Adaptive Automated Threat Recognition (AATR) – Introduction

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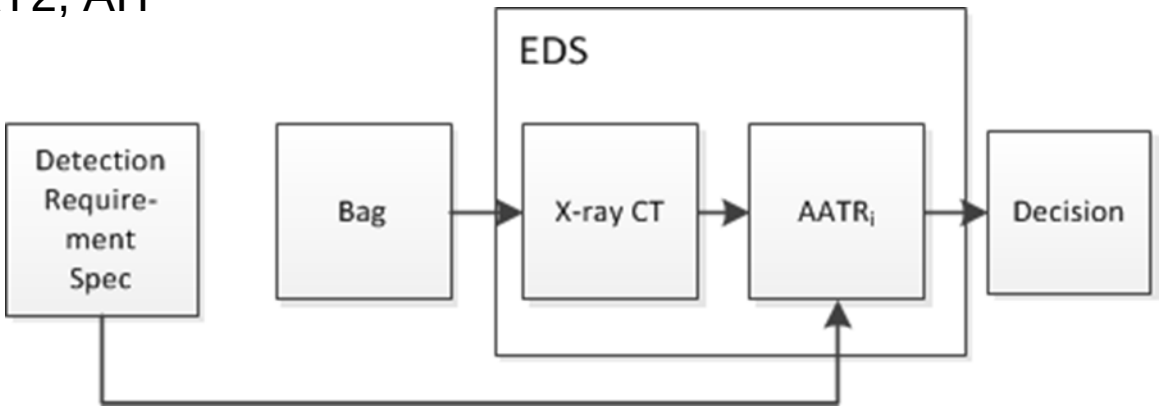
So What? Who Cares?

- Space: CT-based explosive detection scanners (checked and carryon) with automated threat recognition (ATR)
- Problem: Takes too long to field ATRs based on emerging threats from adapting adversary
- Part of the solution: Adaptive automated threat recognition (AATR)
  - Automatically adapt to computer-readable detection requirement specification
  - Goal: same-day deployment of new AATR after new threat identified
- Status: ALERT & LLNL funded to develop requirements, algorithms, metrics and testing methods for AATRs
- TSA benefit: Faster response to emerging threats, trade PD/PFA, change min mass, min sheet thickness
  - Also applicable to AT2, AIT



ADSA Format

- This is a workshop, not a conference
  - Speakers are instructed to begin with “So What? Who Cares?” (elevator speech)
    - Crawford bears responsibility for format (and agenda)
  - Conversation and questions are expected at all times, especially during presentations after first slide
  - Optimal presentation ends after first slide
- Public domain – no SSI or classified material
- No speaker introductions; read handouts

Goal

- Vendors deliver an automated system (or tool, process, denoted AATR) that can be used to create new ATRs.
- ATRs developed without extensive training data and without rigorous TSL testing
  - ATRs can be refined with additional training data and testing
  - AATRs may be complementary to traditionally certified ATRs or could be standalone depending on CONOPS and performance.
- Hence, time from identification to deployment is reduced
- Most of the ~20 steps used today would be eliminated
  - Steps may need to be eliminated if Intel says that country being attacked with new threat
  - High PFA may be acceptable with adapted ATR

Objects of Interest (OOI)

- Data:
  - TO4: 188 SSNs -> Clay, Saline, Rubber (training)
  - TO7: 101 SSNs -> m1, m2, m3, m4 (sequestered)
  - Scanned on medical CT scanner

OOI	Min Density [MHU]	Max Density [MHU]
m1	380	525
m2	770	810
m3	1300	1375
m4	1350	1430

Object Requirement Spec (ORS)

- Types of threat classes
- For each class
  - Minimum mass
  - Minimum thickness (sheets only)
  - Density range
  - Coefficient for calculating weighted PD
  - PD per class
  - Texture: no spec at present
- PFA
- Computer readable

Adaptability Metrics (AM)

