PSCR ANALYTICS

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The Role of Analytics in Public Safety

Analytic technologies will be part of every stage of the public safety communications workflow

*R&D to support an effective public safety **real-time** analytics ecosystem is critical*

Technology needs identified in

- **2016 Analytics R&D Roadmap and 2016 Analytics Summit Report** https://www.nist.gov/ctl/pscr/public-safety-analytics-publications
- **VAPS 2016 Workshop Report:** www.nist.gov/file/346141 and www.dhs.gov/sites/default/files/publications/First-Workshop-on-Video-Analytics_508.pdf

Why Public Safety Analytics Now?

- **Computing power**, networking, and storage enabling massive real-time processing
- A **broadband Public Safety network** taking form enabling high-speed communications
- **Consumer** camera **technology**, mobile phone technology, and gaming processors accelerating hardware technology development
- **Sources of public safety data are exploding** and on the move. Public Safety depends on vast amounts of video data, social media, 911 calls and multimedia apps, responder communications, weather and traffic data, and a variety of logistical data for situation awareness and volumes of policy and procedural data for response.
- Research in a host of **analytics technologies are maturing**
- **Brain-inspired AI technologies** for “teaching” analytic software to understand the complexity of the world **are quickly evolving and scaling**
- **Public Safety needs related to real-time data analysis are sharply increasing**, need to leverage technology to **detect and analyze emergencies in real time**.

PSCR Analytics Portfolio Strategy

Focus: increasing automation to **identify and analyze emergency events** in **real-time** from a **large number of data streams** and **provide first responders with actionable information**.

Optimize data for downstream analysis

- quality/communications/encoding and understand analytic limitations

Analyze all streams effectively in real time

- information sorting, filtering, event detection and characterization

Provide **integrated information analysis**

- fused data analytics across streams

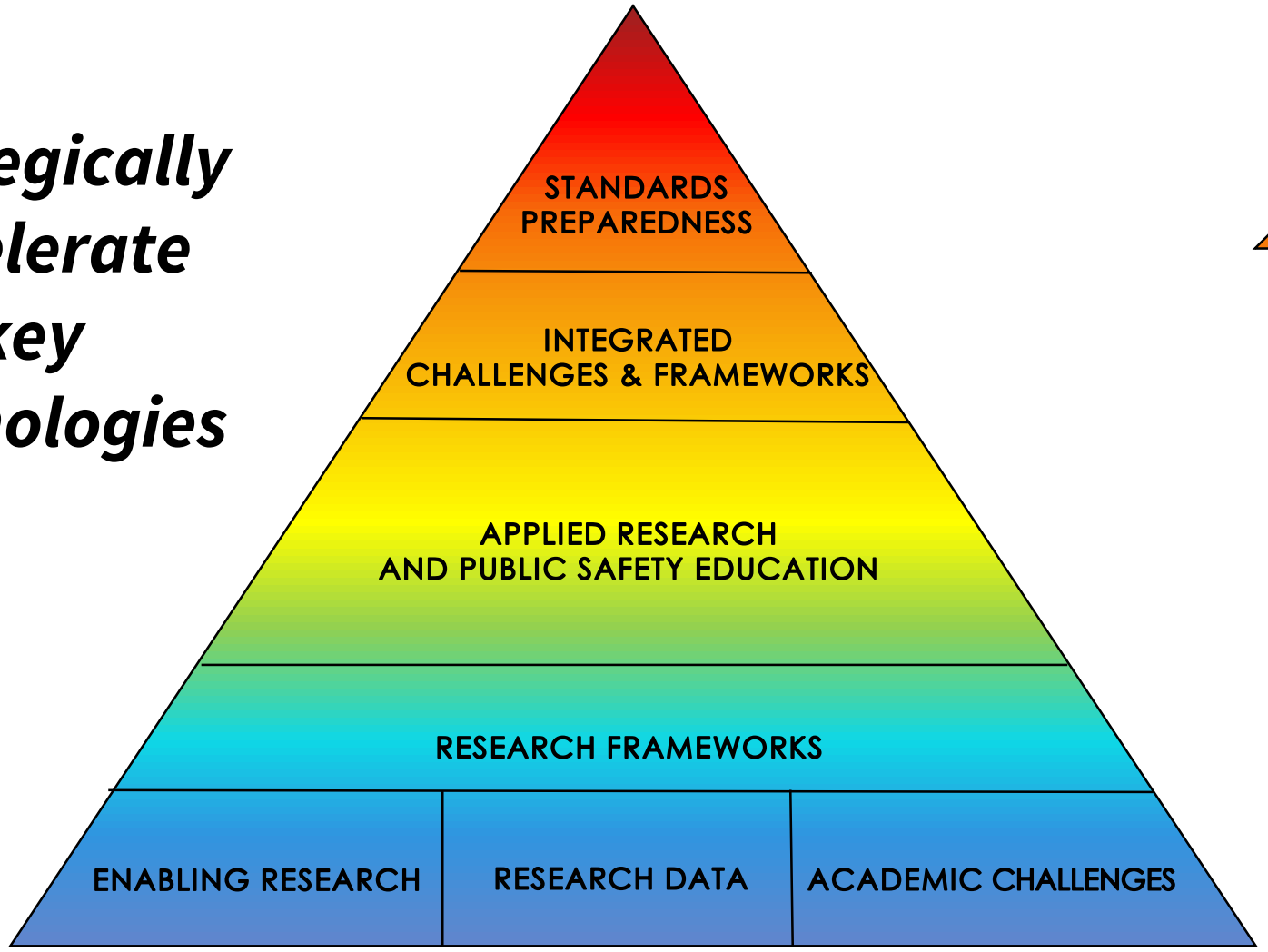
Reduce cognitive information load on first responders

