SAND2018-3073PE

Open Threat Assessment Platform (OTAP)

Data Collection Efforts & Passenger Baggage Object Database

March 23, 2018

Transportation Security Administration

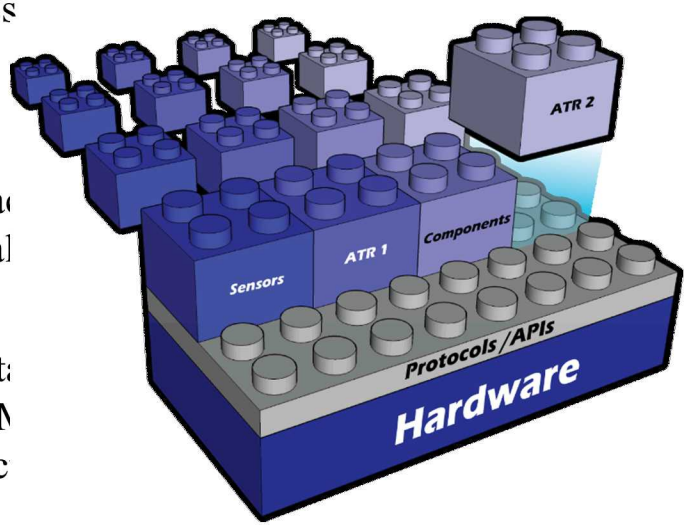
ORCA

OTAP Enables Flexible Combinations of Innovative Solutions

The OTAP project enables new solutions developed by industry (OEM *and* 3rd parties) by creating the tools to implement an *open system architecture*.

OTAP delivers the following:

- **Open Platform Software Library (OPSL)**: A set of open, commonly available, and standardized data interfaces, exchanges, and formats to enable engineering of 3rd-party components for seamless integration into TSE.
- **Mature Requirements for Open Architecture TSE**
- **Prototypes and Demonstrations:** The open architecture approac must be validated through implementation to ensure it is operational robust.
- **Passenger Baggage Object Database (PBOD):** A non-proprieta database of threat and SOC scans to enable 3rd parties and TSE OEM develop certifiable third-party ATRs and ATRs with improved detec capabilities. (PBOD transitioning to TSL).



How does Open Architecture change future technology?

E.g. TSA is looking to standardize the GUI on TSE such as EDS and AT which currently varies by OEM.
Benefit:
- Enhance TSO performance
- Reduce operations training

TSE modularity allows 3rd party to develop new sensors or algorithms that can be plugged into TSE.
Benefits:
- Foster greater vendor competition, enhance innovation, & expedite capability delivery by expanding market/vendor base.
- Provides the flexibility to implement new sensor components and algorithms screening.

A set of open, commonly available, and standardized data interfaces and formats developed by TSA.
Benefits:
OPSL will serve as an interface to enable engineering of 3rd party components

