![NIST | PUBLIC SAFETY COMMUNICATIONS RESEARCH]

DIGITAL DISPATCH

A CURATED LIST OF COMMUNICATIONS TECHNOLOGY TOOLS FOR PUBLIC SAFETY AND THE RESEARCH COMMUNITY

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Overview

The Public Safety Communications Research (PSCR) Digital Dispatch is a curated list of communications technology tools for public safety and the research community to interact with right now. PSCR also intends for the Digital Dispatch to facilitate partnerships and/or collaboration between stakeholders and the researchers behind the resources. The tools listed in this document are publicly available at no cost to use or reference, and have been developed by research and development (R&D) both internal and external to PSCR. While this document serves as a shortcut to a handful of downloadable, actionable resources that are available for public safety to use right now, all existing intramural and extramural research materials can be found in a comprehensive library on the PSCR website.

Background

PSCR's core communities and partnerships are fundamental to the success of the program. PSCR relies on its collaboration with public safety practitioners — fire, police, Emergency Medical Services (EMS), industry, academia, and local, state, and Federal agencies to guide internal R&D initiatives. PSCR works to continuously engage these communities and communicate R&D progress and results regularly. Additionally, through extramural research, PSCR works directly with the solver community to address Public Safety's urgent need to access the same broadband communications and state-of-the-art technologies that consumers on commercial networks now expect.

PSCR conducts a comprehensive technical research program to facilitate improved communications interoperability, broadband capabilities, and information sharing between wireless and IT systems and the public safety community. PSCR worked in coordination with Public Safety, industry, academia, and local, State, tribal, and Federal practitioners to identify critical communications technology gaps. As a result of this coordination, PSCR prioritized the following key technology areas to drive its R&D program: Enhanced User Interface/User Experience (UI/UX), Applied Analytics, Location-Based Services (LBS), and Mission Critical Voice (MCV). In addition, PSCR identified the following initiatives that cut across each key technology area: Security and Resilient Systems. Through internal R&D efforts, PSCR researchers have generated sustainable tools to benefit public agencies and developers.

PSCR also works with public safety agencies, academic researchers, industry partners in both technology and human/social areas, and system developers to support our mission and accelerate the advancement of public safety communications technologies. PSCR leverages Financial Assistance Awards in the form of grants and

cooperative agreements to stimulate critical R&D, advanced engineering, and product development in key technology focus areas. Award recipients have developed various resources that are available for public safety agencies and developers to reference and/or pilot themselves. Many of the external resources included in this catalogue have been developed by award recipients specifically of the Public Safety Innovation Accelerator Program (PSIAP) and the Open Innovation (OI) Program.

The PSCR PSIAP Funding Opportunity focused on six key technology areas that have the potential to transform the future of public safety communications and operations: Public Safety Mission Critical Voice, Location Based Services, Public Safety Analytics, Resilient Systems, Research and Prototyping Platforms, and Public Safety Communications Demand Model. PSCR has awarded over $58 million to 49 research and development (R&D) projects, including four international award recipients, spanning five of the key technology areas aimed at advancing broadband communications technologies for first responders. This funding opportunity is intended to help modernize public safety communications and operations by supporting the migration of data, video and voice communications from mobile radio to a nationwide public safety broadband network, as well as accelerating critical technologies related to indoor location tracking and public safety analytics.

PSCR's Open Innovation program focuses on advancing public safety communications by leveraging the creativity, expertise, and innovative solutions from a diverse array of contributors and collaborators across the globe through financial awards and incentive-based activities. The program looks to solve discrete and well-defined problems surrounding: Crowdsourcing, Prize & Challenge Competitions, Hack-a-thons, Data Jams, Ideation, Collaborative Iteration & Design, and Team-building Activities. The problem solvers (aka Challenge participants) determine the "how" and the "solution" by using their creativity to reach the desired goal. Through Prize Challenges, PSCR has awarded over $1.3M in prizes to 88 winning teams across eight competitions. Participants may advance their research concept, commercial their products, or enhance their business products all while improving safety and efficiency for America's First Responders. Research from both PSIAP award recipients and Open Innovation Prize Challenge participants are included in this Catalogue, in addition to internal PSCR resources.

Contact information is provided for the organization or Principal Investigator responsible for the R&D of each resource. Please reach out to PSCR at pscr@nist.gov for any general questions.

Disclaimer:

The extramural research included in this document was produced by PSCR award recipients. The contents of this document do not necessarily reflect the views or policies of the National Institute of Standards and Technology or the U.S. Government.

Icon Legend:

Intramural Research

Extramural Research

FOUNDATIONAL DOCUMENTS

Portfolio Roadmaps

Public Safety Communications Research (PSCR) lead a coordinated, multidisciplinary research effort to forecast the evolution of emerging technology sectors, identify how that transition would likely impact public safety operations, and recommend technology areas where Federal research and development (R&D) organizations supporting the public safety community could invest their resources to make our nation's responders safer and more effective. As their communications technology migrates from disparate Land Mobile Radio (LMR) networks to the Nationwide Public Safety Broadband Network (NPSBN), first responders are presented with opportunities and challenges to adapt to the emerging technologies in this new environment.

PSCR developed a roadmap framework that is repeatable, scalable, and focuses on translational R&D priorities. This framework ensures the comparability of gaps and R&D opportunities identified in disparate technology sectors, and traces the logic behind developing priorities. By validating the findings of each roadmap with a broader stakeholder-base through investment criteria and R&D summits, PSCR created a process that distills the input of a large working group into a concise set of R&D focus areas that need closest attention.

1 ROADMAP WORKING GROUP	2 ROADMAP PUBLICATION	3 ROADMAP SUMMIT	4 SUMMIT REPORT

Understanding the Roadmaps:

PSCR developed roadmaps for various research portfolios including User Interface and User Experience (UI/UX), Location-Based Services (LBS), and Public Safety Analytics. Each PSCR Roadmap focuses on a specific emerging technology sector that has the potential to greatly increase the response capabilities of Public Safety once it migrates to the NPSBN. For each technology area, PSCR commissioned a diverse stakeholder working group made up of technology experts and end-users from industry, academia, Public Safety, and all levels of government to identify the challenges and opportunities associated with introducing these new technologies into public safety operational environments. Using the recommendations put forth by each working group, PSCR published reports and facilitated R&D summits. These parallel efforts for each research portfolio prioritize the technological needs of Public Safety and outline actionable steps that the community can pursue to better integrate emerging technologies in mission-critical operations. Public safety stakeholders can use these roadmaps to understand the challenges PSCR identified in each of these research areas, what will be solved commercially, and what gaps remain that PSCR has launched research projects to address.