- AMs
  - PD when varying PFA
  - PD/PFA when varying specified OOIs
    - Clay: OOI -> confuser
  - PD/PFA when varying relative weighting (contribution) of a specified OOI
  - PD/PFA when varying specified minimum mass
  - PD/PFA when varying specified minimum thickness
  - PD/PFA: OOIs not found in training data

Adaptability Metrics: PD/PFA function different ORSs

Performer Training / TO4 Data

AM 1: AROC

OOI	Required PD [%]	Required PFA [%]	AATR PD [%]	AATR PFA [%]
S	0.7	0.02		
S	0.8	0.05		
S	0.85	0.08		
S	0.9	0.1		
S	0.95	0.2		

AROC	<insert value here>

AM 2: PD/PFA for Varying OOIs (ORS #1

OOI	Required PD [%]	Required PFA [%]	AATR PD [%]	AATR PFA [%]
C,S, R	90	10		
C	90	10		
S	90	10		

AM 3: Varing PD Weight

OOI	Req PD [%]	Req PFA [%]	AATR PD [%]	AATR PFA [%]
C, S	C:90, S:90	10	C: xx, S: xx	
C, S	C:20, S:90	10	C: xx, S: xx	
C, S	C:90, S:20	10	C: xx, S: xx	

AM 4: PD/PFA for Varying Mass

OOI	Min Mass [g]	Required PD [%]	Required PFA [%]	AATR PD [%]	AATR PFA [%]	Incremental Mass Rnge [g]	AATR Incremental PD [%]
S	400	90	10			N/A	N/A
S	300	90	10			300 - 400	
S	100	90	10			100 - 300	

AM 5: PD/PFA for Varying Thicness

OOI	Min Thickness [mm]	Required PD [%]	Required PFA [%]	AATR PD [%]	AATR PFA [%]	Incremental Thickness Rnge [mm]	AATR Incremental PD [%]
R	10	90	10			N/A	N/A
R	6.5	90	10			6.5 - 10	
R	0	90	10			0 – 6.5	

ALERT Testing / TO7 Data

AM 2: PD/PFA for Varying OOIs

OOI(s)	Required PD [%]	Required PFA [%]	AATR PD [%]	AATR PFA [%]
m1	90	10		
m2	90	10		
m3	90	10		
m4	90	10		

Performers - AATR

- David Castanon, Boston University
  - Trent Montgomery
- Toby Breckon, Durham University, UK
  - Qian Wang, Khalid Ismail
- Dong Hye Ye + Charlie Bouman, Purdue University
- Dave Paglieroni, Lawrence Livermore National Laboratory (LLNL) (funded by EXD)
  - Hema Chandrasekaran, Christian Pechard, Harry Martz
- Avi Kak, Purdue University (unfunded participant)
  - Ankit Manerikar