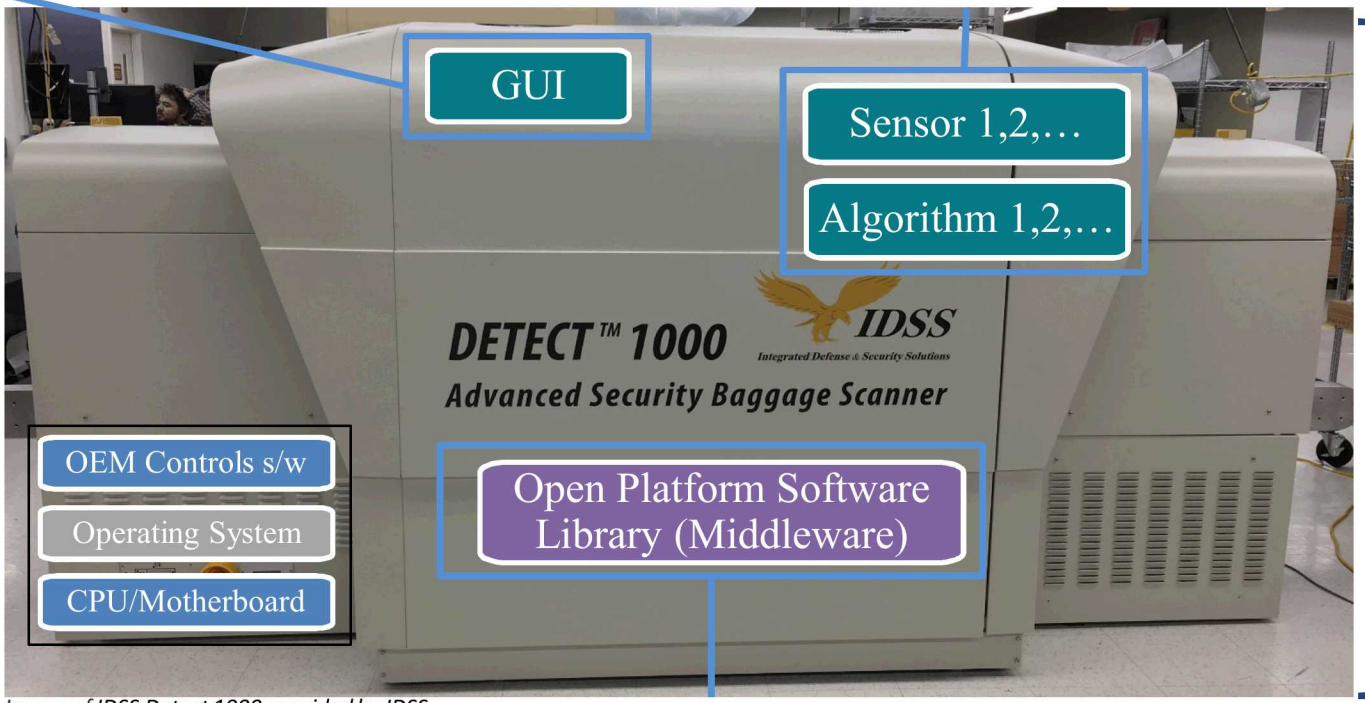


Image of IDSS Detect 1000 provided by IDSS

Key
- TSA-Developed
- OEM-Developed
- OEM or 3rd Party

Transportation Security Administration

Office of Requirements and Capabilities Analysis ORCA

OTAP Project

OTAP enables the implementation of new solutions developed by industry (OEM *and* 3rd parties) by creating the tools to implement an open, modular architecture within TSE.