Resources:

To learn more information about the PSCR Roadmaps, visit the Roadmapping page on the PSCR website.

Check out the publications for each of the portfolio-specific Roadmaps:

- User Interface and User Experience
- Location-Based Services
- Public Safety Analytics

Point of Contact:

For general PSCR roadmapping questions:
- Email pscr@nist.gov

For more specific roadmapping questions:
- User Interface and User Experience: Scott Ledgerwood, scott.ledgerwood@nist.gov
- Location-Based Services: Lisa Soucy, lisa.soucy@nist.gov
- Public Safety Analytics: John Garofolo, john.garofolo@nist.gov

List of Certified Devices ⚙️

The Public Safety Communications Research (PSCR) division at National Institutes of Standards and Technology (NIST) hosts, on their website, a list of certified devices that meet appropriate protocols and standards for access to, use of, or compatibility with the National Public Safety Broadband Network that FirstNet and AT&T built and maintains.

How Devices are Added:

Devices are added to the list through the following process:
1. Regulatory Testing
    - Federal Communications Commission (FCC) Equipment Authorization
2. Industry Certifications
    - PCS Type Certification Review Board Certification
3. Mobile Network Operator (MNO) Testing
    - FirstNet and AT&T Lab Approvals
4. Submission to NIST

Where to Find it:

Visit the Resource Library on PSCR.gov to view and download the complete list.
You can also subscribe to be notified when a new version of the list is available.

Point of contact:

Jason Kahn, jason.kahn@nist.gov
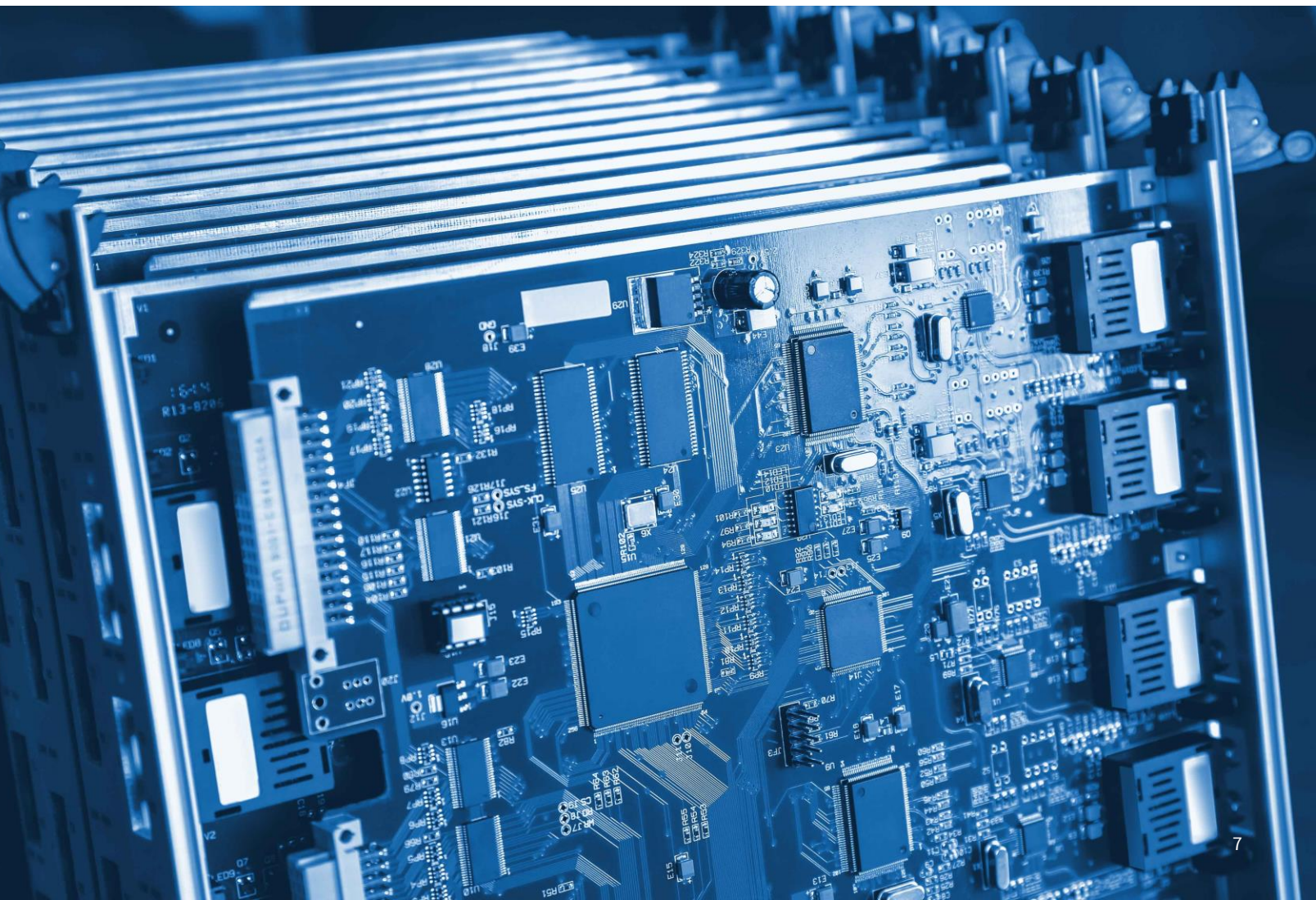
SOURCE CODE

Extensible Tools for Analytics

Extensible Tools for Analytics (ETA) is an open software infrastructure developed by Voxel51 that provides extensible tools for video analytics. ETA is an automated, affordable, video analytics development system that creates custom insights from unique video data and environments in different jurisdictions and integrates these analytics into public safety operational decision making. This platform demonstrates the feasibility of integrating video object and pattern recognition with public safety operations. The system can be extended to agencies across the public safety community to provide first responders with potentially life-saving information, allowing for more efficient and effective operations.

