Computer-Aided Dispatch Interoperability Strategies for Success

March 2023

National 911 Program

911.gov

About the National 911 Program

The National Highway Traffic Safety Administration (NHTSA) National 911 Program (Program), in the Office of Emergency Medical Services (OEMS) at the United States (U.S.) Department of Transportation (DOT), provides leadership and coordination of federal efforts that support 911 across the nation. A seamless interoperable 911 system-of-systems across the U.S. advances NHTSA's mission to eliminate fatalities, illness, and injuries from motor vehicle crashes and improve post-crash care.

The Program works with many stakeholders—including federal, state, local, tribal, and territorial (FSLTT) governments, technology vendors, public safety officials, and 911 professionals—toward a goal of advancing 911 that takes advantage of existing and emerging communications technologies, improving response times and information available to first responders prior to and during a 911 incident.

About this Document

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Final Report

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Table of Contents

Executive Summary

The National Highway Traffic Safety Administration (NHTSA) National 911 Program (Program), in the Office of Emergency Medical Services (OEMS) at the United States (U.S.) Department of Transportation (DOT), provides leadership and coordination of federal efforts that support 911 across the nation.

NHTSA states on its web site that it "… works to ensure that complete, accurate, and timely traffic safety data is collected, analyzed, and made available for decision-making at the national, State, and local levels. Analyzing reliable and accurate traffic records data is central to identifying traffic safety problems and designing effective countermeasures to reduce injuries and deaths caused by crashes."[1] Computer-aided dispatch (CAD) is the beginning point of data collection for traffic records as some of the data described above is extracted from CAD systems.

A CAD system provides essential information for the proper handling of a 911 call. During nearly every emergency incident, the caller relates vital details of the incident to the emergency communications center (ECC), commonly referred to as a public safety answering point (PSAP), that receives the call. This data is then captured in the agency's CAD system (if so equipped) and is critical—both for the caller and the emergency responder—to the subsequent emergency response to that incident.

A critical component in the evolution of 911 call services over the last several decades has been the ability to route calls to the correct ECCs to ensure callers are speaking with the ECC that delivers services to that jurisdiction. As 911 matured, the ability to re-direct misrouted calls from one ECC to the correct ECC also improved greatly. However, as the interconnectivity between ECC 911 telephony technology has evolved, no such level of interconnectivity or data-sharing interoperability has occurred between CAD systems to provide the ability for the ECCs to share data captured from each caller. There is little data sharing between ECCs, which has had a detrimental effect on emergency response. Particularly with multijurisdictional events, the lack of data sharing affects surrounding ECC's abilities to provide coordinated responses and assistance. Improved data communications between ECCs and first responders across jurisdictions are vital to forwarding more accurate information, potentially expediting response and improving life-safety outcomes.

Recognizing that the lack of CAD data-sharing capabilities can potentially impact the reliability and accuracy of collected crash data, the Program sponsored a series of symposiums with 911 practitioners, 911 partner entities and associations, vendors who provide CAD solutions, and non-CAD solution providers that offer software platforms that augment emergency response to discuss their experiences, successes, and challenges concerning CAD data interoperability. Multiple technical and operational issues were identified that have stalled progress toward CAD interoperability and data sharing. The path moving forward requires a two tiered approach. A local grassroots approach, accompanied by a national resource center to support local efforts, along with a national-level approach that explores national leadership to advocate for standards adoption and funding.

[1] Traffic Records | NHTSA

1 Background

Before computer-aided dispatch (CAD) systems were ubiquitous, dispatchers used cards and pads of paper to track activity within a 911 center. Public safety communications systems operated predominantly as standalone systems serving a particular geographic (and very local) area. Today, data shared through CAD reaches well past the dispatch center; it provides downstream records to all agencies in the public safety ecosystem, from police, fire and emergency medical services (EMS) to even criminal trial proceedings, as well as public and media outlets via Freedom of Information Act requests. As technology continues to advance and evolve, the capabilities of CAD have grown, but so has the demand for access to shared data.

Improved data communications between emergency communications centers (ECCs), commonly referred to as public safety answering points (PSAPs), and first responders, and across jurisdictions, are vital to agency response and improved life-safety outcomes. Information captured about an incident in one jurisdiction can make the difference between the life or death of a citizen or first responder in another. There is little data sharing between jurisdictions, which has had a detrimental effect on emergency response. Particularly with multijurisdictional events, the lack of data sharing affects surrounding communications centers' abilities to provide coordinated responses and assistance.

In recognition of the challenges posed by a lack of interoperability between CAD systems, the National Highway Traffic Safety Administration (NHTSA) National 911 Program (Program) commissioned the CAD Interoperability Project. The Program sponsored a series of exploratory efforts into the current state of the CAD industry's ability to support information sharing across jurisdictional boundaries, analyze industry stakeholder feedback on the gaps to true data transfer across CAD platforms and determine what solutions might be implemented to further seamless data sharing nationwide.

2 Purpose

The Program has long been a proponent of advancing 911 emergency communications nationwide. The Program initiated this investigation into the state of CAD system interoperability with the intent of identifying strategies to advance enhanced data exchange among emergency communications centers (ECCs), commonly referred to as public safety answering points (PSAPs). The strategies are intended to be actionable—not merely academic. Understanding the everyday challenges faced by ECC practitioners, the Program seeks to create a framework where actionable strategies are easily accessible to minimize hurdles for ECCs in pursuing greater interoperability.

3 Methodology

3.1 Stakeholder Engagement

To fully understand the challenges of CAD data sharing and to formulate strategies to overcome those challenges, the Program determined that stakeholder engagement was a critical aspect of this initiative and engaged relevant industry stakeholders. The stakeholders who participated in this effort come from a broad spectrum of the industry and are detailed in the following sections.

3.1.1 ECC Practitioners

Although all stakeholders are important, the input of ECC personnel who deal with data-sharing challenges daily was deemed to be critical to this initiative. Active personnel employed at ECCs across the county were invited to participate. An open invitation was distributed via a press release to solicit volunteers for this project; over 80 people volunteered for the symposium. The volunteers were asked to provide specific information to enable the Program to make final selections, based on multiple criteria, to obtain a cross-section of representatives. Representing a cross-section of ECCs by geographical region, geographical area, ECC size, population, and roles at the ECC, 13 ECC personnel were selected. Additional volunteers were selected to participate in follow-up discussions and collaboration sessions. These additional volunteers either faced unique challenges or had experience with CAD-to-CAD data sharing. Agencies participating in this effort are shown in the following table.

Table 1: ECC Participants

Anoka County Emergency Communications, Anoka, Minnesota	Arlington County Emergency Communications Center, Arlington, Virginia
Calcasieu Parish Public Safety Communications District, Lake Charles, Louisiana	City of Goodyear Police Department, Goodyear, Arizona
Kingman Fire Department Communications Center, Kingman, Arizona	Northwest Central Dispatch System, Arlington Heights, Illinois
Northwest Regional Emergency Communications Center, Dublin, Ohio	Orange County Fire Authority, Irvine, California
Ouachita Parish 911 Communications District, West Monroe, Louisiana	Portland Dispatch Center Consortium/Clackamas County, Oregon City, Oregon
Pinellas County Safety & Emergency Services, Pinellas County, Florida	Snohomish County 911 (SNO911), Everett, Washington
Southeastern Massachusetts Regional 911 District, Foxborough, Massachusetts	State of Oklahoma
West Baton Rouge Office of Homeland Security, Emergency Preparedness and 911, Port Allen, Louisiana	Will County 911 Emergency Telephone System, Joliet, Illinois

Windsor Police Service, Windsor, Ontario, Canada	

3.1.2 CAD Solution Providers

CAD solution providers were invited to participate in a symposium as they play a key role in the ability to share CAD data. A broad cross-section of solution providers participated, ranging from large solution providers to relatively new, startup providers. Additional CAD solution providers were selected for follow-up discussions. Solution providers participating in this effort are shown in the table below.