Core OTAP Elements

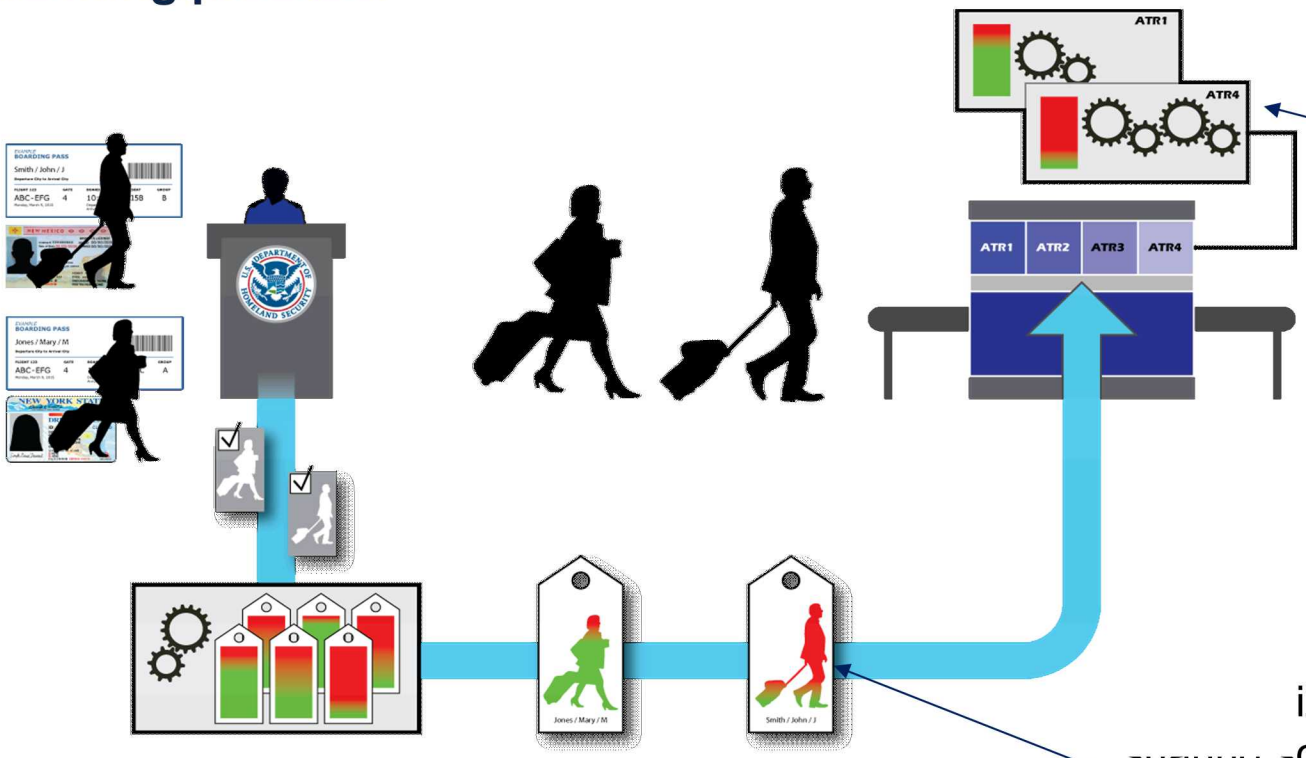
Open Platform Software Library (OPSL)	Set of open, commonly available, and standardized data interfaces, exchanges, and formats
Passenger Baggage Object Database (PBOD)	Repository of X-ray-scanned outputs of potential threats, info on non-threats, & any associated metadata used to train algorithms
ATR Algorithm *Integration*	Set of software applications that process the various signal outputs of X-ray scanners to provide threat ID support
3rd Party Hardware Component *Integration*	Integration of 3rd party specialized hardware component on an OTAP-enabled system

Current Status

- ***Completed OPSL 1.0. Focus on 3rd party ATRs. Ready for release upon TSA review***
- ***Successfully implemented 3D annotation tool and data collection applications at Tyndall***
- Developed seven scan plans for OTAP/PBOD data collection
  - Scan Plans for collection were aligned with CT at Checkpoint Data Collection Plan for Tyndall
  - Initial Data set has been processed
- Collecting data for PBOD database from vendors at Tyndall (IDSS and Analogic)
- Continuing OPSL 1.0 setup on IDSS machine in Boston

Open Architecture Enables More Flexible CONOPs

OTAP creates plug-and-play capability occurs at the *TSE and screening system* level, easing the ability to add new technologies and re-engineer the screening process.



Transportation Security Administration

Office of Requirements and Capabilities Analysis ORCA

Data Collection

There are several threat and stream of commerce data collection efforts that are currently ongoing. The OTAP contract is currently only funded for collecting threat images at Tyndall for use with PBOD.