User Workflow:

Voxel51's ETA enables third-party analytic developers to easily deploy and integrate their analytics on Voxel51's platform. Once ETA is installed locally, users may do the following:

- Register for the application program interface (API) and obtain an authentication token (one-time only)
- Upload data to the cloud via the API
- Schedule analytics to be run on data by issuing job requests via the API
- Periodically ping the API to check the status of any jobs
- When tasks finish, issue an API request to download the outputs, which are concisely represented in a flexible JavaScript Object Notation (JSON) format

Where to Find it:

Extensible Tools for Analytics is available on GitHub.

Point of Contact:

Voxel51, Jason Corso, info@voxel51.com

LTE Coverage Tool

The purpose of the Long Term Evolution (LTE) coverage tool is to enable public safety personnel to measure general LTE coverage quality using a standard smartphone. Source code is published as a software development kit (SDK) to allow developers to enhance the application or use it in other applications. The Department of Homeland Security (DHS) sponsored research conducted by Public Safety Communications Research (PSCR) in this area to determine whether first responders could use an experimental Android application to provide a reliable assessment of in-building LTE coverage. They found that non-experts could quickly master the operation of this system to measure general LTE coverage quality using a standard smartphone.

How to Use it:

The LTE Coverage Tool application and SDK enable first responders and public safety personnel to survey and evaluate coverage by LTE networks in environments where incidents are ongoing or planned. Once users download the app, they adhere to the following instructions:

- Input an offset value in decibels (dB) if needed to raise the reported value for Reference Signals Received Power (RSRP)
- Select "New Recording" to begin a test, and move throughout the desired survey area
- Click on "Pause" at any time
- Press "Resume" to continue the assessment
- Use the "Stop" button to end the assessment

Where to Find it:

The LTE coverage source code is available on GitHub. Visit the Google Play store to download the LTE coverage app.

Point of Contact:

Sam Ray, samuel.ray@nist.gov

Mission Critical Open Platform

The Mission Critical Open Platform (MCOP) was launched to reduce the entry barriers that different stakeholders (device manufacturers, application developers and integrators) face in order to develop and test innovative Mission Critical Push-To-Talk (MCPTT) applications. The MCOP approach comprises the use of fully 3GPP standardized interfaces and the definition of northbound and southbound application program interfaces (APIs) in the devices. Additionally, in order to test that the proposed architecture is fully functional, a MCPTT open-source software development kit (SDK) and app have been released.

The availability of mission critical (MC) grade user experience (UE) open architecture and open-source implementation speed up the commercial product release cycle, enable new stakeholders to enter the public safety ecosystem, and improve the awareness and common understanding of public safety officers (PSOs) and both public safety industry and researchers of the MCPTT suite of protocols. Additionally, MCOP intends to contribute to the innovation acceleration program by making available the resulting UE-side software components at PSCR and live testing facilities.

How to Use it:

The MCOP platform includes different level APIs for apps and UE's MC capabilities integration, the release of a real MC-grade (with eMBMS and Rel'13 and beyond features) open-source reference implementation of both a MCPTT client and Public Safety specific application in Android, and the deployment and maintenance of both an on-site and online live testing platforms in which researchers, developers and other practitioners can test, evaluate and validate their MCPTT compliant innovative apps.

Where to Find it:

The Mission Critical Open Platform is available on the MCOP website.

Point of Contact:

University of the Basque Country, Fidel Liberal, fidel.liberal@ehu.eus

OpenFirst

OpenFirst is the open-source Long Term Evolution (LTE) software-radio platform for first responders, providing a complete mobile broadband network reference implementation for research, prototyping, test and validation of LTE technologies for public safety communication. Building upon the proven success of the srsLTE suite of open-source software-radio libraries and applications, OpenFirst has the potential to significantly accelerate the development and deployment of public safety communication technologies.

A complete, open-source end-to-end network reference implementation is available through simple package installations on standard Linux operating systems, running on standard laptops and PCs. The SRS suite of software radio libraries and applications for LTE already has a thriving community of users and developers. By building upon these foundations, OpenFirst taps into an existing ecosystem, ensuring broad use and wide engagement. As key public safety features are developed within the project, OpenFirst enables and inspires the broader software radio community to focus on public safety communications and continue to innovate in this space.

Software Availability:

All of the software elements of the OpenFirst platform have been released under the widely-recognized and Open-Source Initiative (OSI) approved open-source GNU Affero General Public License version 3 (AGPLv3). By releasing the OpenFirst source code under this license, OpenFirst provides the right to study, use, change and distribute the software to anyone and for any purpose. In this way, OpenFirst ensures the dissemination of the technology and maximizes its usability within a very large software radio development ecosystem, guaranteeing its availability for follow-on research and its long-term sustainability.

Where to Find it:

The srsLTE open-source platform is stored on GitHub, as well as documentation about the srsLTE suite.

Point of Contact:

Software Radio Systems, Paul Sutton, info@softwareradiosystems.com

StatEngine

Prominent Edge developed StatEngine, a real-time, open-source data visualization platform specifically tailored to public safety organization data structures. This platform is built from "best of breed" open-source data analysis and visualization tools and enables wide-scale utilization of powerful, real-time data analytics for public safety organizations (PSOs). Key metrics provided by the analytics tool include turnout and response time for custom time periods, changes in average unit response duration over time, incident type and volume per day of week or year, and geospatial incident plotting that maps where jurisdictions' most active
and high demand areas are located.

Prominent Edge's product is intended to significantly lower the cost and impediments of obtaining powerful, real-time analytics, which are currently only provided by proprietary solutions that may be too rigid and expensive to maintain for resource-limited public safety agencies.

