APCO International
Emerging Technology Forum

Updates From The Public Safety Communications Research Program

PULLING THE FUTURE FORWARD: Accelerating Public Safety Communications Research

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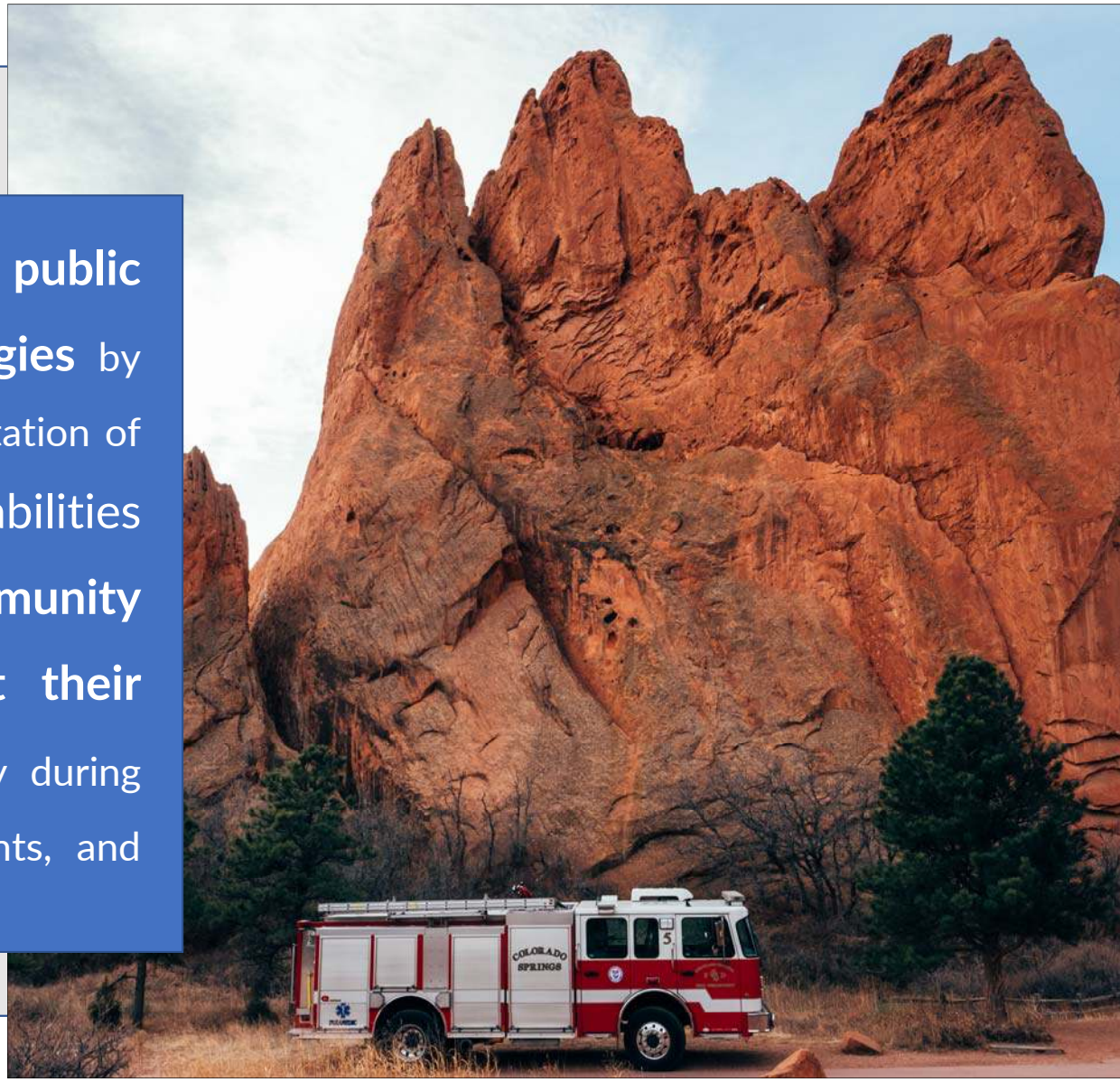
Public Safety Communications Research

PSCR Overview

Primary federal laboratory conducting research, development, testing, and evaluation for public safety communications technologies

PSCR Mission

PSCR is driven towards **advancing public safety communications technologies** by accelerating the adoption and implementation of the most critical communications capabilities **to ensure the public safety community can more effectively carry out their mission** to protect lives and property during day-to-day operations, large scale events, and emergencies.




