domain, build robust social network with burgeoning private-sector & academic community and understand how those partnerships *really* work.**

ix. **Utilize TSALT tools to scope requirements and demonstrate bang-for-buck of OTAP**

Team

Top notch team assembled and now actively working together to complete integration plan

Sandia Personnel	Expertise
Kyle Thompson	X-Ray & Computer Tomography Radiography
Ed Jimenez	Algorithm Development & GPU Computation
John Parmeter	Chemistry & Explosives Trace Detection
Brandon Gutierrez	Commercial X-Ray Systems & Explosives
Derek Trumbo	Software Development; Interface Development
Dave Stracuzzi	Machine Learning
Ann Speed	Cognitive Psychology & TSO performance
Andrew Cox	PI, Systems Analysis, & Integration
Philip Kegelmeyer	Machine Learning
Paul Smith	Technology Transfer

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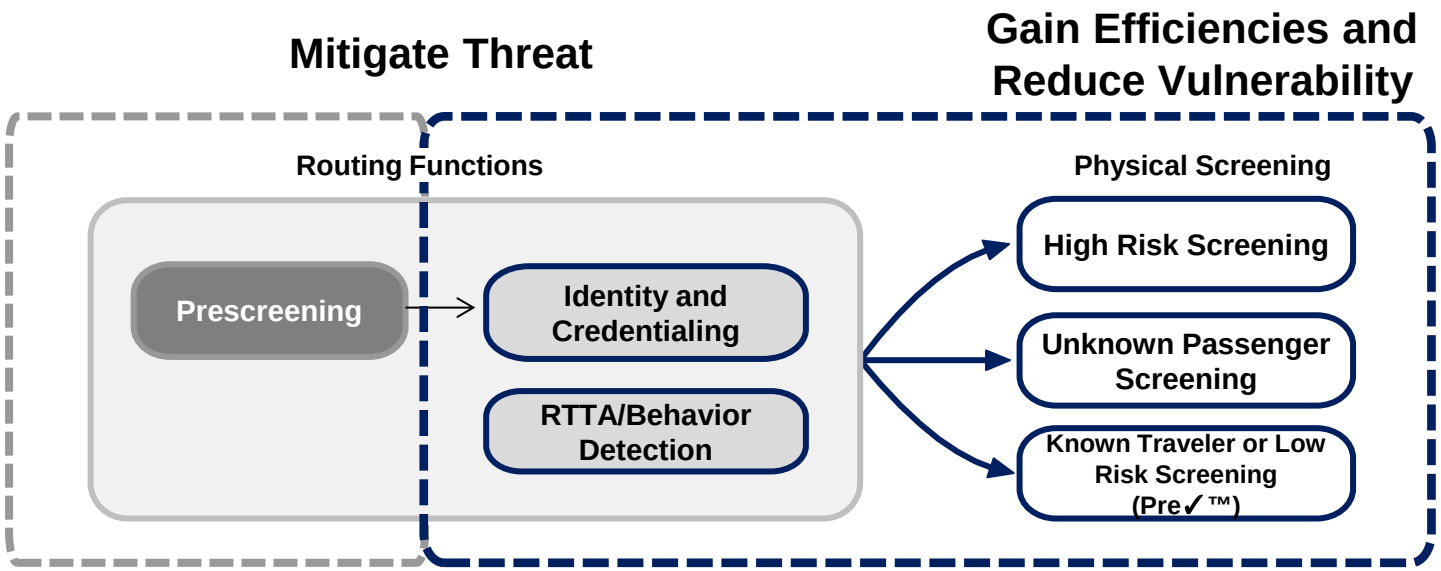
Backup Slides

Current RBS Screening Concept



"Lumpiness" of lane staffing limits efficiencies that can be gained since dedicated PreCheck lane must be manned by minimum number of TSOs	Dedicated lane is manifestation of one-size-fits-all for low-risk pax ➔ no ability to dynamically apply security	No data-persistence across the screening process to adjust screening	No easy, standard way to integrate new sensors ➔ Inflexible architecture	No layer to fuse data and make holistic decision