How to Use it:

Through data sharing, the tool allows organizations across the country to discover potential trends and make improved predictions to optimize resource allocation. PSOs of any size can exploit large volumes of complex, highly relevant, and impactful datasets in real time:
- Navigate to the 'Sign Up' button on the top, right hand corner of https://statengine.io
- Login to access the dashboard once access has been approved by a local administrator
- Explore built-in visualizations on the dashboard and create custom ones
- View basic metrics and complex graphs
- Perform advanced time series analysis
- Plot geospatial data
- Add data enrichments from the Marketplace for a deeper dive into data analysis
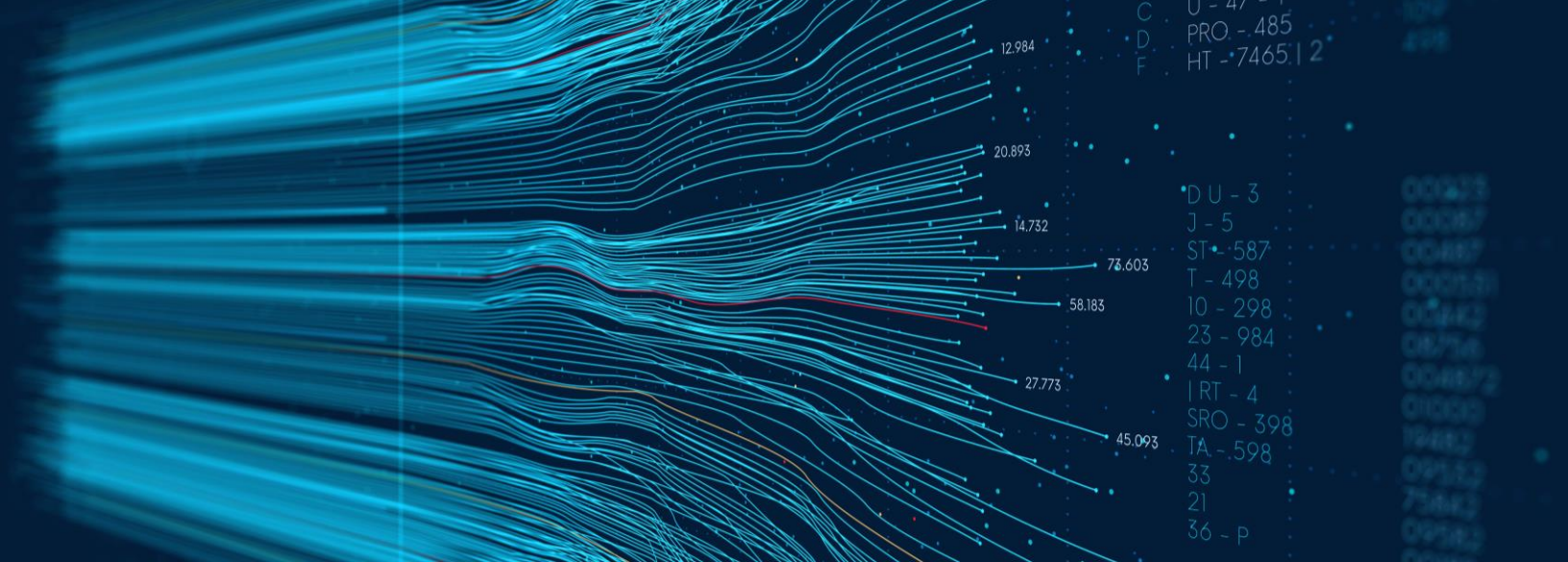- Share active incidents and statistics on social media

Where to Find it:

StatEngine is available on GitHub, with more information provided on their website.

Point of Contact:

Prominent Edge, Tyler Garner, contact@prominentedge.com

Vegvisir

Vegvisir is a peer-to-peer blockchain that uses little energy and can work in a partitioned environment where network communication may be intermittent. The prototype runs on Android devices. It currently supports two emergency response applications: a shared annotated map and a shared command and control task list. Using a new technique called Proof-of-Witness, data placed on the blockchain cannot be removed. It also supports additional confidence in the veracity of the data in the blockchain. The Vegvisir application allows UE's to build an ad-hoc network using WiFi in a cellular limited denied area. The applications allow secure, traceable message and data sharing.

How to Use it:

Currently Vegvisir can be installed on any Android device. Each device also requires a cryptographic certificate binding the device to a unique identifier. After that, emergency response applications on the devices can add data to the blockchain and devices automatically reconcile inconsistent blockchains when they are within communication range. The Vegvisir application is installed on Android mobiles or tablets. While disconnected from WiFi networks the devices will locate other devices within range and create an ad-hoc network between all devices. The application then uses a text messaging interface to enable messaging and data to be exchanged between any device or group of devices.

Where to Find it:

GitHub - Vegvisir-IoT/vegvisir-android

Point of Contact:

Hakim Weatherspoon and Robbert VanRenesse

Virtual Reality (VR) Public Safety Environments

PSCR's User Interface and User Experience (UI/UX) Research Portfolio team developed three public safety virtual reality (VR) environments across fire, SWAT, and emergency medical service (EMS) scenarios. These environments were created in partnership with public safety agencies who reviewed and provided feedback to PSCR, helping them improve and make the scenes as realistic as possible. Developers at PSCR have created various user interfaces in these environments with visual indicators, sounds, and voice commands for each scenario. In the future, such interfaces could be embedded in firefighters' masks or smart glasses worn by emergency medical technicians, for example to aid their emergency response. A visual display might show the temperature or audio might warn that oxygen is low in a backpack tank. The intent of these UIs, tested in the virtual environment, is to present helpful data in an intuitive and non-intrusive manner. Before these interfaces are realized, the virtual reality environments serve as a realistic, safe, and economical method for training environments, prototype testing, and data collection and measurement, both for researchers and public safety agencies alike.

Active Shooter Scenario

Mass Casualty Triage Scenario

Commercial Building Fire Scenario

How Public Safety can Test Prototypes:

Agencies can download their discipline-specific environment on their preferred virtual reality platform and set metrics such as timing 'mission completion' or goals within the scenario such as number of shots engaged. Users then assess how a new prototype helps them improve upon those metrics by testing both with and without it in the VR environment. It is recommended to use PC specifications provided by the headset manufacturers as these are what the VR scenarios are tested against. Refer to the specifications provided by Valve below:

- Video Card: NVIDIA GTX 1070 / AMD equivalent or greater
- CPU: Quad Core
- Memory: 8GB RAM
- Video Output: DisplayPort 1.2
- USB Ports: 1x USB 2.0 port (USB 3.0 required for camera passthrough)
- OS: Windows 10

Use Case for Training:

The PSCR Testbed is an open-source tool for developers to leverage in prototyping enhanced user interfaces. It consists of multiple virtual environments that have specific public safety scenarios and tasks to be completed by a participant. The environments also include measurements for assessing general usability metrics and how well the interfaces assist in completing the various tasks. Someone could potentially leverage the environments to extend to a training application, however, that is not the primary focus.

Use Case for Training:

The VR Environments are available on GitHub.