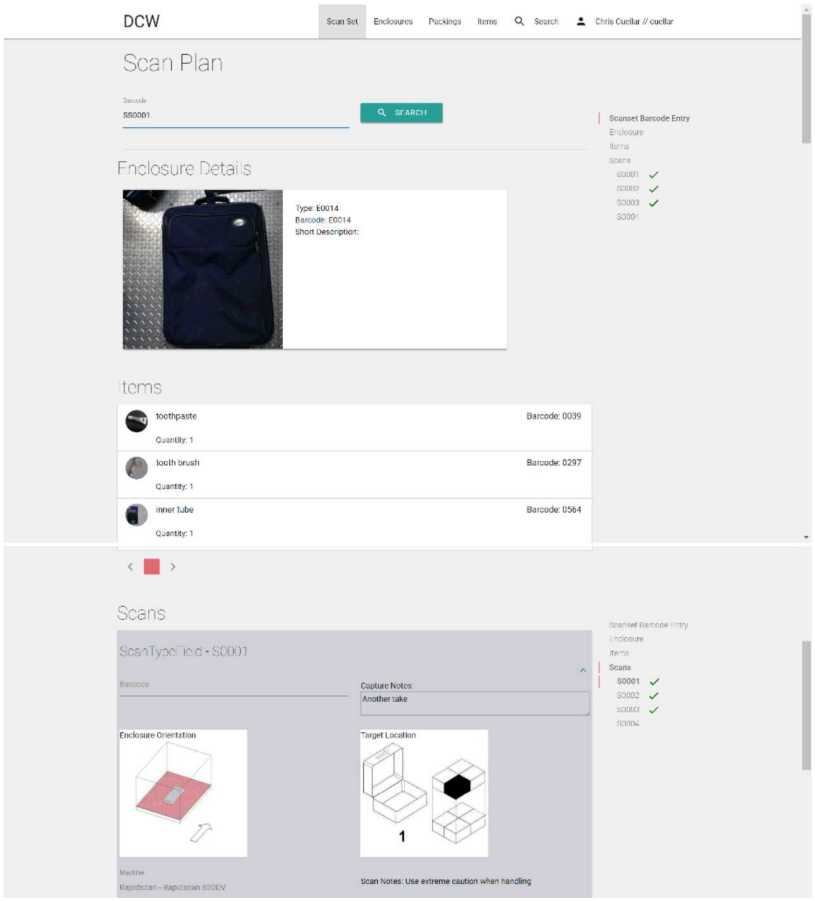
Data Collection Effort	Description
OTAP/PBOD	The collection, annotation, and storage of explosive data at Tyndall. The data is stored in a common image format and shared with third party algorithm developers.
APSS	The collection of military, commercial, and homemade explosives data at TSL and Tyndall according to the APSS Detection Standard. The data is in a proprietary format. Analogic and IDSS data is also converted to DICOS and can be used for PBOD.
Sandia Stream of Commerce (SoC)	SoC refers to the collection of images without any threat items to support machine learning and APSS CT Window 2 efforts.

Collaboration

- While the OTAP Program's focus is on threat data collection, OTAP can leverage the data being collected in the Stream of Commerce and APSS efforts after converting the data into a common format
- Stratovan is currently working with Analogic on applying algorithm to checkpoint CT under the APSS Contract

Passenger Baggage Object Database (PBOD)

- Database of annotated (ground-truthed) scans of threat and non-threat passenger bags. Data features include:
  - Threat (size, type): obfuscated to avoid classification issues
  - Ground truth annotation + picture
  - Clutter/packing items: barcoded listing of packed items for each bag
  - Orientation
  - Scanner meta-data (machine type, energy, etc.)
  - Scans in DICOS format
- Intended for distribution to vetted 3rd party ATR developers