Table 2: Solution Providers

Caliber Public Safety	CentralSquare Technologies	CSI Technology Group
Hexagon Safety and Infrastructure	Mark 43	Motorola Solutions
Ryzyliant, Inc. d/b/a/ ez911	Soma Global	Sun Ridge Systems
Tyler Technologies	Versaterm Public Safety	

3.1.3 Partner Agencies

The role of partner agencies and their influence on policy and standards cannot be overlooked and was critical to this initiative. National organizations that have been supporting ECCs—the Association of Public-Safety Communications Officials (APCO) International, the National Association of State 911 Administrators (NASNA), the National Emergency Number Association (NENA), and Integrated Justice Information Systems (IJIS) Institute—participated in this effort and provided consequential feedback.

3.1.4 Non-CAD Solution Providers

Non-CAD solution providers bridge the gap between non-traditional sources of data applications and public safety telecommunicators and first responders with software platforms that augment emergency response. Their input was important in this initiative as many are trying to close the interoperability gap. Entities that participated in this effort are shown below.

- Advanced Technology International (ATI)
- Emerging Digital Concepts (EDC)
- RapidSOS
- Rave Mobile Safety (Rave)

3.2 Procedures

The Program used a variety of procedures to engage stakeholders. ECC practitioners were invited to participate in a symposium to discuss CAD data sharing. The symposium included dialog on data-sharing challenges, question and answer sessions, whiteboard sessions, and a solutions discussion. A second symposium, following the same format, was held with the solution providers and ECC practitioners.

Additional ECC practitioners and solution providers met with the Program. Dialog and collaborative discussions were held with partner agencies as well as non-CAD solution providers. The symposiums and all subsequent exchanges were facilitated by experienced subject-matter experts (SMEs).

Reports were created during this initiative and published for further review and comment.

A final virtual meeting was held with the ECC practitioners to explore and finalize strategies to address data sharing.

3.3 Materials

PowerPoint presentations containing discussion topics and video presentations were used to facilitate discussions regarding data-sharing challenges during the symposiums. Virtual whiteboards preloaded with structured questions were also used during the symposiums and permitted both the ECC practitioners and solution providers to respond anonymously. Data collected during the symposiums was used to formulate questions and facilitate discussions for subsequent deliberation.

3.4 Reporting

Each task within this effort produced a final written report as a deliverable shared with participants to ensure the ideas were captured accurately. The tasks were designed to methodically build on each other and assist in the production of this final report that touches upon the current status of CAD interoperability, the feedback and recommendations from 911 industry stakeholders, and strategies to consider to further the industry toward data-sharing interoperability.

4 Challenges to Data Sharing

4.1 ECC Stakeholder Perspectives

4.1.1 Consequences of Inability to Share Data Across Jurisdictions

ECC stakeholders were quick to provide feedback on the detrimental impact that the lack of data sharing across jurisdictions has on emergency responses. The fact that ECCs have valuable information in their possession obtained from callers in distress that they cannot easily share with their ECC counterparts in neighboring jurisdictions is a systemic problem throughout the country. Although these ECC practitioners can transfer a caller over the 911 phone system or via an Emergency Services Internet Protocol (IP) network (ESInet), where available, most cannot transfer any data captured within their CAD system from that caller. This data includes the nature of the incident, more precise location data of where the incident occurred, evolving characteristics of the incident, people involved, and the ECC's preliminary assessment of whether police, fire, or EMS resources or all three are warranted. The ECC stakeholders advised that they have experienced serious emergency response issues due to the absence of data sharing. Figure 1 below details some of the issues the ECC stakeholders encounter.

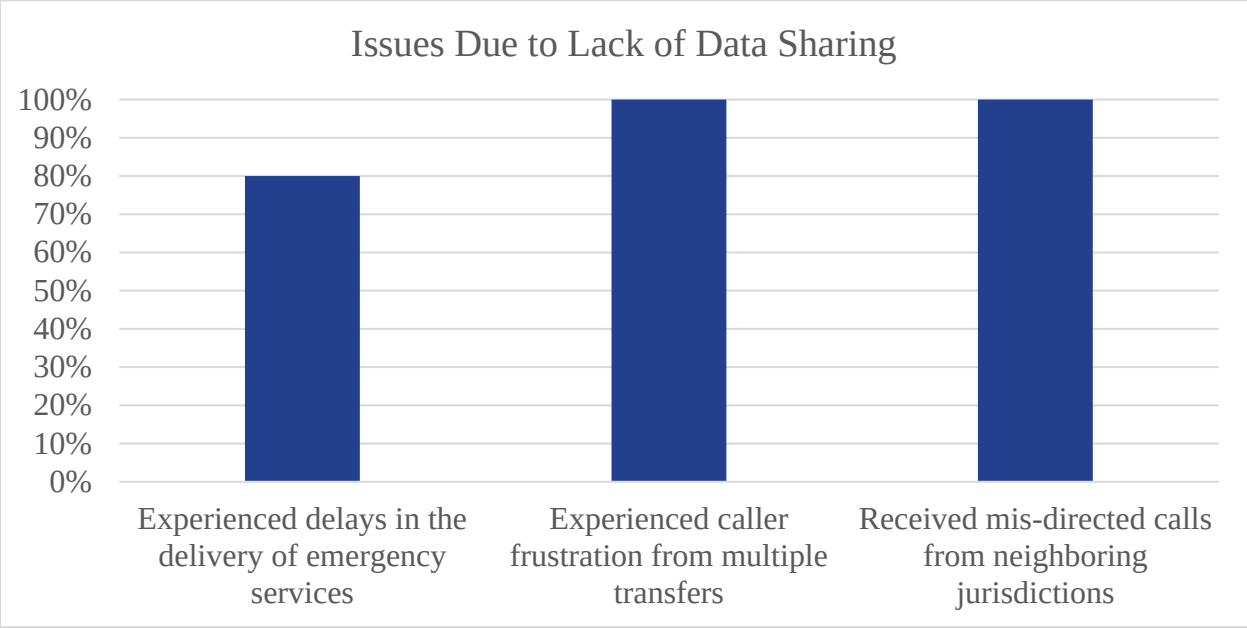

Figure 1: ECC Identified Issues Due to Lack of Data Sharing

4.1.2 Primary Obstacles to Seamless Data Sharing Between Jurisdictions

The ECC stakeholders cited several key challenges to CAD interoperability that hinder a jurisdiction's capability to integrate with neighboring ECCs or establish data exchange hubs (DEHs) to facilitate the integration of multiple ECCs. The leading impediments to data interoperability are summarized in Figure 2 below. Primarily, the stakeholders identified items such as a lack of funding, lack of standards and standards enforcement, the need for common terminology, disparate policies and procedures, political

hurdles as well as other challenges. These areas are examined in greater detail in the sections that follow.