Point of Contact:

Scott Ledgerwood, scott.ledgerwood@nist.gov

WDLN Data Ferry

The WildfireDLN is a generic hardware/software solution establishing a decentralized Data Logistics Network (DLN) via Data Ferries and Command Center Base Stations. The DLN allows for the seamless transfer of data among any network nodes that are within range of each other, with the mobility of the Data Ferries allowing for a large area to become connected quickly. The Data Ferry hardware platform are built from System-on-a-Chip (SoC)-class systems such as the Raspberry Pi, which provide opportunities for low cost and low power, battery-driven deployments that are easily carried into the field on a variety of platforms. The software suite defines the method, rate, and priority of data transfer and can be customized by the end user. The use of a software suite to control communications eliminates the need for homogeneous hardware, enabling an agency to utilize hardware they already have on hand, such as tablets and mobile phones. This capability also will allow for agencies with different hardware to collaborate and share data with ease. With the compute and I/O capabilities of SoC products increasing over time, there is additional opportunity to provide in-situ computation services on ferry nodes in addition to running the core DLN software stack.

How to Use it:

DLN provides a solution when data is needed and Internet or other communication capabilities are not sufficient. The DLN is a decentralized federation of available nodes and connected devices (ferries) with a dynamic architecture that operates over intermittently connected and heterogeneous networks. Ease of use and performance "behind the scenes" is a fundamental feature of DLN. The ferries can be deployed ad hoc or placed in a mesh pattern for full area coverage, depending on the first responders' needs.

Where to Find it:

https://github.com/datalogistics/wildfire-dln

Point of Contact:

Nancy French

Modified Rhyme Test Speech Intelligibility GUI

The purpose of this software is to offer a graphical user interface (GUI) for performing modified rhyme test (MRT) intelligibility research. MRT intelligibility is a subjective measure of how intelligible a given keyword is. Subjects are played audio and asked to select the keyword they think they have heard from a list of 6 keywords. The keywords are all structured as consonant-vowel-consonant. Each list contains keywords that rhyme in a certain sense: either the leading or trailing consonant varies between words in a batch.

How to Use it:

See README on github

Where to Find it:

https://github.com/usnistgov/mrt

Point of Contact:

Sam Ray, samuel.ray@nist.gov

CDVL SAWATCH 2.0 DEMO

CDVL is a digital video library intended for researchers and developers in the fields of video processing and visual quality (both objective and subjective assessment). Progress in these areas have been limited by the availability of high quality royalty-free test material. CDVL provides relevant video clips for different types of video processing and quality measurement applications. This fills a critical industry need.

CDVL's goal is to support and maintain a repository of content and knowledge that will facilitate and foster collaborative research and development in the area of consumer video processing and quality measurement. CDVL accepts and shares contributions of video content that are most relevant for determining the effectiveness of consumer video processing applications (e.g. corrective/reconstructive processing, enhancement, and re-formatting) and quality measurement algorithms. Video clips can be

downloaded for the purpose of assessing visual quality using subjective or objective methods and the results can then be shared with other CDVL users. Video clips can be accessed through a browse and search type of interface that incorporates clip descriptors (e.g., resolution, scanning format, frame rate, chroma sampling structure, content type, coding complexity, etc.) as well as recommended usage guidance (e.g., users may find candidate 1080i video clips that are suitable for de-interlacing applications). CDVL fosters a collaborative approach to maintaining high quality original source content as well as a sharing of research results in the areas of consumer video processing and quality evaluation.

How to Use it:

Upload image to CDVL and allow for algorithm assessment. Overall MOS provided for image quality.

Where to Find it:

https://www.cdvl.org/

Point of Contact:

Margaret Pinson

Analytics Container Environment (ACE)

Analytics development and testing framework based on container concept with user interface to support experimentation and testing of analytic tools - now Cloud compatible and has been tested as an on-demand ACE Cloud service deployment.

How to Use it:

 See the github distribution readme

Where to Find it:

https://github.com/usnistgov/ACE

https://github.com/usnistgov/ACE-UI

Point of Contact:

Jim Golden, edmond.golden@nist.gov

NIST Differential Privacy Challenge Open Source Algorithms

The Analytics Container Environment (ACE) is a tool developed in support of the National Institute of Standards and Technology (NIST) Public Safety Communications Research (PSCR) Division, which provides a modular framework for running containerized analytics on streaming video. As is under active development.

The purpose of the NIST ACE project is to enable easier prototyping of cutting edge analytics to the public safety community. ACE aims to overcome some of the current challenges in prototyping analytics to the public safety community, which include technical challenges such as the lack of standard interfaces between analytics, the experimental nature of analytics (not designed to function as a part of a pipeline or distributed system), and the "black box" nature of analytics. Public safety organizations face other logistical, policy, and resource challenges as well, but our hope is that by addressing the technical challenges and reducing the cost and complexity of deploying analytics over the course of the NIST ACE project, interested organizations will be able to experiment with and utilize analytics in their environments.

How to Use it:

See the documentation for each algorithm set.

Where to Find it:

https://www.nist.gov/ctl/pscr/open-innovation-prize-challenges/past-prize-challenges/2018-differential-privacy-synthetic

https://github.com/usnistgov/ACE

Point of Contact:

Gary Howarth, Gary.Howarth@nist.gov

UVA Cognitive EMS Pipeline

Decision support pipeline for a Cognitive Assistant System for Emergency Medical Serivces (EMS). The system aims to improve situational awareness of the first responders/paramedics by automated collection and analysis of data from incident scenes and providing suggestions to them. The figure below shows the overall architecture of the proposed system. For more information visit the project page at: https://www.nist.gov/ctl/pscr/cognitive-assistant-systems-emergency-response

How to Use it:

See documentation on github.

Where to Find it:

https://github.com/UVA-DSA/EMS-Pipeline

Point of Contact:

Prof. Homa Alemzadeh, ha4d@virginia.edu

CMU Video Event Reconstruction and Analysis (VERA) System

Tools to support reconstruction of events from multiple video and image data clips and multimedia and Digital Evidence Vault: An evidence vault for open source investigations.

How to Use it:

See documentation.

Where to Find it:

https://www.cmu.edu/chrs/technology_program/vera.html

https://www.cmu.edu/chrs/technology_program/dev.html

Point of Contact:

Prof. Alexander G Hauptmann, alex@cs.cmu.edu

SDNET

SDNET - Benchmark data and evaluation tools and metrics for data synthesizers to support research and applications in differential privacy. This package provides tools for standardized and reproducible comparison of synthetic generator models on real-world data and use cases. Both datasets and metrics were developed for and vetted through the NIST PSCR Differential Privacy Temporal Map Challenge. Note: This resource may also qualify as a data set.