To transforming public safety operations.
From fixing interoperability issues...
MOTOROLA
SETTINGS

PSCR Innovation Accelerator Program

Middle Class Tax Relief and Job Creation Act of 2012 passed. FirstNet is created.

Section 6303 provides $300M to NIST to perform critical R&D to ensure success of FirstNet.

Focus on MCV & LMR to LTE.

Addressing R&D necessary to push beyond current broadband technology.

Working closely with Public Safety and FirstNet every step of the way.

Open Innovation program utilizing grants and awards to address high priority public safety R&D needs.

5 Key Research Areas

Cross Cutting Research Areas

How are we doing this?

5 Key Research Areas

Cross Cutting Research Areas

PSCR's primary strategic focus in the LMR to LTE area is in capabilities that can interface existing LMR systems with LTE (and future broadband) systems.

Internal Research

- Implementing software defined radio (GNURadio/ USRP) for proof of concept to bridge LMR to interworking function without LMR radios/ base stations

- PSCR serves as the convener for a working group with the Department of Homeland Security Emergency Communications Preparedness Center

While access to broadband data is improving public safety operations and providing new applications, voice remains the most critical communications capability.

Internal Research

- Mission Critical Push-to-Talk
  - Push-to-Talk and QPP Modeling
  - List of FirstNet Certified Devices and 3GPP RAN Test Cases
  - Test Bed
- Mission Critical Quality of Experience
  - Measurements
  - LTE Impact on LMR
- Direct Mode
  - Device-to-Device Modeling
  - MCV Call Model

External Research

- PSIAP-2017 – MCV – 9 current award recipients, Nearly $10 Million
- PSIAP-2019 – QoE – Over $2 Million

NEW in 2019

#1 OpenFirst (Software Radio Systems)

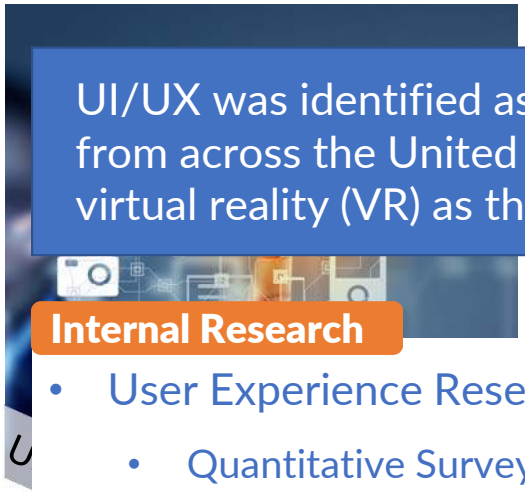
- Providing an **open-source end-to-end LTE network platform** for public safety R&D to create a reference implementation of key LTE features for first responders.

#2 Mission Critical Open Platform (University of the Basque Country)

- This application programming interface for public safety devices interfaces with 3GPP compliant MCPTT application server in LTE core, and **allows anyone to create app for public safety devices that inherently operates on LTE MCV capabilities.**

#3 MCV Quality of Experience Measurements (NIST/PSCR)

- Implements measurements of any half-duplex MCV system **relative to user experience**, treats systems as “black boxes” only referenced to PTT button presses and intelligibility of voice and timing, and allows systems (namely LMR and LTE MCPTT) to be compared in apples-to-apples manner.



UI/UX was identified as a priority research area for PSCR. Stakeholders from across the United States identified augmented reality (AR) and virtual reality (VR) as the R&D areas.