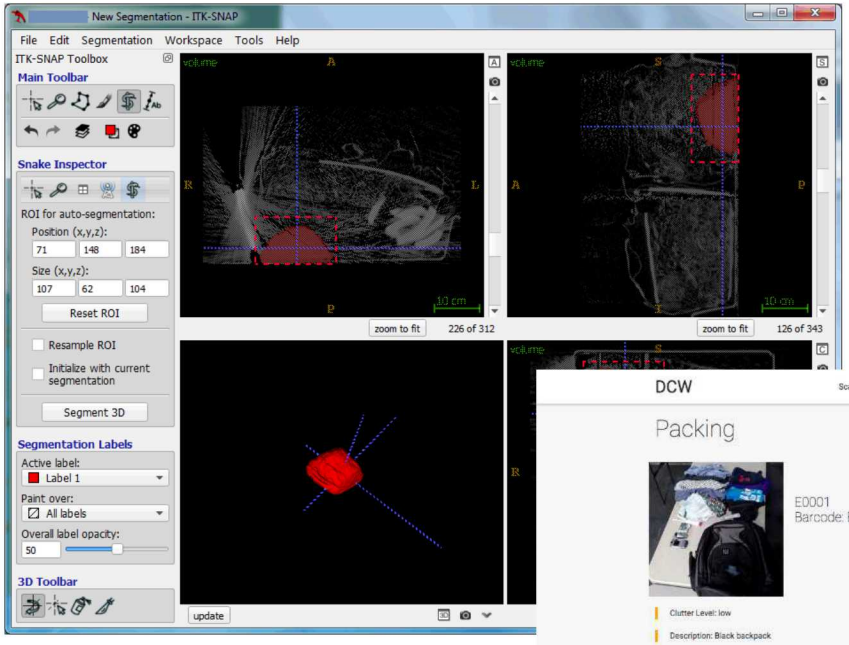
Transportation Security Administration

Notional Data

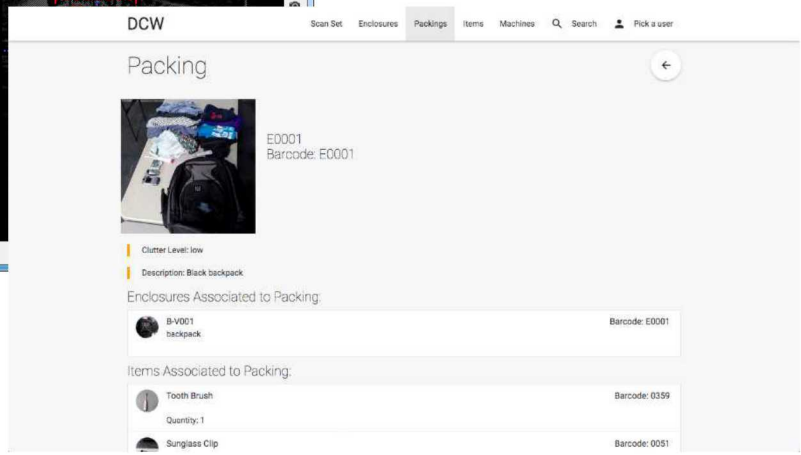
Office of Requirements and Capabilities Analysis ORCA

PBOD Tools

1. Annotation Tool (built on ITK-Snap)
2. Inventory tool (including barcode reader functionality, & picture assist)
3. DB & Search front-end



Notional Data



PBOD Tools designed to i) ensure quality of data and ii) make collection process more cost-effective