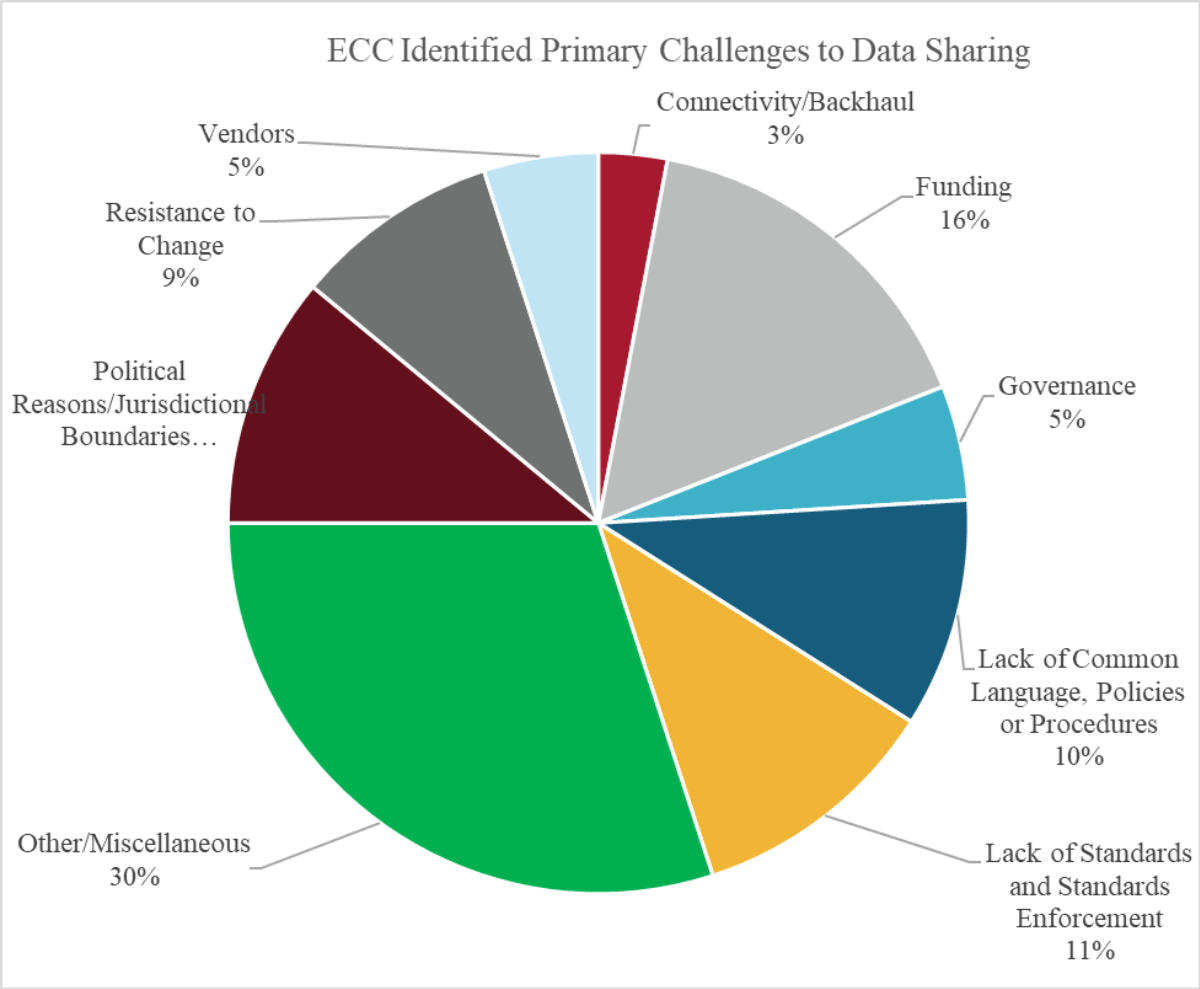

Figure 2: ECC Identified Primary Challenges to Data Sharing

4.1.3 Funding

The ECC stakeholders noted that one of the most significant obstacles to data sharing is cost and securing appropriate funding. The cost to add data-sharing capabilities on top of the already prohibitive cost of a new CAD system, including start-up and long-term maintenance costs, is beyond the financial ability of many agencies. In many cases, there is a lack of support to provide additional funding to extend data capabilities beyond jurisdictional boundaries. One stakeholder, who is part of a successful DEH that interconnects several CAD systems, advised that the solution provider of their DEH previously charged $100,000 to connect a new agency to the hub, which did not include the ongoing maintenance to support the connection. It should be noted that this does not cover the cost for the initial implementation of a DEH; the $100,000 noted here is to connect an agency to a pre-existing hub and translate their data into a consumable format by other agencies.

The stakeholders also observed that many ECCs are cost-conscious, with other budgetary items to consider (e.g., personnel costs, other systems) and are unwilling to spend on the necessary technology enhancements required for data sharing. It was also noted that many small ECCs simply do not have the budget to implement data sharing with their neighboring ECCs. A majority of ECC stakeholders believe that funding at a national level would help alleviate budgetary deficiencies across ECCs.

4.1.4 CAD Interoperability Requires Standards

The stakeholders agreed that there is no national body or 911 authority to enforce national standards such as those published by APCO or NENA.

In October 2022, NENA published the Emergency Incident Data Object (EIDO)[2] specification, which has become the de facto standard for emergency incident data exchange. NENA notes the information that can be contained in an EIDO as follows:

> *An EIDO contains information about a single incident including: the calls related to that incident, the responders assigned to the incident, the participants and vehicles involved in the incident, etc. EIDOs will often include the caller's information like name, number, and location. EIDOs can also include agents' notes, information about responder equipment, agencies involved in the incident, and lots of other incident information.*[3]

The stakeholders noted that APCO and NENA are good for setting standards but have no enforcement authority to ensure they are adopted by ECCs and solution providers. The overwhelming majority of stakeholders believe some entity or government authority (most likely state) should be responsible for standards enforcement (see Figure 3 below).

[2] https://www.nena.org/page/EIDO
[3] NENA-REF-011.2-2019_EIDO_&_I.pdf (ymaws.com)

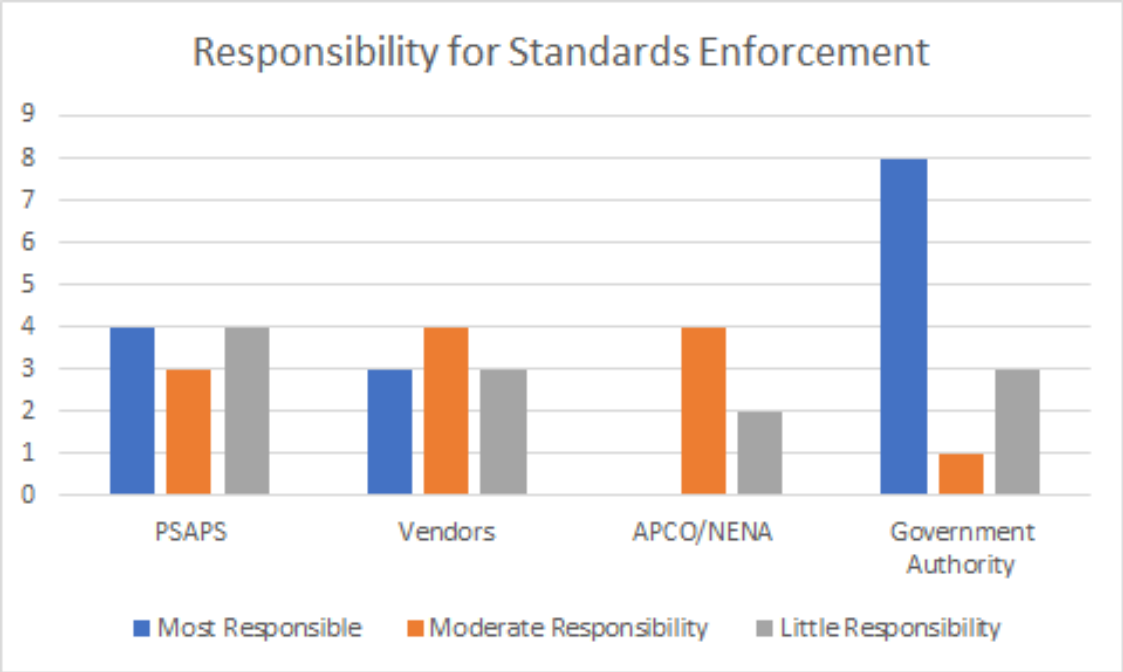

Figure 3: ECC Opinion on Responsibility for Standards Enforcement

Some stakeholders believe that there is a need for umbrella standards at the federal level and more refined standards at the state level, and if these federal and state standards are not in place, no one will play by the rules. Other stakeholders believe that government involvement could take too long to put standards in place and could result in inadequate outcomes. Some stakeholders noted that there are already far too many agencies involved in 911 operations, which leads to confusion rather than clarity, and cited as an example the National Incident-based Reporting System (NIBRS)[4] for reporting criminal offenses to the Federal Bureau of Investigation (FBI). While there is a national standard to which all police agencies must adhere, NBIRS allows states to apply other data elements to the standard that are specific to the state beyond what the FBI wants to collect. Such a national standard for emergency incident reporting, if adopted by ECCs and the CAD solution providers, could be of great benefit in correcting the disparities that exist today.