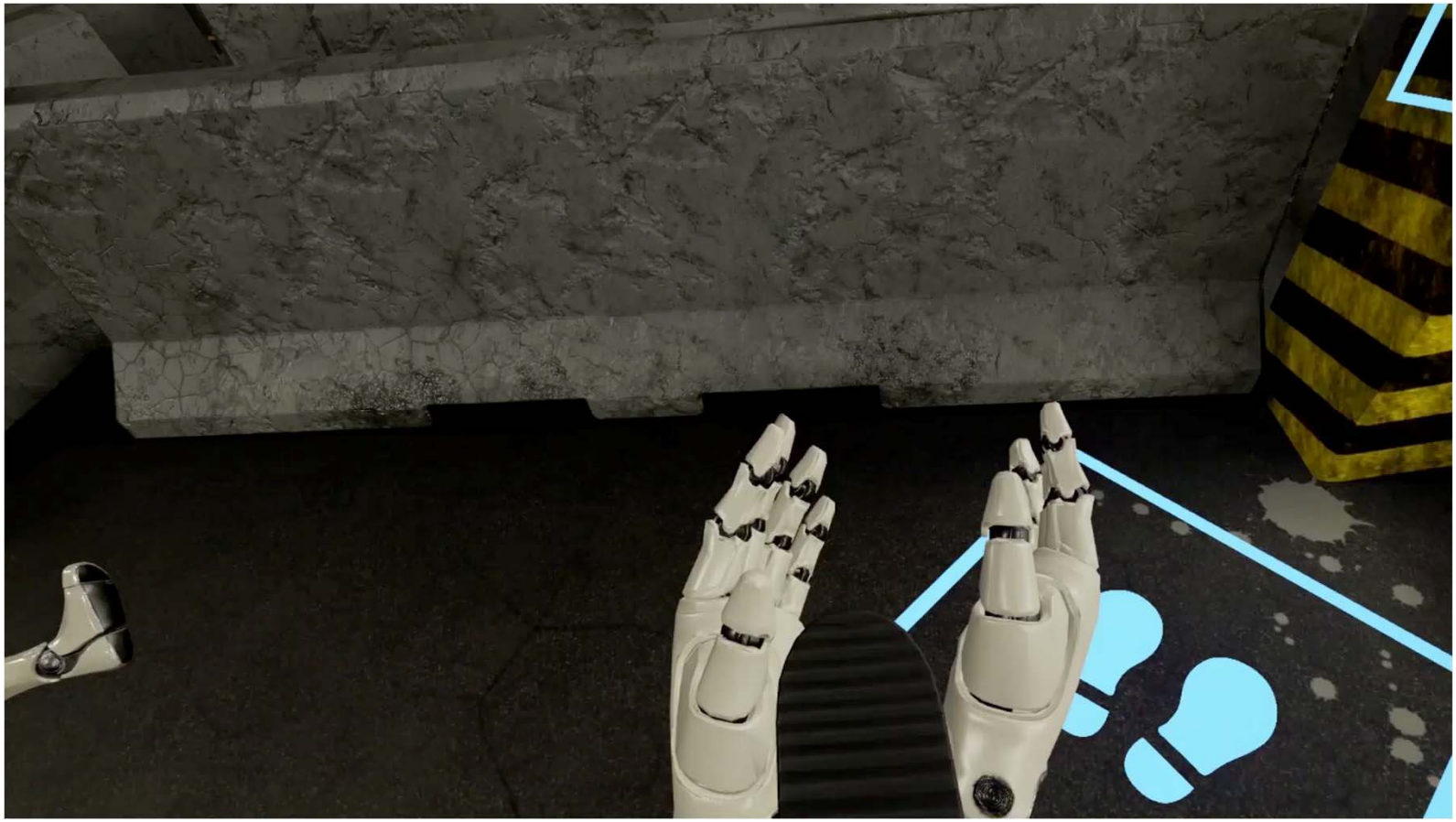
Internal Research

- User Experience Research and Testing Methodologies
  - Quantitative Survey
    - Estimated sample size of 16,500 first responders
- Virtual Reality Environments
  - Active shooter, multi-victim triage, and building fire scenarios