How to Use it:

Usage guidelines provided on GitHub with distribution.

Where to Find it:

https://github.com/usnistgov/SDNist

Point of Contact:

Gary Howarth, Gary.Howarth@nist.gov

MCV Testbed: An Open Platform for Experimental Research in Critical Voice Communications

The Land Mobile Radio (LMR) emulator is an open platform for conducting experiments with Mission Critical Voice (MCV) communication systems. MCV systems are employed by most public safety organizations such as law enforcement, emergency medical services, fire, search and rescue, military, and by selected private organization (taxi, logistics, and traffic control). A variety of environmental factors and communication system properties can impair intelligibility, i.e., the comprehensibility of transmitted speech in given conditions. The LMR emulator project provides components that can be used to build a model of a MCV communication system in a controlled environment (lab), plan and execute experiments involving human subjects, and systematically evaluate the influence of various environmental and system parameters on intelligibility.

How to Use it:

The software is designed to be installed on commodity hardware (Intel NUC, Ethernet switches, Raspberry Pi) in a controlled lab environment. All software is freely available from our Gitlab repository at https://gitlab.com/irtlab/mcv-testbed. Installation and configuration instructions are provided together with the software.

Follow the installation instructions to setup your own testbed. Review the documentation in the GitLab wiki and make pull requests. The source code is freely available on GitLab under the MIT license. Use the issue tracker to submit feature requests and report bugs.

Where to Find it:

Project website: https://irtlab.gitlab.io/mcv-testbed

Point of Contact:

Jan Janak, Artiom Baloian, Dan Rubenstein, Henning Schulzrinne

Analytics ACE Nano ⚙️

ACE Nano is an extension to ACE framework tools to support use of NVIDIA Nano GPU processor to accelerate computer vision processing.

How to Use it:

This repo contains the work done to integrate the Nvidia Nano IoT device into the ACE framework. It is setup in two components. Jetson setup and the YOLO (darknet) inference server. Please see project website below for further instruction.

Where to Find it:

Project website: https://github.com/usnistgov/ace-nano

Point of Contact:

Jim Golden, edmond.golden@nist.gov

EasyVizAR: Edge-supported Augmented Reality for Visual Collaboration in Indoor Scenarios 🤝

EasyVizAR provides a comprehensive solution for visual collaboration between emergency responder team members through augmented reality (AR) equipment. Our solution demonstrates the capabilities of AR to enhance situational awareness and collaboration among team members in indoor scenarios. Some of the demonstrated capabilities include easy access to maps with synchronized landmark points, visual navigation cues to a target point, and a command dashboard providing a top-down view of the situation. EasyVizAR incorporates a modular edge computing system that augments the capabilities of AR devices and ensures secure and responsive exchange of critical data among team members of different roles.

How to Use it:

EasyVizAR can be set up easily with an Ubuntu server, one or more Microsoft HoloLens 2 devices, and a WiFi network. Follow the installation instructions linked from our GitHub organization to set up your own testbed. The edge server source code is freely available on GitHub under the MIT license. Discuss with our development team on GitHub, submit feature requests, or report bugs.

Where to Find it:

Project website: https://github.com/EasyVizAR

Point of Contact:

Suman Banerjee suman@cs.wisc.edu, Lance Hartung hartung@cs.wisc.edu

SearchAR : An Augmented Reality System for Enhancing Onsite Wayfinding and Situational Awareness 🤝

The SearchAR Interface is a cutting-edge augmented reality (AR)-based system designed to enhance wayfinding and situational awareness in emergency response, crucial functions for onsite dispatch supports. It equips users with an immersive AR experience, enabling real-time interaction with various spatial information and environmental factors. With its hand-attached menu activation, users can effortlessly navigate through a suite of controls to adjust and monitor critical variables such as building layout and proximity to hazards like fire. This interface provides augmented visualization of the environment in different forms – 2D map, interactive 3D map, projected waypoint markers, and a global view of entire building at 1:1 scale. It also provides analytical functions such as a customizable and intuitive control panel that adapts to the unique demands of emergency response, field operations, and complex situational assessments. SearchAR's innovative approach to environment interaction promises to transform how we understand and respond to our surroundings, making it an essential tool for sectors that rely on rapid, informed wayfinding decision-making.

How to Use it:

Download, unpack and install the Unity project to your Windows PC. Setup HoloLens2 with Wi-Fi hotspot to enable the interactions. Review the user manual for detailed operation instructions.

Where to Find it:

https://www.dropbox.com/scl/fo/95yjg2d7ljvvigpeb8lvh/h?rlkey=j0ru6ii5hud8qsdcpx6jco93f&dl=0

Point of Contact:

Jing Du, eric.du@essie.ufl.edu; Fang Xu, xufang@ufl.edu

DATA SETS

Audio Quality and Intelligibility Project

Public Safety Communications Research (PSCR) created measurement capabilities and simulated operational environments to complete public safety user testing for Program 25 (P25) and newer vocoders technologies. The goal of the Audio Quality and Intelligibility project is to understand how background noise affects radio communications, and to determine how technology choices can accentuate or mitigate background noise issues. The audio codec (also called speech codec, voice coder, or vocoder) is a key hardware/software component in every digital radio or handset. At a transmitting location, the codec processes incoming audio into a concise digital representation for efficient transmission over the air. At the receiving location, the codec converts this digital signal back into an approximation of the original audio signal.

Collaborate with PSCR:

The PSCR program, in collaboration with the Department of Homeland Security Office of Interoperability and Compatibility, works with practitioners to develop and implement tests that measure how digital radios and other communication system components operate in the presence of loud background noise.

Reports and Data:

PSCR published four major reports containing speech intelligibility measurements results for many existing and emerging radio systems and other communication system components. These reports fully document the carefully controlled conditions and rigorous statistical tests that are paramount to the measurements. Reports and data are available at www.pscr.gov and www.its.bldrdoc.gov:

- Speech Codec Intelligibility Testing in Support of Mission-Critical Voice Applications for LTE
- Intelligibility of Analog FM and Updated P25 Radio Systems in the Presence of Fireground Noise: Test Plan and Results
- Intelligibility of the Adaptive Multi-Rate Speech Coder in Emergency-Response Environments
- Intelligibility of selected radio systems in the presence of fireground noise: Test plan and results

Download audio source files using the following instructions:

1. Review the Terms of Use following these steps. Ensure you are in agreement with the terms of the license. If you do not agree with the terms, do not download the packages.
2. If you agree with the Terms of Use, download the packages.
3. In the file list, click the name of a compressed file to download it.