4.1.5 Standard Business Practices - Common Protocols and Procedures

Many stakeholders believe that some business practices contribute to the lack of data sharing. For example, many ECCs are reluctant to change their operations, embrace new technologies, or adopt practices that do not align with their operational model. Some ECCs are just risk-averse and are reticent to do things differently from the institutional norm that has been inculcated into their operations. In the stakeholders' experiences, they have seen ECCs or government authorities that are simply unwilling to share data or relinquish control. Others cited the sensitive nature of some CAD data—the Health Insurance Portability and Accountability Act (HIPAA) protecting medical information and the FBI's

[4] https://www.fbi.gov/services/cjis/ucr/nibrs

Criminal Justice Information Services (CJIS) policy protecting CJIS-specific information were also noted as barriers to data sharing.

Poor governance, or a lack of governance, is another area prohibiting seamless data sharing. ECCs can be under the domain of multiple entities (e.g., sheriff's offices, police departments, county boards, and other groups), resulting in both operational and political barriers. The differing entities that control ECCs have varied response standards, further contributing to the lack of data sharing. The ECC stakeholders noted that a lack of standard policies and procedures across jurisdictions creates a significant obstacle to data sharing.

4.1.6 Need for Common Terminology

Most stakeholders agreed that the lack of common terminology across jurisdictions is a major impediment to uniformity and seamless data sharing. DEHs serve as the middleware in several jurisdictions to translate incident types in one jurisdiction into an understandable incident type in a neighboring jurisdiction. In 2019, APCO updated its *Public Safety Communications Common Incident Types for Data Exchange* (APCO 2.103.2-2019).[5] Using an excerpt from the document, refer to Figure 4 below, one can see that five motor vehicle crash types have been utilized in the standard.

MVA	MOTOR VEHICLE ACCIDENT, NO INJURY - CAN BE RECEIVED AS AUTOMATED CRASH NOTIFICATION	Motor vehicle accident, no injury - can be received as automated crash notification
MVAHR	HIT & RUN	Vehicle accident hit & run
MVAINJY	MOTOR VEHICLE ACCIDENT WITH INJURY - CAN BE RECEIVED AS AUTOMATED CRASH NOTIFICATION, INCLUDES CAR, PEDESTRIAN, ATV ACCIDENTS	Motor vehicle accident with injury - can be received as automated crash notification, includes car, pedestrian, ATV accidents
MVAUNK	MVA UNK	Motor vehicle accident unknown injury can be received as automated crash notification crash notification
MVCP	MOTOR VEHICLE COLLISION ON PRIVATE PROPERTY	

Figure 4: Motor Vehicle Accident Types

4.2 CAD Solution Provider Perspectives

4.2.1 Perspective on Interoperability Obstacles

Solution providers related similar obstacles as those reported by the ECC stakeholders but shared a commercial marketplace perspective that provides unique insights into the interoperability dilemma. Namely, the solution providers are driven by the customers and the marketplace that require software

[5] https://www.apcointl.org/~documents/standard/21032-2019-common-incident-type-for-data-exchange/?layout=default

that can be tailored or configured to customer-specific needs. The CAD providers related that they are never asked to deliver software that adheres to a standard other than the customer's specific standard. They related that if the marketplace required conformance to an established standard and the customers required compliance, it would likely alter this mindset, but currently this is not the case.

One solution provider noted that interrelationships between agencies could be an obstacle. Jurisdictions are typically very careful and protective of their data, which impacts efforts in interagency information sharing. However, when asked what obstacles most hindered data sharing, solution providers overwhelmingly cited a lack of standards as the critical element (see Figure 5).

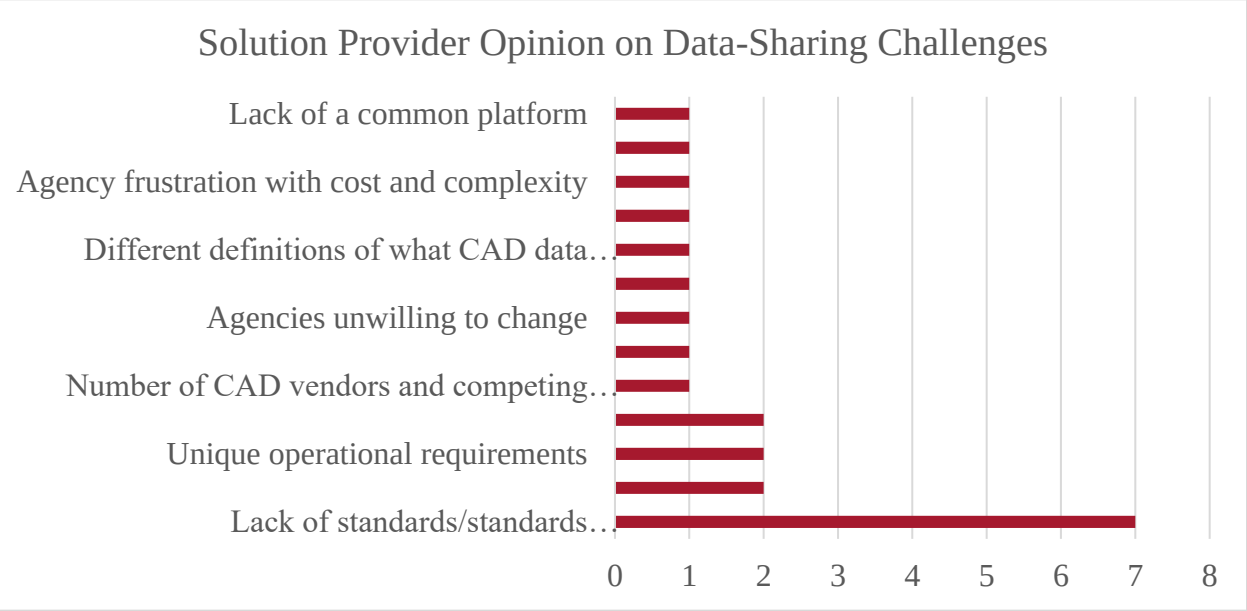

Figure 5: Solution Provider Opinion on Data-Sharing Challenges

4.2.2 EIDO Standards Compliance

The solution providers noted that the approach to making CADs interoperate is lacking. Most CAD systems were developed as the system of record for an agency. The CAD systems are not designed to interoperate easily with other applications. There are difficulties in translating nature, address, and other important incident properties. Different CAD systems can have different rules about what types of incidents can be processed and what data those incidents are required to have or not have. Moreover, the same CAD system may be configured differently from one ECC to another, further complicating seamless data sharing.

The solution providers were asked whether their CAD product(s) would be compliant with the EIDO standard or whether they had intentions to align with the EIDO standard. Figure 6 represents the responses of the nine CAD providers.