Performers - Support

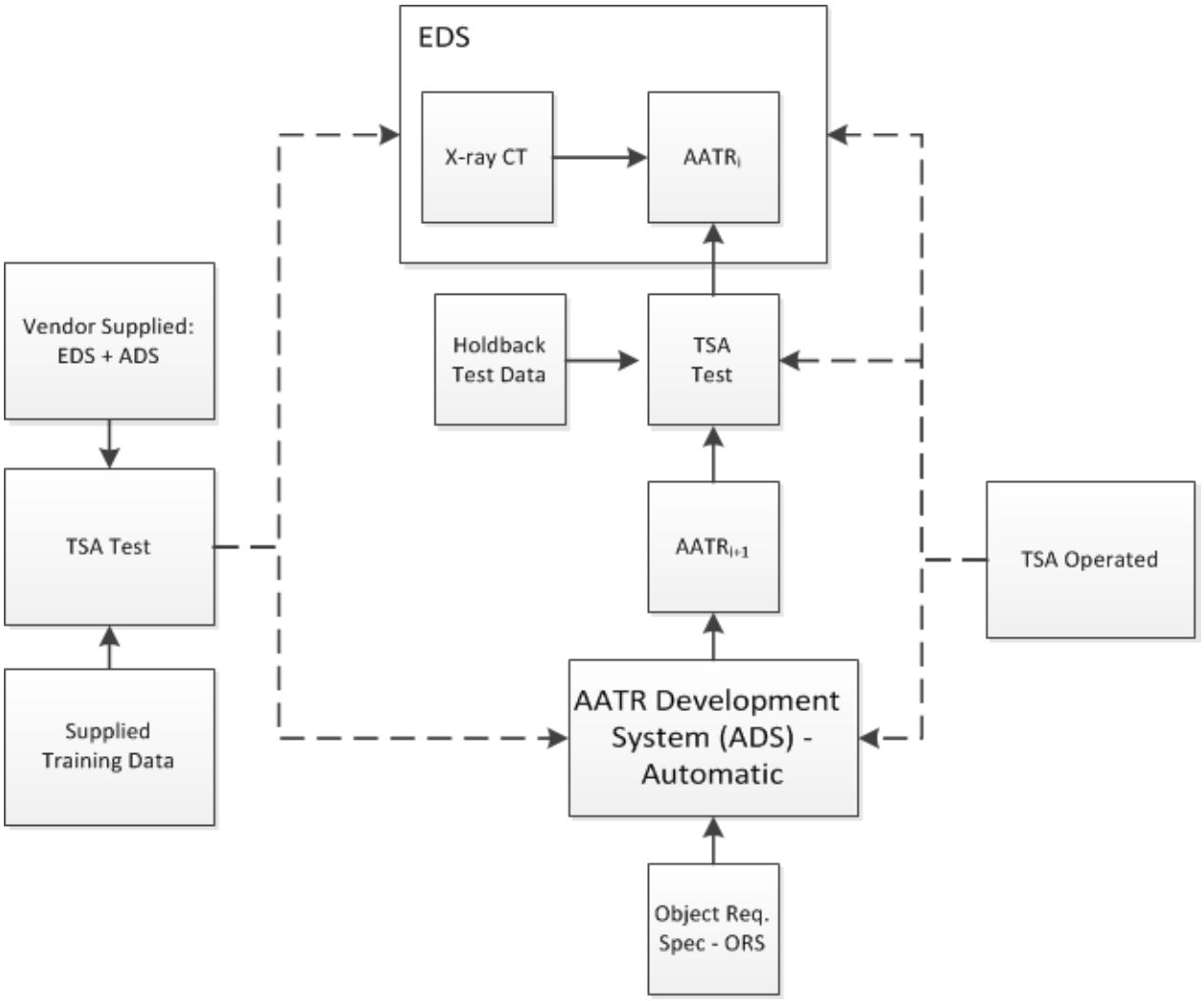
- Tools
  - Franco Rupcich, Cich Solutions
- Technical Leads
  - Carl Crawford, Csuptwo
  - Harry Martz, LLNL
  - David Castanon, Boston University