Point of Contact:

Jim Golden, edmond.golden@nist.gov

Fire Data Lab

Western Fire Chiefs Association (WFCA) partnered with Interra to build a data analytic framework that creates live connections to the data systems of fire departments. The award enabled WFCA to deploy the analytics technology to fire departments nationwide. This provided opportunities for fire departments to receive training, ongoing guidance, and technologies required to engage in data analytics, also facilitating collaboration across departments. These tools immediately provided each department with the capacity to conduct cross-domain performance analysis in a common framework. To date, this framework, called the Fire Data Lab (FDL), facilitates data storing, sharing, and analytics for over 36 fire departments serving a population of over 20 million people. To date, over 3 million National Fire Incident Reporting System (NFIRS) Emergency Incidents are included in the Fire Data Lab, and 2 different sets of data have been set aside for immediate checkout and use by research institutions:

1. Year 1 Fire Data Lab Set (Jan-Mar 2018 unit & incident results of participants)
2. Year 2.1 Fire Data Lab Set (Jan – Mar 2019 unit & incident results of participating PSOs)
3. Year 2.2 Fire Data Lab Set (April – June 2019 unit & incident results of participating PSOs)

How to Use it:

This newly available dataset is anonymized and shared with the federated, cloud-based FDL warehouse. Authorized users can interact with the live, dynamic data pool of millions of calls from across the Western United States with tools for comparative analytical capabilities, community metrics, regional trending, and predictive incident forecasting based on time and location.

Disclaimer: Much care was taken to ensure that the data is as clean as possible. All data submitted by agencies must comply with the XML standard and is exposed to several error rules upon processing. However, for the most part, the NFIRS ingest does not correct any identified errors (outside of minor formatting at ingest). The FDL program does not have the authority to require agencies to correct errors retrospectively, but errors are viewable and known by the agencies, with hopes of future data refinement. Thus, the information contained in this dataset is provided as reported by the participants.

For More Information:

Learn more and sign up to receive news updates on the Fire Data Lab website and to make a request for data for your research purposes contact David Van Ballegooijen.

Publication:

https://firedatalab.com/wp-content/uploads/2019/06/Community-Solutions-Summit-Report-Final.pdf

Point of Contact:

Western Fire Chiefs, David Van Ballegooijen, dave@wfca.com

IoT Data Foundations Project Feedback Form

The purpose of the IoT Data Foundations Project website is to provide stakeholders and interested parties with information regarding foundational IoT data schemas derived from the DHS Publication "Data Foundations for First Responders." This information will be used to refine current PSCR research regarding IoT data and to develop future research.

How to Use it:

The Google Form allows participants to provide feedback on the featured data objects or the website itself. The link can be accessed via the webpage: https://www.nist.gov/ctl/pscr/iot-data-foundations-project

Participants may provide contact information or post anonymously. They need only fill out the sections relevant to them, separated according to the webpage content. After submitting the information, it will be sent to PSCR

Where to Find It:

PSCR Website – IoT Data Foundations Project

https://www.nist.gov/ctl/pscr/iot-data-foundations-project

Direct Link:

https://docs.google.com/forms/d/e/1FAIpQLSdfvVv2ZNPPl1aGEgrgxT8Uuxkdr-TGvya_PJdnWytbcs5R7g/viewform

Publication:

https://firedatalab.com/wp-content/uploads/2019/06/Community-Solutions-Summit-Report-Final.pdf

Point of Contact:

Alison Kahn, alison.kahn@nist.gov

PSCR Usability Results Tool: Voices of First Responders

In order to understand the first responders, their experience, and their needs related to public safety communication technology, the NIST PSCR Usability Team conducted a multi-phase, exploratory sequential mixed methods study, including a series of in-depth interviews with approximately 200 first responders and a nationwide, large-scale survey completed by over 7,000 first responders in 911/Dispatch, Emergency Medical Services (EMS), Fire Service, and Law Enforcement. The results of these interviews informed a nationwide, large-scale survey completed by over 7,000 first responders. This tool provides public access to over 20,000 first responder quotes from the first responder interview data, as well as the 7,182 survey responses. This tool also provides a means to analyze the survey results, creating charts and tables dynamically based on filter selections. Any interview quotes or survey results used in published materials should properly attribute this tool as well as the appropriate NISTIR reports in the series of volumes published.

How to Use it:

Search results for both tools are displayed in tabular format with sortable, customized columns. Visit the Frequently Asked Questions page for both the Survey Results Tool and the Interview Quotes Tool to learn more about how to navigate the results, filter data, and download a PDF.

Where to Find it:

The PSCR Usability Results Tool is available on the NIST website.

Point of Contact:

For more information about the NIST PSCR Usability Team research, or for questions regarding the PSCR Search Tool, please send an email to usability@nist.gov.

Automated Streams Analysis for Public Safety (ASAPS) Development Dataset

Multi-modal dataset to support AI research in automated emergency detection, alerting, and characterization created by Lafayette Group Inc. under NIST Contract #GS-23F-0134N for PSCR. Designed to capture a day in the life of a small artificial city with emergencies observed from 42 different data streams – video, 911 calls, dispatch communications, CAD records, social media postings, and gunshot sensor data. The data is a combination of staged/enacted emergencies and synthetic data. The dataset consists of 8 continuous hours and contains 150 actors, 42 synchronized data streams, 29 camera views, 911/dispatch audio communications, CAD records, social media postings, gunshot sensor data, event and evidence ontology, 62 annotated emergencies, and 950 evidence annotations. The dataset was made available on December 12th, 2021.