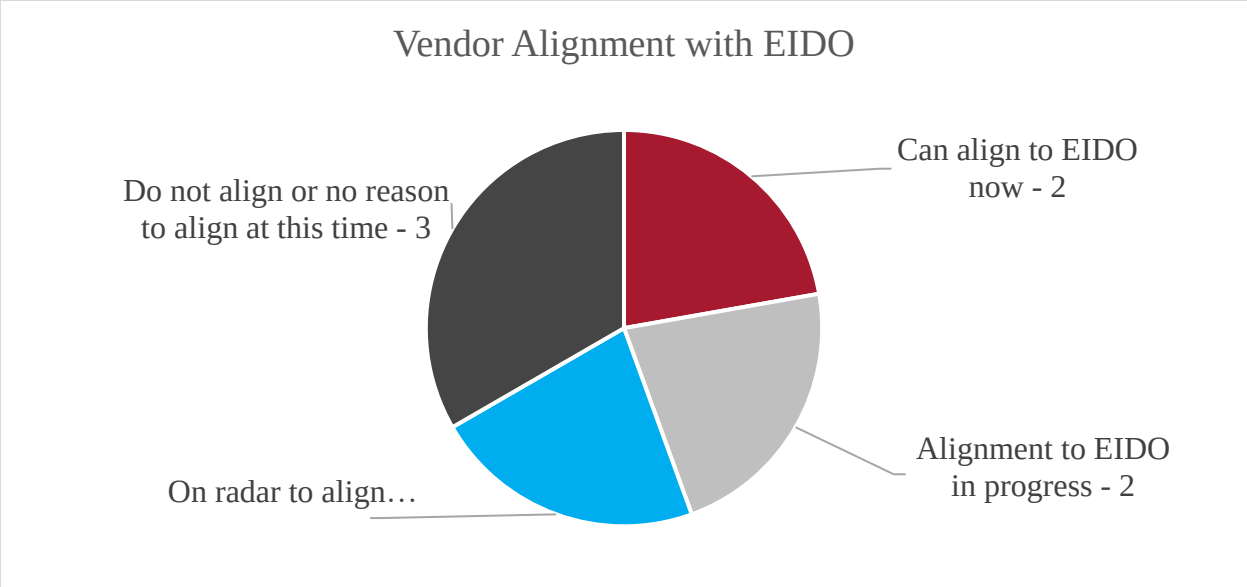

Figure 6: Vendor Alignment with EIDO

4.2.3 Market-driven Software Development

Many of the solution providers were quick to note that they developed products based on the requests of their customer base. If the customers are not requesting standards-based CAD products, their companies do not invest the capital to develop them—it is that simple. As shown in Figure 6, some solution providers have stated that using the EIDO standard is not a priority for them currently; others indicated it is on their roadmap for future development. Many reasons were given for this, with the major contributor being it is not a highly requested customer requirement; however, the overarching reason is there are no federal or state standards driving solution providers to conformance. Thus, solution providers and agencies themselves can "opt-out" from any standard that is not required at the federal or state level.

The solution providers advised that technology (i.e., CAD systems communicating with one another) is the easy part; it is the manipulation of data into non-standardized, local terminology that complicates standardization. Solution providers and ECC stakeholders agreed that standardization and willingness to adopt standards are integral in this endeavor moving forward.

As a reference point, NENA first published its i3 standard for Next Generation 911 (NG911) call-handling equipment (CHE) and the network that supports the delivery of NG911 in June 2011. Version 3 of the standard was released in October 2021.[6] CHE solution providers are acutely aware of this standard, and it is a best practice to require i3 compliance in any request for proposal (RFP) for 911 CHE. The same evolution must occur with CAD and its adherence to standards, such as the EIDO and soon-to-be-released Incident Data Exchange (IDX).

[6] https://www.nena.org/page/i3_Stage3

The NENA i3 standard paved the way for compliance with NG911 standards among the 911 CHE provider community. A similar evolution must occur with CAD and adherence to the EIDO/IDX standard.

When asked what their company vision is for their CAD products to align with an EIDO/IDX standard in the future, the solution providers gave very straightforward responses, as indicated in Figure 7.

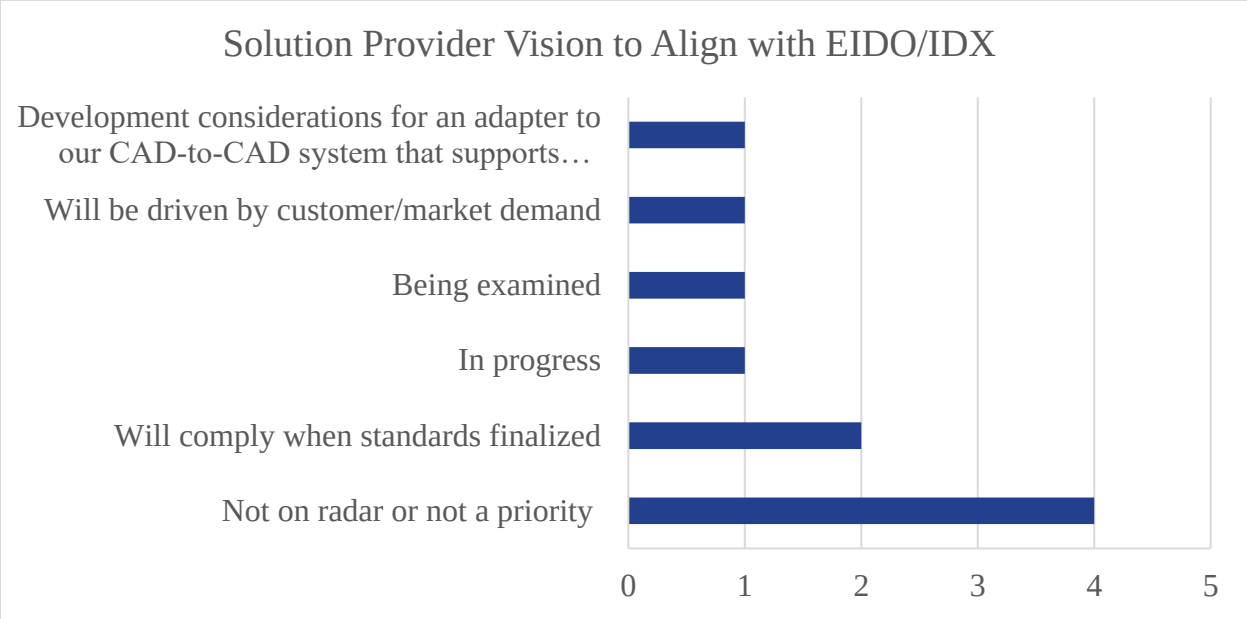

Figure 7: Solution Provider Vision to Align with EIDO/IDX

4.3 Non-CAD Solution Perspectives

A core aspect of this report is the views shared by the non-CAD solution providers that offer software platforms that augment emergency response. These solutions can include more accurate location services, situational awareness platforms, or DEHs that facilitate CAD data exchange across jurisdictions. Until this point, the objective of the Program's data gathering was centered on ECC practitioners and the CAD providers that offer solutions to capture critical incident data. Now, the focus shifts. To gain a more holistic perspective of why data interoperability across jurisdictions is so difficult to achieve, a wider net was cast to gather the views of providers that offer solutions to close that gap.

The Program met with four solution providers that offer systems that augment emergency response; a brief synopsis of each follows. The comments and observations provided are grouped into topic areas, as was done with the CAD solution providers.

4.3.1 Participants

4.3.1.1 Advanced Technology International

ATI provides the Alastar[7] platform that enables enhanced situational awareness to emergency responders and ECCs alike. Alastar can consume live camera feeds, CAD event data, social media tipline information, mapping data, and other components that enhance situational awareness. The platform also offers data analytics and incident planning.

The Program spoke with the Director of Software and Services Mark Aukamp, and Principal Systems Engineer Bart Coghill. They advised that they have been providing the solution for eight years and have approximately 25 deployments. While Alastar does not currently offer a true CAD-to-CAD experience with bi-directional interaction between ECCs in real time, there are alert capabilities within the platform—such as geo-fencing a specific location to notify other agencies of an incident reported (e.g., law enforcement authorities being notified of an incident at a voting location or school).

4.3.1.2 Emerging Digital Concepts (EDC)

EDC was founded in 1997 by President and Chief Executive Office Chris Wiseman and Chief Technology Officer Greg Crider. Their product, NG-CAD-X, is a bi-directional CAD-to-CAD interoperability platform, which was first deployed to counties within the National Capital Region (NCR) around Washington, D.C., with a total of eight participating agencies at this time.