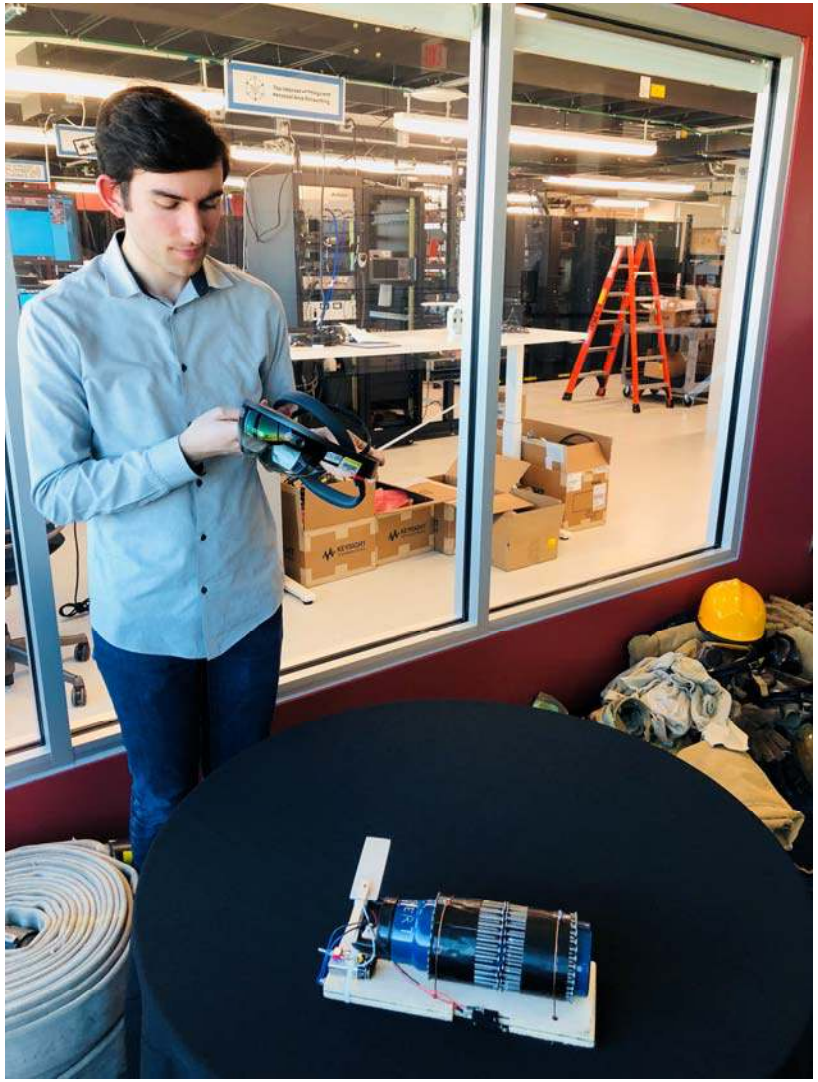
External Research

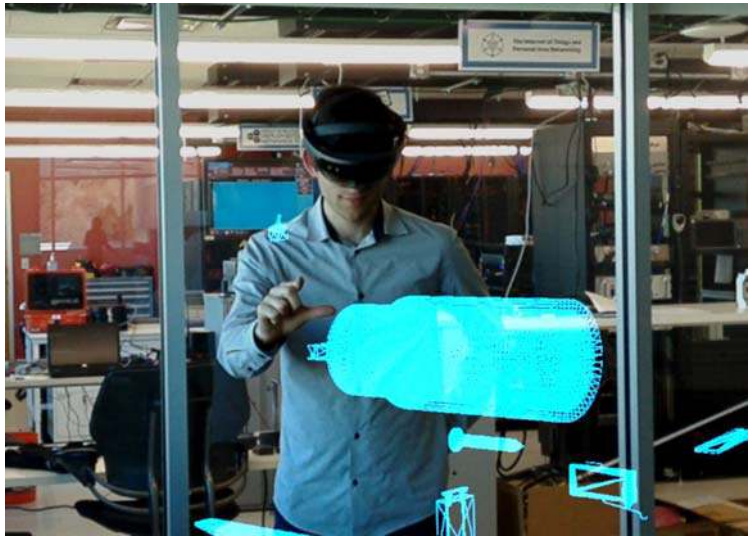
- VR/AR for Improved UI
  - VR NAV HUD Prize challenge – 6 Finalist, $125,000 Prize Purse
  - PSIAP-2018–UI – 7 Awardees and Cooperative Agreements, $6.4 Million
- UI/UX Haptic Interfaces
  - Current prize challenge iteration to build off of VR HUD NAV Challenge

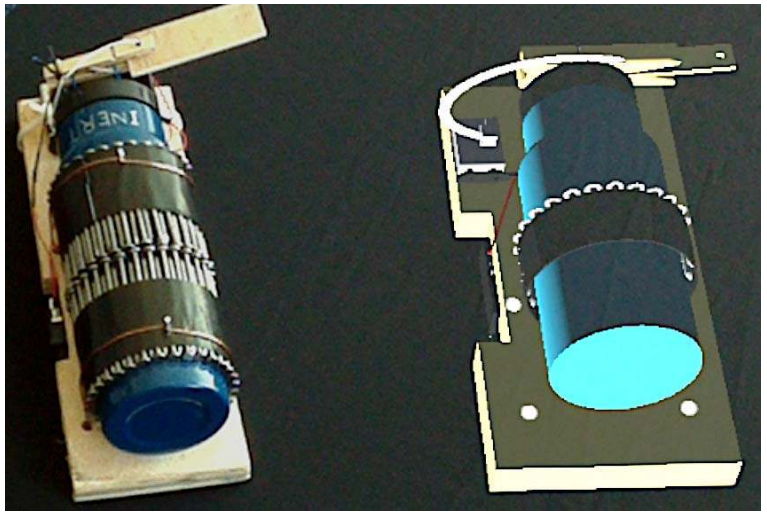
PSCR UI/UX at work using virtual reality…



… and in Augmented Reality.