Future RBS Screening Concept

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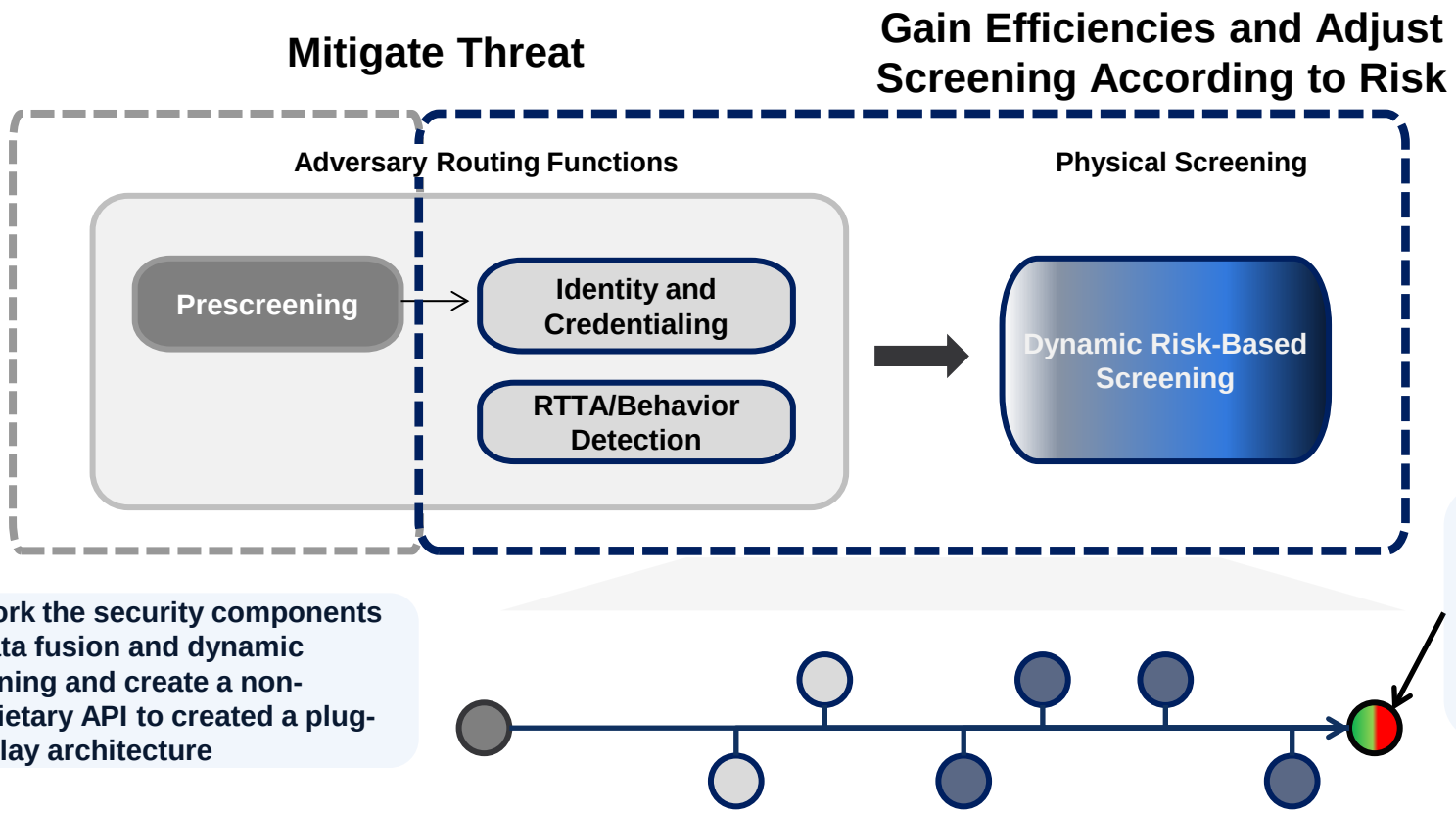

Introduce an API and IT architecture which allows for a) data persistence, b) data fusion, and c) dynamic physical screening based on risk. ***These foundational elements will enable the emergence of Dynamic Risk Based Screening***.

Implementation Case Studies

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- **D-RBS v1 (2006)**
- **BDO Rollout (2006-2011)**
- **Checkpoint Evolution (2008)**
- **AIT Rollout (2010)**
- **AT X-ray Rollout (2011)**

Main Finding: Creating and testing a prototype in the field before investing heavily in a new technology or system is crucial for success.

- Iterative operational testing of early prototypes uncovers issues—especially human factors issues—that were not predicted by simulations or controlled experiments

- Very early field testing saves time and money, and minimizes policy conflict

TSA Capability Investment Plan

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Aviation Threat Detection	Real Time Threat Assessment	Integration & Flexibility	Systems Engineering & Governance	Intermodal Threat Detection
(C) Minimize divesting requirements	(C) Enhance canine threat detection	**(T) Standardize tech. platforms, interfaces & data formats**	(A) Enhance risk assessment capabilities	Chem/Bio detection
(A) Enhance ETD system performance	**(T) Improve TSO screening performance**	(C) Improve TSA's T&E processes	(A) Improve OSC processes & operations	High-throughput detection
(C) Enhance checkpoint imaging/X-ray tech.	(A) Enhance behavior-based detection	**(C) Accelerate OSC's STIP**		Surveillance & anomaly detection
(C) Develop & deploy CAT				System resilience & recovery
(A) Enhance checked baggage tech.				

Key

Investment Need

- **Directly addressed by prototype**
- Influenced by prototype effort
- Not directly supported through this effort

Investment Type

(C): Core
(A): Adjacent
(T): Transformational