Mr. Wiseman, Mr. Crider, and Director of Communications Lori Preuss shared that EDC's DEH was developed on the National Information Exchange Model (NIEM) XML[8] standards and has evolved to incorporate JSON[9] as well. In April 2022, EDC launched their CAD-to-CAD DEH in the Denver region, which will eventually host 11 agencies exchanging CAD data for mutual aid. EDC also has DEH projects in Texas and Florida.

4.3.1.3 RapidSOS

RapidSOS was founded in 2012 with its focus being the ability to share accurate location information to ECCs via the use of embedded location services in smartphones. Through agreements with Apple Inc. and Google in 2018, RapidSOS was able to access the location of iPhones and Android smartphones. RapidSOS has expanded the platform to wearables, connected vehicles (telematics), and security and safety systems with over 400 million connected devices accessible through its platform. In 2021, the RapidSOS platform reported that it supported over 165 million emergencies and covers 95% of the U.S. population.

Chief Public Safety Brand Officer Karin Marquez, Head of Public Safety Partnerships Dave Sehnert, and Senior Software Engineer Jordi Cabanas explained that the RapidSOS Portal provides a browser-based application that pushes NG911 additional data and accurate location information based on the caller's number. The portal can run concurrently on the same screen as CAD; however, dozens of CAD providers embed the RapidSOS data within CAD through an interface. RapidSOS is expanding its

[7] https://www.alastar.com/
[8] Extensible Markup Language
[9] JavaScript Object Notation

portfolio with an Emergency Data Exchange (EDX) platform specifically designed as a centralized DEH or, as described by RapidSOS, an intelligent data platform for public safety.

4.3.1.4 Rave Mobile Safety

Rave Mobile Safety, formerly Rave Wireless, was founded in 2004 and introduced its Smart911 product in 2010. Rave's product suite now offers other capabilities beyond Smart911, including Rave Alert, Rave Aware, Rave Panic Button, and others.

Vice President of Product Strategy Matthew Serra spoke of Rave's evolution and its experiences in the 911 domain. Mr. Serra shared that the company first sold to the higher education community and then applied the concepts they learned to the state, county, and municipal government environments. Rave's early platform sought to bring location information into the ECC, but then evolved to give communities a service portal—sign up and we can alert you of a critical event near you or provide your data to emergency services. Expanding on the mission of making people aware, Rave introduced Rave Aware—a platform specifically designed to communicate and share data with surrounding jurisdictions. Rave Aware is in use or in the late stages of deployment in over a dozen ECCs, and will soon be deployed across the State of California.

4.3.2 Non-CAD Solution Providers Observations and Opinions

The four non-CAD solution providers were advised that their comments would remain anonymous and be grouped with the other providers' comments. This was instrumental in achieving maximum candor and obtaining true insights from solution providers outside of the CAD community, but intimately aware of the challenges faced by ECCs as it pertains to interoperability. The sections that follow contain their comments grouped into categories.

ECC Adherence to Agency Codes and Need for Code Translation

- No one ever abandons their way of operating, as a result we believe that translation of codes will always be a necessity.
- Allowing agencies to map their codes to another, smaller code set is much easier than trying to re-engineer what they do now, which is particularly challenging.
- Agencies are always seeking more specificity on a mutual aid request, so they are sending the right apparatus and personnel.
- Allowing an ECC to utilize its incident codes maintains operational efficiency at the dispatch level.
- A DEH should be viewed as a funnel, with a wide array of data coming in, but more simplified, easily digestible data coming out.
    - This allows ECCs to continue their current data entry methodology without injecting change into the end-user experience.

EIDO Standards

- It is rare for customers to request their CAD solution be standards-compliant.

- EDIO adoption will take some time and there will need to be a bridge where data between two systems must be translated and that need may never go away completely.
- There is no code standard for a code translation.
- A common language is "table stakes" for this industry moving forward.
- EIDO is just a just a container; a solution needs to translate format and values.
    - There must be an ECC practitioner that intermediates in performing the translation.

Feedback on CAD Solution Providers

- The CAD vendors do not want to be easily interchanged.[10]
- The CAD vendors never build anything unless it's a must for their customers.
- Many believe a DEH solution should not be tied to a specific CAD vendor as the competing CAD vendors do not always cooperate.
    - We often hear from ECCs that they want a neutral DEH, not a CAD vendor DEH that might dissuade other vendors from connecting.
- Some CAD vendors are trying to differentiate themselves in leaning into the future, while others are not and stick with the status quo.
- The CAD solution providers need to conform with the CHE standards.
    - Requiring vendors to adopt standards is a big driver.
- When one CAD provider adopts the EIDO standard, that can serve as a driver for the rest in the marketplace.

Operational and Process Related Issues

- Two-way communication between PSAPs is critical.
    - Situational awareness is the low-hanging fruit, sharing a CAD event to make a neighboring jurisdiction aware of your incident.
    - The higher-level goal should be to provide acknowledgements back, available resources to assist, information about units assigned to assist—location, status, time of arrival.
- The receiving ECCs need to get the right amount of information to make informed decisions.

Interagency Politics and Governance

- Translating codes is a minor technical issue when compared to governance between agencies.
- The governance and politics of implementation are barriers to overcome.

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[10] The Program interpreted this statement to mean that vendors often do not publish APIs and have no commercial interest in exchanging data with competitors.

- Many cite the need to protect CJIS data that could be imbedded in CAD events, if it is not segregated out of the CAD event information.

- Some agencies are more receptive in trying to establish data interoperability than others—sometimes there is flat-out resistance.

4.4 Partner Entity Perspectives

4.4.1 APCO

With a large international membership that works closely with ECCs, APCO has been at the forefront of emergency communications operations for 87 years. APCO recently released its publication, *APCO International's Definitive Guide to NEXT GENERATION 9-1-1*.[11] The guide aligns with APCO's core mission to provide industry expertise and technical assistance.

> *This guide is intended to fill a gap in resources available to ECCs by providing explanations and recommendations based on a comprehensive understanding of what NG9-1-1 means and ECCs' experiences with efforts to deploy precursors to NG9-1-1. Other resources focus on technical aspects of NG9-1-1 call flow or take a broader perspective of broadband implications for ECCs. This guide builds upon those resources to help ECCs make decisions today on a variety of issues – procurement, budgeting, hiring, training, etc. – and brings a common understanding of how to move forward.*[12]

In September 2022, Steve Leese, Senior Consultant, provided APCO's perspective on the state of CAD interoperability. He advised that after several decades, technology and the ECCs have not aligned on common standards but added that we are not facing a technology issue, a sentiment that was shared by many participants in this study. Mr. Leese stated, "despite the fact that we're on disparate networks, different platforms, we can integrate." However, Mr. Leese recognized that there are obstacles that have impeded progress, whether it is vendor profitability issues or local policies and procedures; he believes that what it is going to take to tip the needle is educating people. The ECC practitioners need to ensure that adherence to standards is in their CAD RFP to vendors. He further added that APCO has templates and has four CAD standards documents[13], but it is incumbent on the ECC practitioners to utilize these when approaching the vendor community for new solutions.

4.4.1.1 CAD Solution Providers Instituting Change

Mr. Leese shared that it will only take one vendor with an intuitive, highly interoperable product to shift the balance. He stated that cloud-hosted and browser-based solutions have opened doors that were never opened before. It is only a matter of time before a CAD provider changes the market; that is when one is likely to see real change and a movement toward highly interoperable solutions meeting

[11] https://www.apcointl.org/ext/pages/APCOng911Guide/APCO_NG911_Report_Final.pdf
[12] Ibid.
[13] https://www.apcointl.org/technology/interoperability/interoperability-standards/

marketplace demand. The more interoperable they make their products, the more profitable they will be. Mr. Leese believes there is huge potential for software as a service (SaaS) in the future. He cited the market change with "Z" coordinate adoption by providers like AT&T and the telematics services that OnStar provides are indicative of the change taking place in the industry.