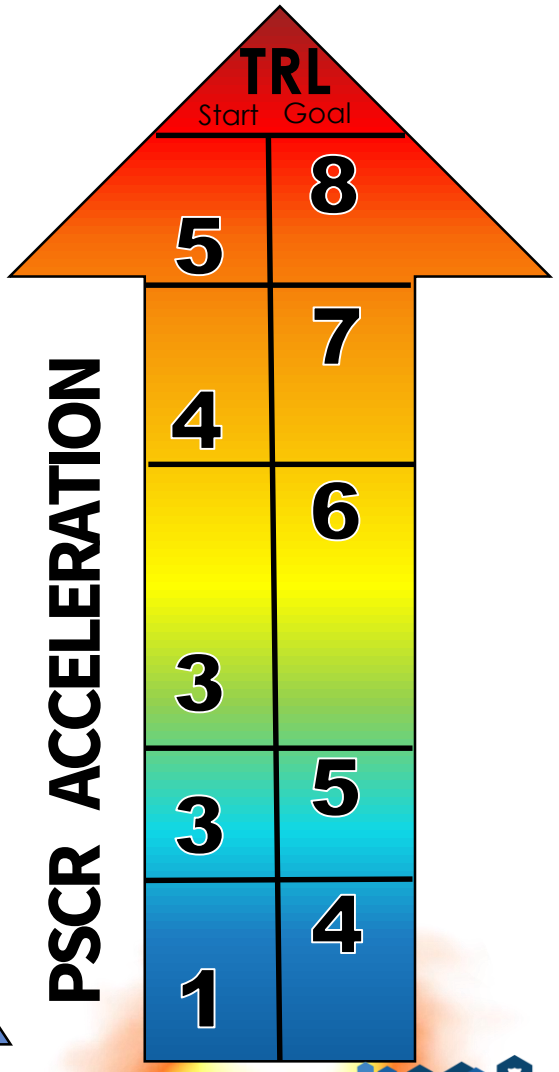
- tailored prioritized information delivery in actionable form