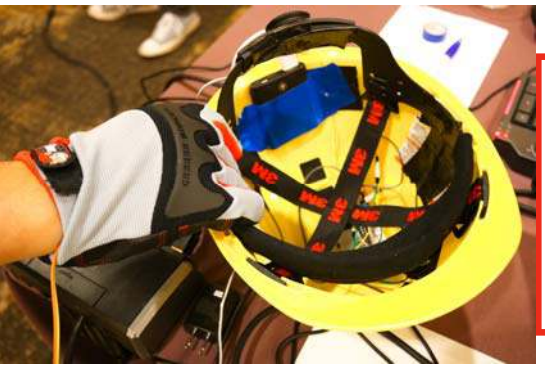
NEW in 2019

#1 Mixed Reality Training & Testing Facility for First Responders (TRACLabs)

- An interactive demo for fire attack and search and rescue, showing the ability to track, monitor, and replay in VR environments for testing and training purposes; included tracked props (e.g. furniture, nozzle).

#2 Cognition-Driven Display for Navigation Activities (Texas A&M)

- This research works with **measuring cognitive load** and developing an information personality model for first responders. It identifies the cognitive gap experienced when in a high stress environment.



#3 Haptic Interfaces for Public Safety Challenge (NIST/PSCR)

- Challenge contestant prototypes included insoles, gloves, vests, belts, helmets, and backpacks. Each tackled the challenge of creating a **haptic interface to assist in first responder tasks** from different perspectives.

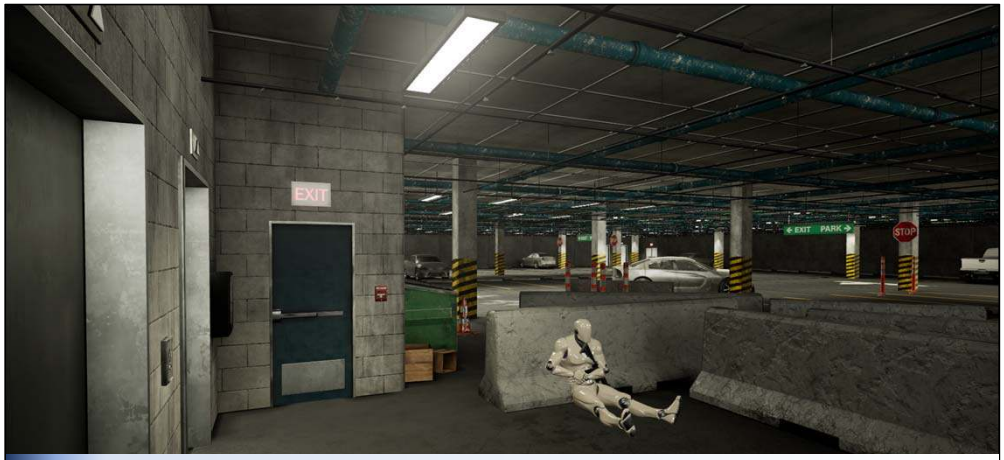
Can haptic interfaces assist first responders?

Types of Haptic Feedback:

- Tactile – that sense of touch
- Vibration – like your phone buzzing
- Force feedback – sense of pressure
- Thermal – that hot/cold sensation

Current test environments:

Emergency Medical Services



Law Enforcement

Fire

Haptic Interfaces for Public Safety Challenge

3 Virtual Scenarios
1 Live Test

Prize Purse of $425,000

Two Contestant Types

- Haptic Providers
- Haptic Development Teams

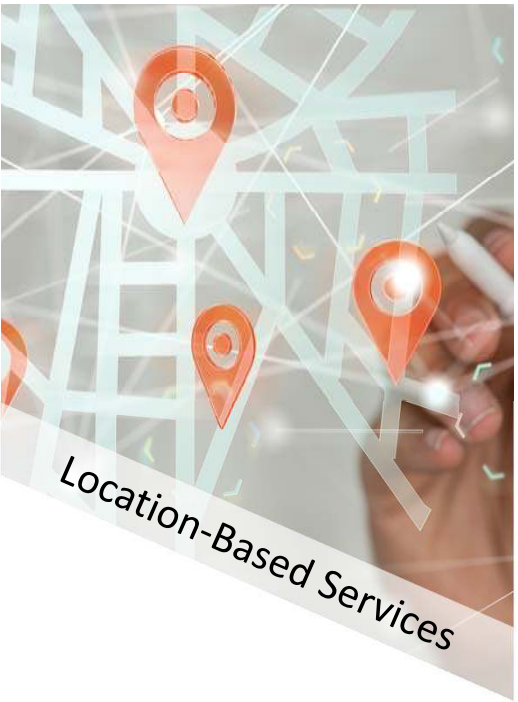
The ability to locate, track, and inform first responders while indoors under difficult conditions remains a critical capability sought by public safety.