4.4.1.2 Interoperability, EIDO, and Other Data Exchange Avenues

Mr. Leese suggested that the more interoperable CAD solution providers make their solutions the more profitable they will be. Mr. Leese cited an example he published[14] in May 2018 where profitability sometimes supersedes providers' desire to easily facilitate interoperability. In his experience as a communications director, his ECC implemented a CAD-to-CAD solution with a neighboring ECC that shared the same CAD solution of the same software version on similar hardware, but the vendor charged each ECC for an interface and recurring maintenance for the interface. Asked whether a common standard such as the EIDO is the path forward, Mr. Leese advised that the standard being compliant with NIEM was a big issue to overcome and added that it is now somewhat compliant with NIEM.

APCO has not publicly embraced EIDO, a JSON-based object, as the standard to share emergency incident information between agencies and their public safety software systems, whereas NENA has adopted the JSON-based EIDO for sharing incident information. As Mr. Leese indicated, the EIDO has incorporated many of the functional elements that the NIEM standard requires, such as person type and vehicle type.

The first three rows of the Person Type table in the EIDO standard (Table A-1 Person Type) have been recreated below to illustrate how the NIEM data element in column 2 is transformed into its JSON equivalent.

JSON Name	NIEM Data element	Type	Description	Comment
ageMeasure	nc:PersonAgeMeasure	nc:TimeMeasureType	A measurement of the age of a person.	
birthDate	nc:PersonBirthDate	nc:DateType	A date a person was born.	
birthLocation	nc:PersonBirthLocation	nc:LocationType	A location where a person was born.	

The discission with Mr. Leese turned to another data exchange initiative that has been deployed in 21 states and the District of Columbia[15] – ASAP[16] to PSAP. ASAP to PSAP allows an alarm service to send alarm messages directly to an ECC's CAD system. The CAD system can then transmit acknowledgement

[14] https://www.apcointl.org/2018/05/10/what-does-interoperable-mean-in-the-real-world/

[15] https://tma.us/programs/asap/#:~:text=ECC%E2%80%99s%20in%20Testing%20or%20Implementation%20%20%20ADS,%20%20Stanley%20%2010%20more%20rows%20

[16] Automated Secure Alarm Protocol

and update messages to the alarm service as the emergency response progresses. With slightly less than 120 ECCs deployed over 11 years, the initiative has not been widely adopted or extensively implemented, yet the standard has continued to evolve with the latest update published in May 2021.[17]

4.4.1.3 Advancing CAD Interoperability Nationally

In discussing methods to advance CAD interoperability nationally, Mr. Leese advised that it is APCO's belief that it must be needs and jurisdiction driven, coming from the grassroots level. As jurisdictions insist on interoperability, it will garner more attention at the state level because it is well understood that in emergency communications and response that the more we share the better off we are. APCO strongly believes in its member base and is an association that best aligns with where public safety technology needs to be.

When asked about a national symposium to propel the adoption of CAD interoperability, Mr. Leese was skeptical, citing so many moving parts and jockeying for position. "I don't know that this would be feasible." He stated that the national Public Safety Next Generation 9-1-1 Coalition[18] continues to drive for legislation and that its efforts inform where solution providers need to be. He added, "we won't get to where we need to be through a symposium or summit unless it's codified in the law that the solution providers must share data seamlessly and be interoperable."

4.4.2 National Emergency Number Association (NENA)

Having had a laser focus on 911 call receipt, transfer, and integration across jurisdictions for decades, it was a natural evolution for NENA to turn its focus on jurisdictional integration as the 911 call is processed within a CAD system. Where significant progress was made nationally with the rollout of 911, Enhanced 911 (E911), and now NG911, CAD interoperability is sparse and limited to regional deployments. NENA is a strong proponent of taking the lessons learned with the evolution of 911 interoperability and applying that knowledge to CAD. Just as the transmission of 911 calls needed an IP standard to function in the 21st century—i3—a standard had to be developed for CAD as well.

With respect to a new CAD standard for interoperability, NENA provides the following explanation on its website:

> *As agencies and regions move forward with implementing NG9-1-1 and IP based emergency communications systems, it is critical that they adhere to a standardized, industry-neutral format for exchanging emergency incident information between disparate systems located across disparate agencies and other stakeholders. The Emergency Incident Data Object (EIDO) Standard provides a standardized Javascript Object Notation (JSON) format to convey this information, including from call handling to Computer-Aided-Dispatch (CAD), from CAD to CAD, to field responders, and to other entities.*[19]

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[17] https://www.apcointl.org/~documents/standard/21013-2021-asap-to-psap/?layout=default
[18] https://ng-911coalition.org/
[19] https://www.nena.org/news/584569/NENA-Releases-ANSI-Approved-Emergency-Incident-Data-Object-EIDO-Standard.htm

In September 2022, the following NENA staff met with the Program:

- Brian Fontes, Chief Executive Officer (CEO)
- Brandon Abley, Director of Technology
- April Heinze, 911 and PSAP Operations Director
- Brooks Shannon, Interoperability Program Manager

The NENA staff commented that, to date, the CAD-to-CAD successes have been purpose-built engines to feed data from one CAD database to another CAD database; in other words, they are "one-offs" with no real adherence to standards. Initially, it was the Emergency Incident Data Document (EIDD) trying to set a benchmark for the vendor community, now it is the EIDO. The 911 CHE providers are on board with the standard; however, everyone must be on board to propel interoperability forward rapidly in the CAD marketplace. There is so much rich data that can be shared and consumed, but it is not happening.

Mr. Shannon stated that, formerly, he was the vice president of product at an international CAD company, and it could not get traction to move toward a standards-based CAD product. Their company was not unlike all the others—currently, there is no incentive for the vendors to adopt standards. The vendor community is focused on capturing their customers and if other vendors cannot conform to standards, there is no value in modifying your product to do so. This is especially true when vendors charge for interfaces and charge to connect to DEHs; it is simply not a top priority, especially when vendors face their own challenges with adequate staffing. Mr. Shannon candidly stated that his former company could do it, but they just would not apply the resources. Asked about CAD vendor reluctance because the software engineering effort was significant and costly, they were quick to respond that this is a "red herring"—it is no great feat of software engineering to output JSON, and that it can be accomplished with one day of coding. You cannot find software engineers that do SOAP[20] and XML[21] , it is all REST[22] and JSON now. Mr. Abley stated that JSON EIDO provides seamless data exchange and the architecture is elegant.

EIDO was developed to ensure that there is a uniform method to communicate safely and securely, noting that Canada has already adopted it as the national standard. It bears noting that the Canadian Radio-television Telecommunications Commission has greater authority to mandate such standards across Canada as opposed to what can be legislated in the U.S. The point is that EIDO has been thoroughly engineered and is live outside the U.S. and those buying CAD in the U.S. should demand that the system conforms to the standard before acquiring it.

4.4.2.1 Data Exchange Hubs

Considering that many practitioners and CAD solution providers referenced the need for DEHs as an interim measure, the reaction was split as to the role moving forward. Ms. Heinze, who came from the PSAP environment, understood that many believe that DEHs will be needed to translate for those platforms that do not output data that conforms to the standard, very similar to a 911 legacy network

[20] Simple Object Access Protocol
[21] Extensible Markup Language
[22] Representational state transfer

gateway (LNG). However, Mr. Abley stated that employing DEHs could slow the adoption of the EIDO standard and that the architecture is designed to do this directly, just like NG911. Ms. Heinze added that she agreed that, in the long run, when everyone is EIDO-compliant, emergency communications will be best served. She related her experience in ECC operations where the cost alone for dedicated T1 connections between ECCs was prohibitive without the added maintenance costs of keeping a CAD-to-CAD connection viable. Ms. Heinze stated that homegrown or agency-developed CAD systems present a real issue in the adoption of a nationwide CAD standard. Until these systems and other regional CAD systems can be brought into conformance, a gateway like an LNG will be needed to perform translations. To achieve interoperability, the long-term goal should be EIDO, but DEHs can serve as an interim measure to bridge the gap for many CAD platforms that do not comply with the standards. These interim solutions must have an expiration date; there has to be a time when EIDO has to reign. It is necessary to plug away at this and get the vendors at the table.