Acknowledgements - Logistics

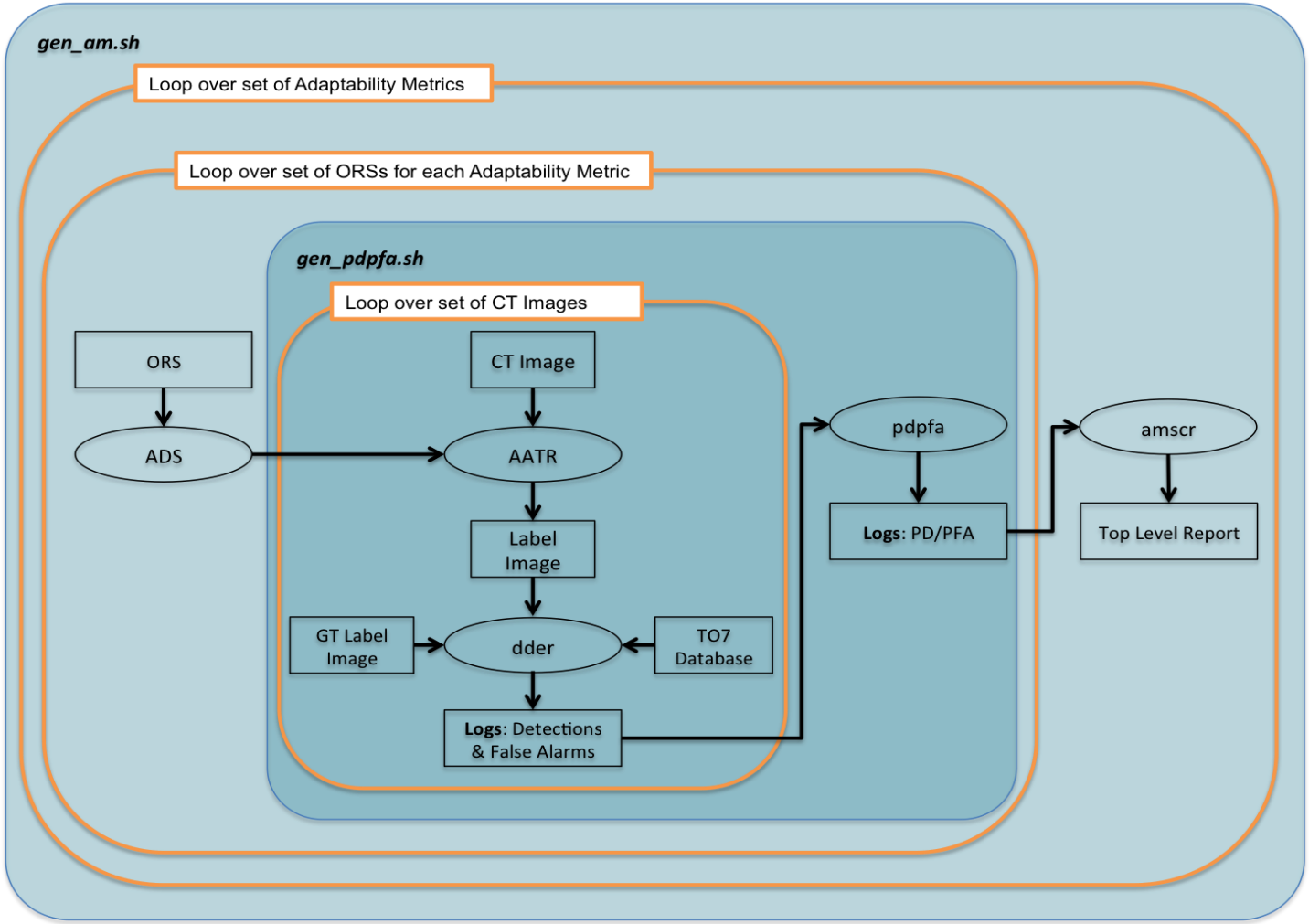
- Melanie Smith, lead
- Tiffany Lam
- Deanna Beirne
- Kristin Hicks
- Anne Magrath
- Pooja Ravichandran
- Sara Baier