PSCR Analytics R&D Strategy FY17 – FY22

NIST

Strategically accelerate key technologies

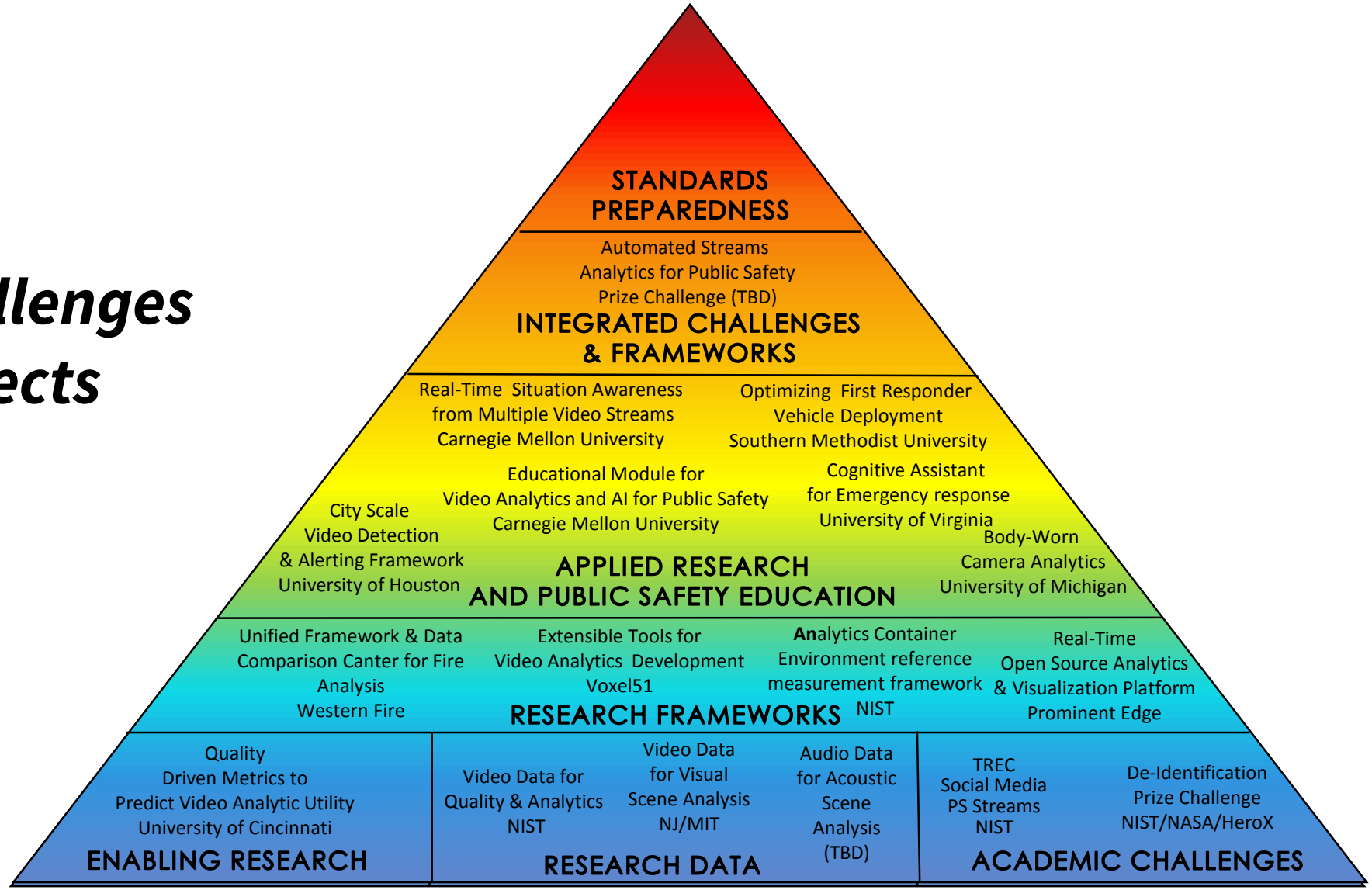




PSCR ANALYTICS

PSCR Analytics R&D Portfolio FY19

- ***11+ Grants***
- ***2 Prize Challenges***
- ***4 NIST Projects***



PSIAP 2017 Analytics Grants (Part 1)

University of Cincinnati: making fundamental breakthroughs in quantitatively understanding the relationship between video quality and video analytic performance

New Jersey Office of Homeland Security and Preparedness: Creating data collections to support video analytic R&D in 3 public safety scenarios: traffic stop, lost backpacker, foot pursuit

Prominent Edge: Developing extensible fire department performance analysis tools utilizing open source architecture

Western Fire Chiefs Association: Creating cross-department fire database and analysis sharing network

Voxel51: Developing building blocks on open source architectures to support the agile creation of customized video analytic applications by public safety IT professionals

PSIAP 2017 Analytics Grants (Part 2)

Southern Methodist University: Developing framework to co-analyze multiple data sources of information in optimizing logistics for emergency response in cities

Carnegie Mellon University: Developing a real-time approach to processing multiple sources of video to create a fused 3D understanding of an emergency scene

University of Virginia: Developing a multi-modal cognitive assistant to support hands-free communications between EMS and hospital databases and knowledge bases

University of Michigan: Developing wearer and scene analytics for body camera data

University of Houston: Understanding the gaps, bottlenecks, and technical challenges in deploying video analytics at city scale