Internal Research

- LiDAR Point Cloud Mapping Demonstrations
- OGC Indoor Mapping & Navigation Pilot:
  - 10 deliverables, 7 companies, 5 countries

External Research

- Positioning
  - PerfLoc Prize Challenge
- PSIAP-2017– LBS – Over $6.3 Million
- PSIAP – 2018 – Point Cloud City – Three Current Awards, Over $775K
- PSIAP – 2019 – iAxis – One current award, $200K



NEW in 2019

#1 Tracking Techniques are Adapting to New and Unseen Environments

- Several teams with varied approaches are starting to get (very preliminary) results in the 3 m range. (UC-Irvine, UMich, Oxford).
- Tested in head and foot-mounted navigation systems in constrained and zero visibility scenarios (Oxford).
- GPS-denied mobile app + Vehicle Mode beacon feature yielded easy-to-use 3D maps (TRX Systems).

#2 Transforming Point Clouds to IndoorGML (OGC)

- Mobile mapping systems equipped with LiDAR and 360-degree cameras, first responders could efficiently capturing 3D point clouds.
- It is then possible to transform the point clouds to IndoorGML to generate navigable routes in/out/through building.

#3 Machine Learning Techniques Improve Visual-Intertial Odometry (CMU)

- Machine learning techniques are showing potential to significantly improve localization when used to create mobility models, calibrate inertial sensors, create point clouds, and in multi-sensor fusion algorithms.


Marriott
European
Commission

Analytics, identified as a priority R&D investment area for PSCR, will play a role in every component of future public safety workflows, including optimizing FirstNet to reach its full potential.

Internal Research

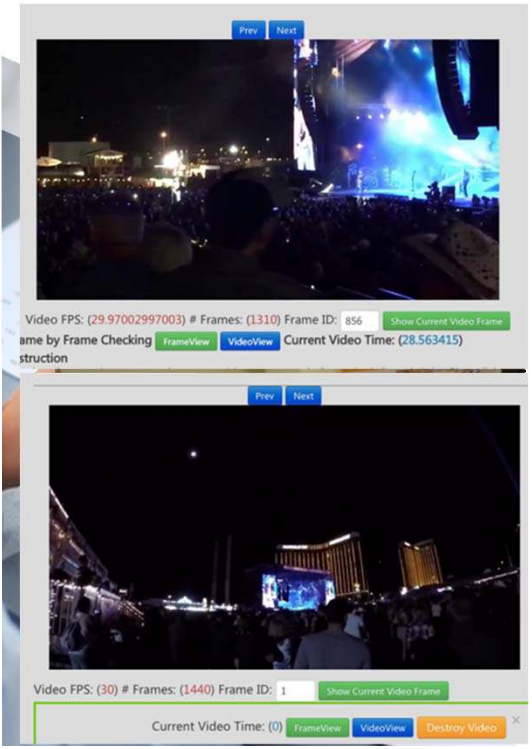
- Information retrieval for public safety text challenge – social media incident streams

External Research

- Public Safety textual data deidentification and differential privacy Prize Challenge – recently completed!
- Automated Streams Analytics for Public Safety (ASAPS) live real-time multimodal analytics grand prize challenge
- PSIAP-Analytics Grant – 10 current award recipients, Over $12 Million

Differential Privacy Prize Challenge

NEW in 2019



#1 Optimizing Fire Response with Big Data (Western Fire Chiefs, Prominent Edge)

- Now deployed at 60+ USA fire stations.
- Helping fire chiefs improve response, train first responders, and balance resources.

#2 Real-time and Cost-effective Video Analytics (Voxel51, UH, City of Baltimore)

- Demonstrating how public safety video data can be leveraged to create custom analytics to detect emergencies.
- Template for cities to leverage owned video data to create and fine tune real-time alerting video analytics bespoke to a city's data and needs.