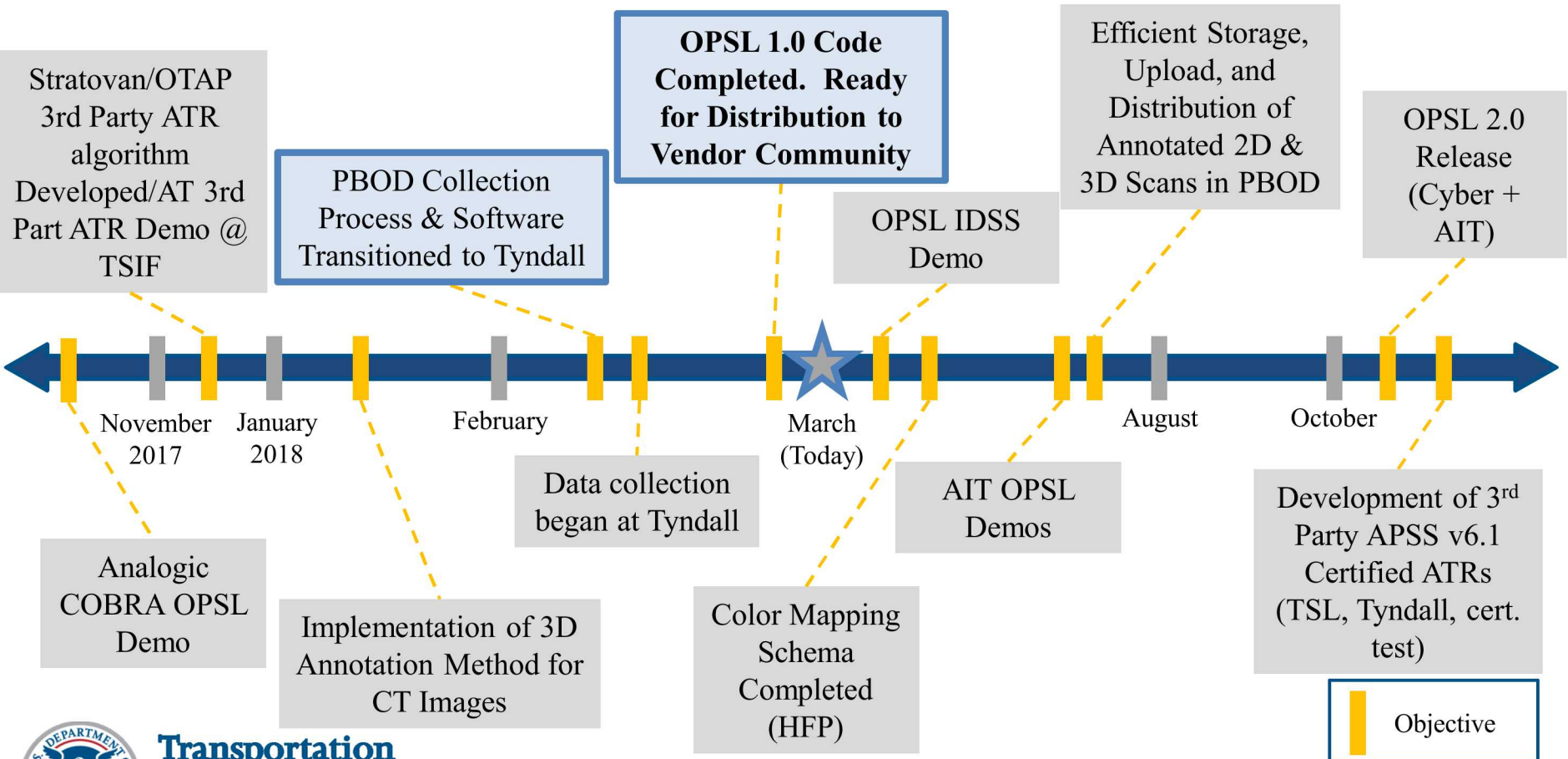
MRAD (Means for Rapid ATR Development)

- Run multiple 3rd-party ATRs against PBOD scans drawing directly from the PBOD DB to calculate performance metrics.
  - Avoids manual testing and all the errors that are attendant with manual processes while providing ATR feedback within a day or less
  - (More work planned this summer to fully accommodate CT and AIT data)

Notional Data

OTAP Objectives & Timeline

Recent wins, such as Stratovan's development of a system agnostic ATR, have verified the remaining OTAP objectives for 2018 and serve as stepping stones to achieve an open, modular architecture.



Transportation Security Administration

Office of Requirements and Capabilities Analysis ORCA

Striving Towards an Open Architecture

Successful demonstrations of OTAP elements have served as incremental progress towards achieving a modular, open architecture in which system upgrades can occur seamlessly and rapidly.

3rd Party Algorithm Development

Stratovan successfully designed and developed a 3rd party prototype ATR and ran the algorithm on Rapiscan and Smiths /Morpho 9800 CT machines.