Video Data Collection for Quality x Object Understanding Analytics

Developing unprecedented annotated video resources to support BOTH

- automated quality analytics
- object identification and activity analytics
- … and the intersection of the two

Collected in rich realistic environments

- Simulated convenience store robberies with various kinds of visually confusable objects
- Simultaneously collected cameras of highly varying quality

➢ **Will support future evaluations of quality analytics to predict performance of content understanding analytics**

- Useful in calibrating camera systems and understanding the limitations of use of data and certainty of analytic results

Differential Privacy Synthetic Data De-Identification Prize Challenge

- Goal: Develop practical capability to de-identify personal information in public safety data to support information dissemination and analytic research
  - 2018-19 progressive challenges to solicit approaches, code algorithms, and test solutions
  - Continuous leaderboard development approach; blind evaluation to determine winners.
  - Utilized fire data and historical census data
  - 5 winners declared:
    1. Umass Amherst - marginals
    2. Purdue/Zhejiang Universities team - marginals
    3. PrivBays - GANs
    4. John Gardner – histogram model
    5. UCLA/IBM team – graphical model
- Results being published in NIST Internal Reports and Journal of Privacy and Confidentiality; Algorithms are being made available by the contestants in open source for further research

➢ Seminal effort in de-identification of tabular data. Future efforts could address textual data and NLP challenges.

Social Media Incident Streams Academic Technology Evaluations

- Evaluation under NIST annual Text REtrieval Conference (TREC) to identify clusters of tweets related to a particular public safety emergency.

➢ From 2018 evaluation: about 5% of tweets are PS relevant, over half of those can be automatically retrieved and categorized.

- *Richard McCreadie, Cody Buntain, and Ian Soboroff. "TREC Incident Streams: Finding Actionable Information in Social Media", to appear in the 2019 International Conference on Information Systems for Crisis Response and Management.*
- Second iteration underway; developing concept for dissonance measurement track in FY20-21

Analytics Container Environment (ACE) Reference Framework

- Goal: framework and tools to enable the agile creation of applied analytics measurement testbeds spanning application integration, communication effects, and distributed and edge computing
  - Evaluating available open virtual container environments (docker and kubernetes) to determine their suitability as an integration platform for analytic algorithms.
  - Experimenting with architectures variations to understand impact on network load and performance to optimize configuration.
  - Customizing an ACE framework version for experimental deployment and developing docker containers for the analytics.
  - **Collaborating with Public Safety Innovation Accelerator Program grant recipients and Baltimore Citiwatch to develop, integrate, and test novel video analytics in context of reference framework.**

Collaboration with Baltimore CitiWatch

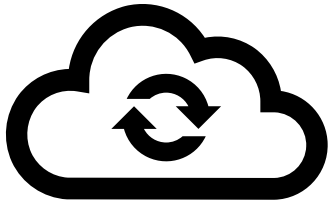
Demonstrate Agile Extensible Development/Testing of Video Analytics in Public Safety Environment