#3 Real-time Approach to Incident ID via Publicly-Provided Data (Carnegie Mellon)

- Showed that a real-time multi-modal approach to gunshot geo-location and gun type classification can be implemented from publicly-provided video in multimedia 911 and social media apps.
- Created a real-time 3D model via publicly-provided video streams + CCTV streams – mapping and fusing each video clip to its location in the model – allowing first responders to see how and where video clips fit together.

Security, including cybersecurity, is an area which will affect every aspect of public safety communications. PSCR serves to develop and enhance security solutions to current and future public safety communications.

Internal Research

- Federated Identity Credential and Access Management (ICAM) & Enhanced Authentication
- Mobile Single Sign-on (SSO) Shared Devices
- Mobile Application Security Vetting
- Public Safety Handset and Wearable Security

External Research

- Expanding the SIM Card Use Challenge – final phase judging this month!

NEW in 2019

#1 Expanding the SIM Card Use for Public Safety (NIST PSCR)

- Mobile apps require a secure area to store authentication credentials, preferably hardware-based authenticators for additional security.
- The SIM that is already inserted into all mobile devices provides secure storage and allows remote provisioning; it can be transferred to multiple devices or a new device.

#2 Federated Identities Foundational for Secure Interoperability (NIST PSCR/NCCoE)

- The national public safety network can now facilitate interoperability across the USA and through all disciplines
- Access controls have to only allow the right people access to the right data, for the right reason.
- PSCR is partnering with the NCCoE to build a Network Architecture to support Federated Identities and Enhanced Authentication for Public Safety.
- **Partnership will provide a test bed** where industry, PSCR, and other research organizations can evaluate and incorporate other public safety communication research objectives.

Search "NIST PSCR Cybersecurity Webinar" in your preferred web browser.

Public safety communication systems must continue to work, and are even more necessary under circumstances in which other networks fail.

Internal Research

- Broadband Demonstration Network – Deployables
  - Architect, prototype, and demonstrate the use of standalone Deployable System solutions to provide users with broadband services

External Research

- PSIAP-2017– Resilient Systems – Over $6.5 Million
- Unmanned Aerial System Flight and Payload Challenge
  - Winning team completed a UAS prototype and demonstrated flight capabilities within public safety build and cost limitations
  - Awarded $50,000

NEW in 2019

#1 Live Video Streaming Soon to Have Analytics Capabilities (Spectronn)

- Completed a commercial trial of their SiFi HetNet router for the Boston Marathon, addressing the problem of poor microwave backhaul.
- Partnered with an analytics award recipient to add analytics to their multiple streaming video analytics capability for crowd monitoring, etc.

#2 Data Access for Wildland Fire Incident Command (Michigan Tech)

- New hardware and software synchronizes files between the server and user devices in remote front line locations during Wildland fires.
- May expand beyond Wildland Fire to mount the Ferry systems on city busses to transfer HD video from street cameras back to police HQ servers.

#3 Distributed Fog/Edge Computing (Texas A&M, UC Riverside)