How to Use it:
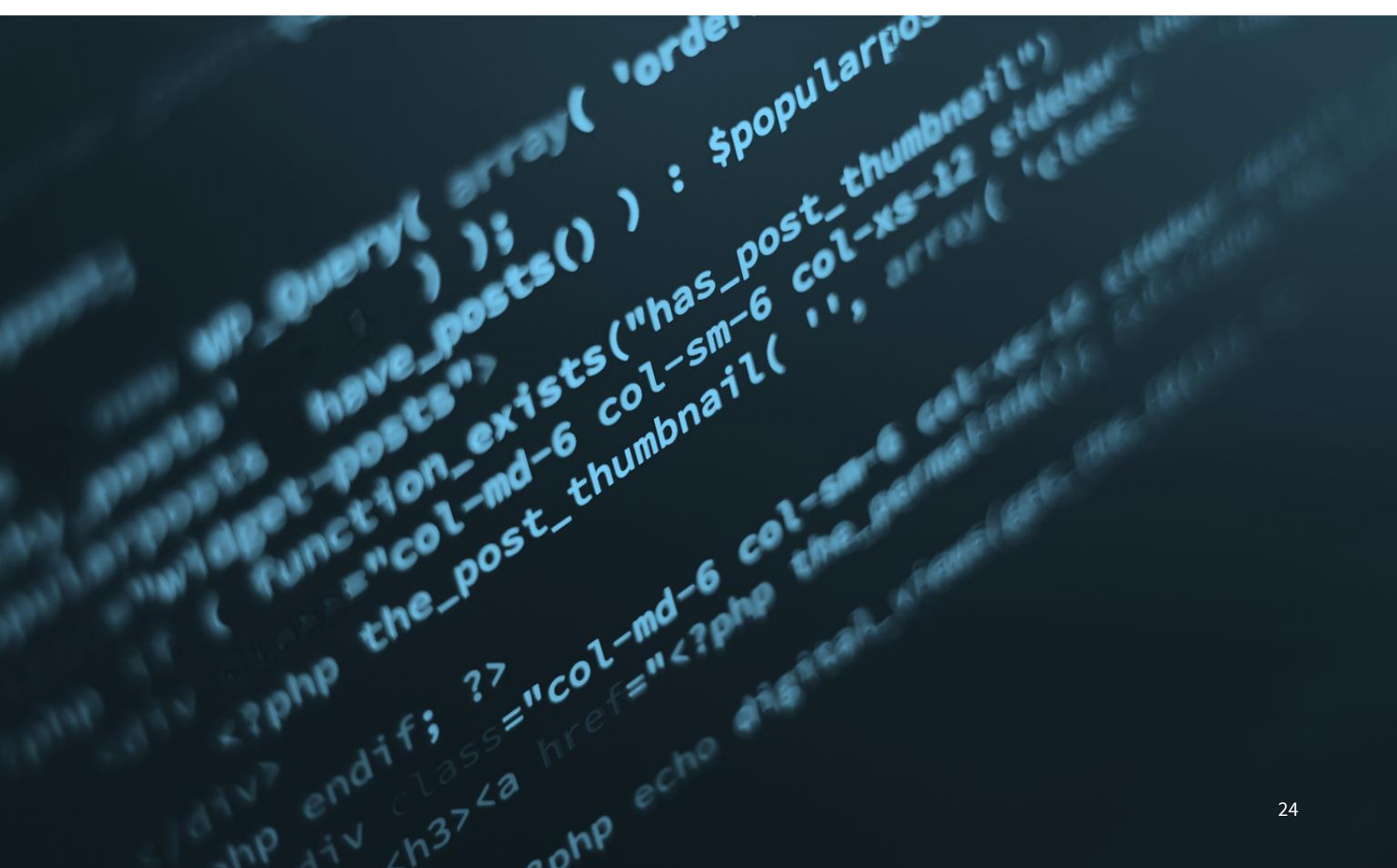
Usage guidelines provided with cloud distribution.

Where to Find It:

Data available via Cloud distribution at: https://asapsdata.nist.gov

Registration and signed data use agreement required.

Point of Contact:

asaps_poc@nist.gov

OTHER MATERIALS

i-Axis Best Practices Guide

The i-axis Best Practices Guide is a collection of guidelines and recommendations from innovators and early adopters for addressing common public safety problems and solutions for Indoor Location-Based Services. The Best Practices Guide is based on functionality that is currently available. It focuses on technology related to indoor mapping, tracking, and navigation and seeks to provide guidance to the public safety community while also identifying gaps in technology in an ever-changing world.

How to Use it:

Download the PDF at the i-Axis website.

Where to Find it:

https://i-axis.napsgfoundation.org/

Point of Contact:

i-axis@publicsafetygis.org

HazVR

HazVR is a completely new approach to prepare for HazMat incidents and risks. For the first time, trainees can grasp essential, hands-on HazMat skills that would normally be impossible to teach without exposing the trainee to dangerous live agents.

How to Use it:

Trainees are able to practice proper air monitoring habits and learn to interpret readings, thanks to a realistic air monitor that simulates all of the behaviors and limitations of the real thing. Virtual monitors demonstrate accurate (T90) sensor times when placed into gasses, alarm at the correct levels, and otherwise behave indistinguishably from real instruments.

Trainees enter into a variety of scenarios hand-crafted by expert HazMat trainers to impart critical knowledge, not only in respect to the proper usage of their instruments but also the behaviors and properties of the gasses they are trying to detect.

For More Information:

Immersive HazMat Virtual Reality Training | NIST

Point of Contact:

Contact us at hazvr@nextgeninteractions.com

to discuss options for utilizing HazVR with your organization.

	Classroom	Live-Action	On-The-Job	HazVR
Team Training	✔	✔	✔	✔
Engaging		✔	✔	✔
Experiential		✔	✔	✔
Safe	✔	✔		✔
Visualize Gases				✔
After-Action Reviews		✔	✔	✔
Metrics				✔
24/7 Access				✔

RESOURCE LIBRARY

Resource Library

PSCR is dedicated to helping the research community flourish by providing valuable resources including a comprehensive collection of reports, studies, and publications. View all PSCR publications and available resources in one location. Organized by portfolio area, the PSCR resource library provides access to recent research updates and articles to date.

How to Use it:

Visit the Resource Library to learn more about recent research breakthroughs and understand the challenges that lay ahead; discover considerations recommended for various devices or protocols; and hear from researchers about emerging technologies in the public safety world.

Browse by the following research areas:

- User Interface/User Experience
- Mission Critical Voice
- Location-Based Services
- Public Safety Analytics
- Security
- Resilient Systems

Navigate quick links to view the most popular and most recently published resources.

Check out featured student research.

Watch topic-specific webinars as part of PSCR's webinar series.

Point of Contact:

Email, pscr@nist.gov

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