Analyze the Infrastructure

University of Houston/ Houston PS Video Program

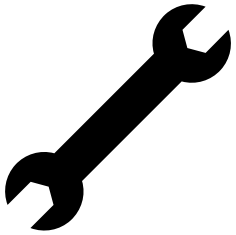
Understand the Analytic Needs

Baltimore CitiWatch



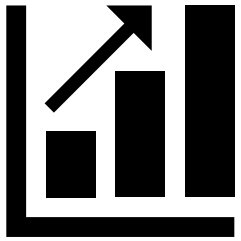
Curate the Analytic Modeling Data

Baltimore CitiWatch/ Voxel51



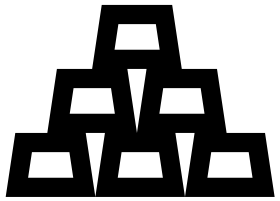
Build the Analytic Tools and Models

Voxel51



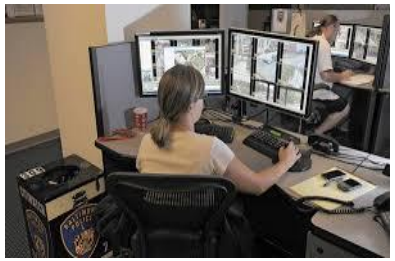
Refine and Test Models in the Lab

Voxel51



Integrate Within Measurement Framework

NIST ACE



Test with Public Safety Users

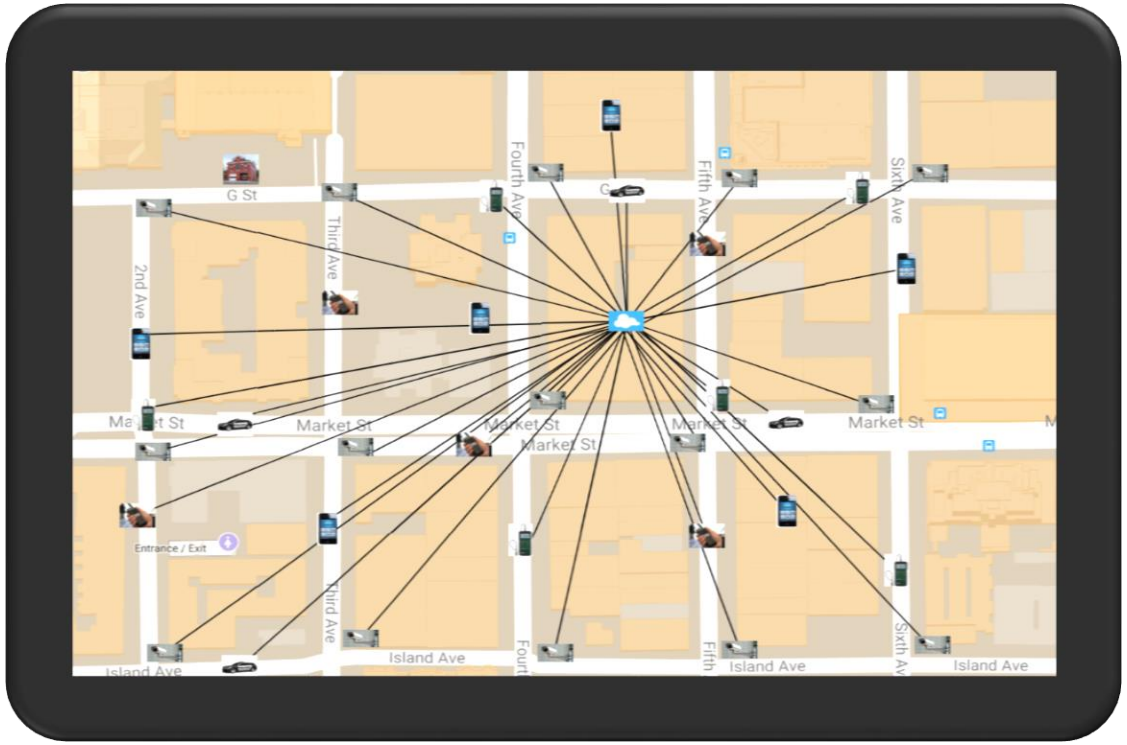
Baltimore CitiWatch

Iterate and Document Best Practices

Automated Streams Analytics for Public Safety (ASAPS) Prize Challenge (coming in FY20-22)

Goal is to foster capabilities in real-time detection and analysis of emergencies from video, first responder communications, 911 communications, social media, and sensor data

- Unprecedented data incorporating **parallel synchronized multimodal data streams** from long periods (hours) of time
- **Real-time streaming simulation** end-to-end test harness
- Early phases will focus on **automated emergency detection and analyses** from multiple modalities
- Later phases will focus on **delivery of emergency analyses information** to first responders in usable visualizations and interfaces
- Challenge is in acquisition phase for support including data collection, test harness development, and challenge implementation



Summary of Progress in PSCR Analytics Portfolio

Standards (*preparedness*)

Public Safety Methods

Research Capacity

Disruptive Approaches & Technology

Products

- Understanding analytic needs in public safety community:
  - The **challenges** in processing public safety data and providing real-time support
  - The **complexities** of the public safety data ecosystem
  - The **emerging needs** regarding interoperability and security
  - **Collaboration methods** and **best practices**
- Developing analytic R&D capabilities and products:
  - **Data quality analytics** and their relationship to analytic performance
  - **frameworks, tools, and technology evaluations** to accelerate development and lower barriers to entry and customization by public safety stakeholders
  - **Significant data resources, prize challenges**, and an at-scale integrated prize challenge opportunity to build critical R&D mass
  - **A number of application capabilities** to detect and analyze a variety emergencies, support emergency logistics, and provide actionable information to public safety stakeholders

QUESTIONS?