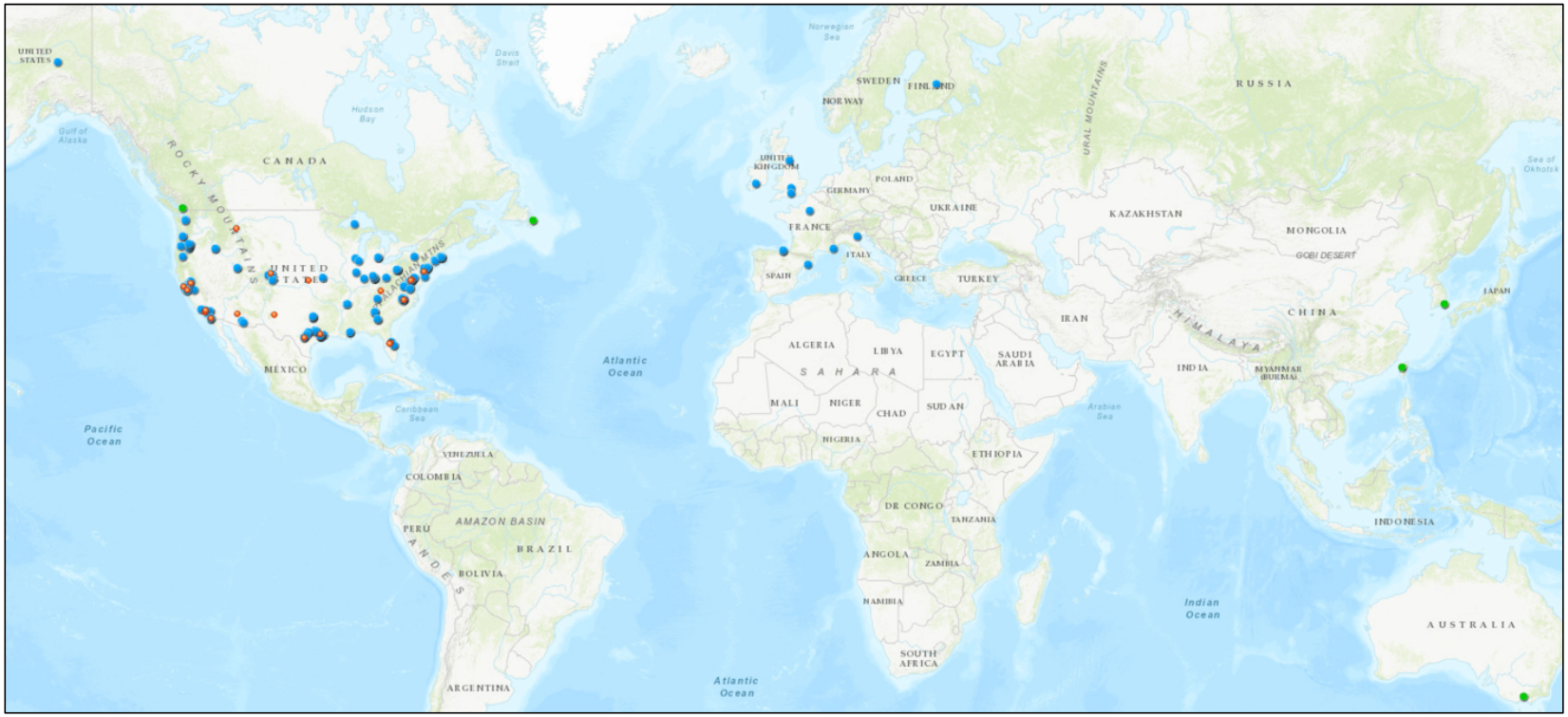
- Smartphones carried by first responders are capable of performing analytics on shared data using the computing and storage power of nearby devices, eliminating the need for constant high capacity connections to the Internet.

PSCR

PULLING THE FUTURE FORWARD

PSCR

Pulling the future forward will require a worldwide effort.



We will get there through partnerships with researchers across sectors.

In FY2020, we'll continue to fund research.

RECENT OPPORTUNITIES

- Mission Critical Voice Test Equipment
- Tech to Protect
- Haptics Challenge
- SIM Card Challenge

FUTURE OPPORTUNITIES

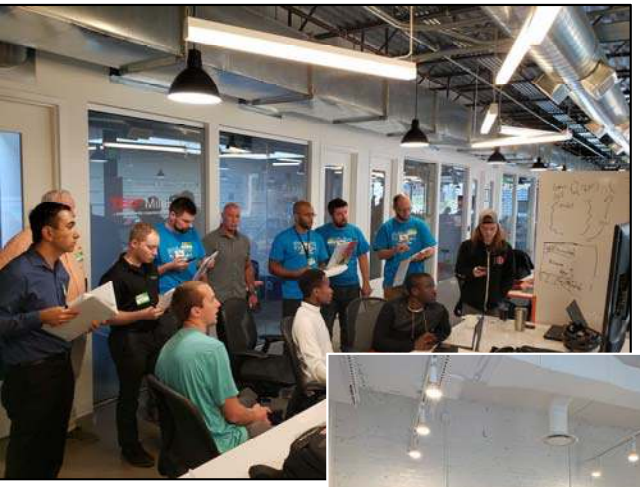
- Public Safety Data Analytics
- 3D Indoor Tracking
- Unmanned Aircraft Systems (UAS) Flight and Payload II

https://www.nist.gov/communications-technology-laboratory/pscr/funding-opportunities

TECH TO PROTECT CHALLENGE

First LIVE Codeathon completed!

- 27 submissions, 13 winners – all high quality participants
- 100K in prizes to be awarded by NIST (out of 150K possible)
- Participants responsive to the mission, contests, etc.
- 39 judges and reviewers organized and deployed around the USA
- 7 out of 10 contests responded to





Next LIVE Codeathon November 1-3.

I MORE! → llenge.org

Get your hands on the tech! Try PSCR's AR demo.

THANK YOU

Questions?

PSCR