BACKUP SLIDES

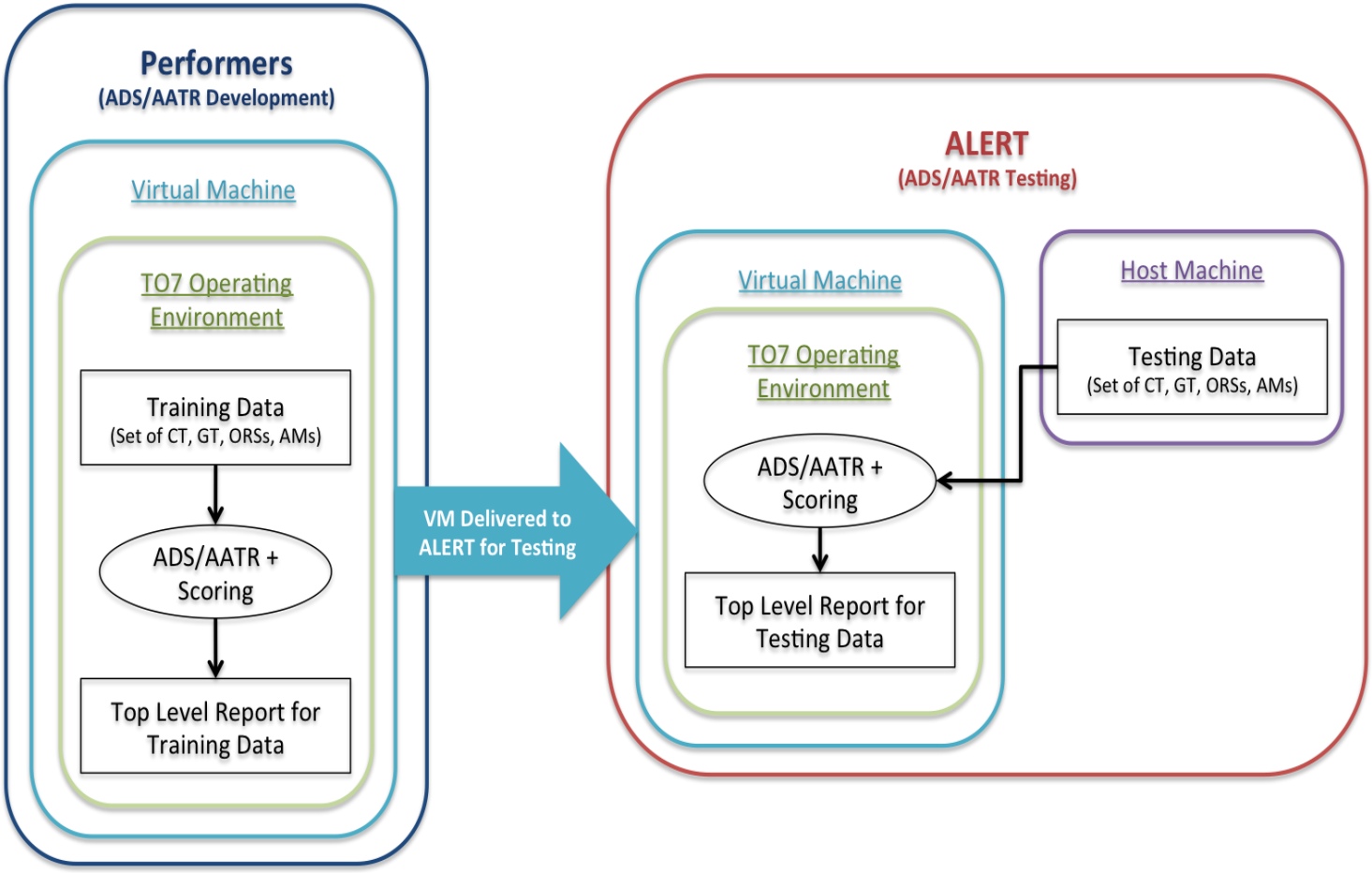
Potential TSA Usage



Test Environment Implementation



Virtual Machine - Testing



Testing performed in phases (steps) to allow debugging and improvements.

Support Functions (Tools)

- Sample ATR
  - Reading image; Writing results (label, log files)
  - Replace ATR functions with your own
- Sample ADS
  - Interfaces to tools and to sample ATR
- Scoring software
  - Detection using recall/precision
  - PD/PFA
  - Compiles results from all runs & AMs into single Top Level Report
  - Must run in Linux
- Master driver program
  - Runs ADS/AATR for different detection requirement specs
- Simulated images for validation available
- Image conversion to FITS
- Ground truth - Mevislab

Performer Training / TO4 Data

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C, S	C:20, S:90	10	C: xx, S: xx	

AM 4: PD/PFA for Varying Mass

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