- ✓ Delivered a 3rd party vendor-neutral ATR system with comparable detection performance on single-energy data at the 75% and 50% threat mass level
- ✓ Developed a system applicable to checked baggage, CT-based air cargo, and CT-based checkpoint
- ✓ Utilized machine learning based detection with automated training/testing and minimal data requirements

OPSL 1.0 Demonstrations

OPSL hardware and software was delivered to Boston for a demonstration on an IDSS machine. (Analogic COBRA OPSL demo completed in August '17)

- ✓ Accepts DICOS data input and bolt-on 3rd party ATRs enabled by OPSL 1.0.
- ✓ Also provides basic 3rd party viewer, command-and-control, archiving, and risk-based screening modules.
- ✓ OPSL 1.0 will include specific documentation on OPSL-compliant DICOS formats to streamline the process for vendors to integrate with OPSL

3rd Party ATR Development for AIT

Vetted vendors are provided OPSL-compliant, DICOS format data to develop system agnostic algorithms. As OPSL and DICOS mature, the ATRs developed will integrate into the systems more efficiently and increase P(d) while decreasing P(fa).

OPSL Enabled HD- AIT with 3rd Party ATR

Developing OPSL software for AIT modularization to enable the incorporation of 3rd party algorithms

- MVP: Demo using OPSL and a test ATR able to be executed on a live AIT

A'-A' Format Demo on HD-AIT

Developing and validating a draft specification to format raw data derived from HD-AIT detectors

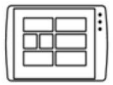
- MVP: Basic reconstruction algorithm or ATR produced by performer or 3rd party using the A'-A' format

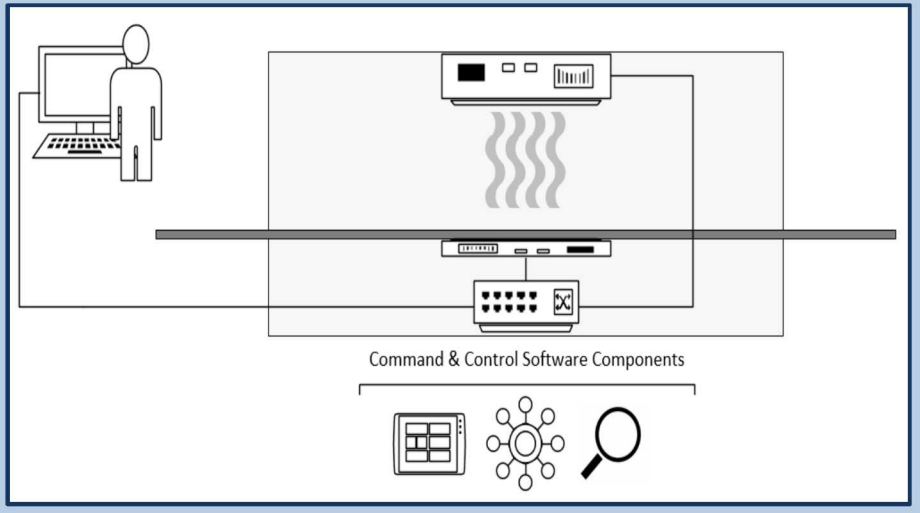
AIT Kaggle competition has provided the opportunity to demonstrate A'-A' format to construct 3rd party ATRs.

Planned Work: TSA/OAPM/AIT is seeking to modularize the current AIT and deploy some of the winning Kaggle ATRs

Modular Architecture

OTAP introduces modular components by defining system infrastructure and interfaces which enables plug-and-play functionality and increases system flexibility.

Hardware Components		Software Components	
Symbol	Component	Symbol	Component
	X-Ray/CT Sensor		Open Platform Software Library (OPSL)
	Baggage Handling System (BHS)		3rd Party Algorithm (ATR)
	Command & Control Unit		System Controller (GUI)
	Display/TSO Work Station		



Serving as both a file format specification and middleware, OPSL is a key element of OTAP that will serve as an interface to enable the engineering of 3rd party components.