4.4.2.2 National Initiative

The discussion with NENA led to what could be accomplished on a national level to solve this problem—a national symposium. Mr. Fontes expressed that a virtual policy summit may prove useful if it can examine how a national 911 standard has benefitted Canada. The U.S. is falling so far behind compared to other countries, especially our partners to the north. There is certainly a lack of funding, lack of leadership, and lack of standards, yet there is a need to keep beating the drums to get all policymakers on board.

4.4.3 National Association of State 911 Directors

NASNA began, informally, in 1989, and within five years was incorporated into the organization it is today. NASNA reports that its "sole focus is to facilitate the success of 911 programming at the State, U.S. Territory, and District level." Since its initial efforts with wireless E911 location and multi-line telephone systems in the 1990s, NASNA reports on its website that:

> ***NASNA focuses on three areas:***
>
> 1. *Developing strategic partnerships with key organizations and individuals who share our interests*
> 2. *Serving as an information sharing and support network for state 911 program administrators*
> 3. *Strengthening relationships with federal lawmakers and agencies*[23]

NASNA's core membership is state 911 program administrators, and NASNA believes that each state's "911 program is unique – and that uniqueness enriches and adds value to membership in NASNA and to any who seek perspective on how states provide 911 to their citizens."[24]

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[23] Ibid.
[24] Ibid.

In late September 2022, Harriet Rennie-Brown, Executive Director and Budge Currier, President of NASNA, were consulted.

Mr. Currier, California's State 911 Coordinator, stated that currently the biggest challenge to CAD interoperability across the country is that there are no hard and fast requirements for CAD vendors—no standards—and that limitation has led to standalone programs and proprietary platforms. He explained that even some CAD systems that claim to be interoperable between like systems are not and vendors with deployments of their product in a given state face obstacles. He advised that even across California's 438 PSAPs there is a belief that each has special or unique requirements and that they have the best solution for their needs. It is systematic across platforms that data cannot be changed, and California is working on a project to change that.

4.4.3.1 EIDO Standard

The EIDO conveyance model is the first standards-based solution and will allow for a rich amount of CAD incident data to be shared. EIDO provides the ability to store the data and the conveyance mechanism to ship the data. Mr. Currier advised that standards are the path to seamless interoperability, and we cannot rely on the CAD industry to set the standards. Yet, we do have to ensure the industry is successful. As it stands now, the former EIDD standard is dead; EIDO is the new standard and, like all standards, it is iterative and will have to evolve.

4.4.3.2 Advancing CAD Interoperability Nationally

Both Mr. Currier and Ms. Rennie-Brown agreed that advancing CAD interoperability will have to be a grassroots effort, unlike Canada which can institute a national mandate. Mr. Currier added that when it comes to advancing standards, the federal government does not typically do well. Where you have seen some states mandate a CAD platform, that is not the norm. Mr. Currier related that the success that the California Office of Emergency Services (Cal OES) has had over the last several years with NG911 proves that interoperability can be achieved at a state level. Mr. Currier added that there has to be a business case, and the only way to be nimble in the current technological environment is to be in the cloud—six-to-nine-month development cycles are a thing of the past.

Mr. Currier advised that California is now employing the same methodology for CAD that it used for CHE. The intent is to share applications over the ESInet that are hosted in a cloud environment. Just as California certified CHE providers to be NG911-compliant in a lab environment, the intent is to do the same for CAD providers over the next one to two years. California will then have multiple platforms, both CHE and CAD, to share data between.

4.4.3.3 Legacy CAD Systems

As put forward to other participants during this study, Mr. Currier was asked about legacy vendors that do not modify their software to output EIDO-compliant data. He responded that those platforms must be afforded an opportunity to integrate for a set period. Whether it be an adapter or other translation mechanism, Mr. Currier agreed that there will likely be a period to map vendor solutions to the standard, and further expressed that permissions must be established where data owners determine who can view what data (not everyone can see the data).

4.4.4 Integrated Justice Information Systems Institute

The IJIS Institute was formed initially as an industry working group focused on integrated justice. In 2001, the IWG evolved into the IJIS Institute, becoming a nonprofit corporation. Today, the IJIS Institute's mission has expanded as described below.

> *The IJIS Institute is an inclusive organization, welcoming to its membership all practitioners and companies that provide information technology-related services, products, and solutions to local, tribal, state, and federal agencies in the public safety, law enforcement, justice, and homeland security arenas. The Institute is also expanding its reach into new areas like health and transportation.*
>
> *From the initial 14 charter members in 2001, the Institute has grown to nearly 400 Members. Together, we are working towards success in public-sector technology and information sharing projects and initiatives.*[25]

Currently, the IJIS Institute has a CAD-to-CAD interoperability test lab project underway.

In early October 2022, Ashwini Jarral, Director; Maria Cardiellos, Executive Director, and Phil Winiarski, Senior Project Manager, shared their lessons learned.

Mr. Jarral advised that he has been heavily engaged in addressing the issues that affect CAD interoperability for ten years. He stated that interoperability is not a technology platform—it is comprised of two lanes: a technology lane and a data lane. The data lane must address different terminology, different data elements, and other factors. What began with the EIDD information document in 2014 has now evolved into the EIDO standard published in October 2021. Mr. Jarral advised that there cannot be multiple standards because they will conflict. Interoperability just cannot be connecting two disparate CAD systems. Mr. Jarral stated that it was time to take a step back. CAD systems are at different states of maturity, different levels of technology adoption, and a solution is needed that is not dependent on the state of CAD technology. It was time to begin with operational use cases; technology can do whatever you need it to—let the operational scenarios and practitioners decide how it will work.

4.4.4.1 Test Lab Environment

It is critical to test CAD systems in a lab environment; it defeats the purpose if the standards cannot be validated in a lab environment. IJIS found with the i3 standard that everyone had their own interpretation of compliance. IJIS does not use standards but uses specifications. IJIS builds a data exchange environment in the lab, then tests a CAD application, and validates that it meets established specifications. Whether it be standards or specifications, a CAD application must demonstrate that it can conform in a test environment. IJIS will develop implementation specifications that are not intended to change CAD systems—if you use NIEM use NIEM, if you use EIDO use EIDO. CAD systems are not

[25] Ibid.

going to change, so put something in the middle. Mr. Jarral stated that IJIS has been "preaching to vendors" that if you apply to standards, you can reduce cost and not have to support multiple platforms.

4.4.4.2 Data Exchange Hub

As a comparison model for data exchange, the IJIS Institute developed a similar initiative for the pharmaceutical industry— the RXCheckHub.[26] The Prescription Monitoring Information Exchange (PMIX) National Architecture connects 49 disparate prescription drug applications exchanging data via one standard.

The CAD solution providers are not going to be compliant overnight and, in the interim, there will need to be adaptors or another mechanism to transform non-compliant data outputs. Whether it be XML, NIEM XML, or EIDO, it does not matter; if the CAD output can be mapped to the standard, data can be shared. Mr. Jarral noted that although CAD vendors may claim it is a heavy lift, IJIS sees it as a light path forward. Mapping to the standard is not a big lift, especially for the bigger companies that have the resources to perform the conversion. Through IJIS's work, it has been discovered that the core data set stays the same—map it once and then you can replicate that data map. In the end, the key will be the test lab, as it becomes a reference environment. CAD vendors will have to bring their solution into the environment, test against the specifications, and then a conformance report is generated to show any errors. Once the errors are fixed and conformance is shown, the product is validated to be deployed to the field. One can liken it to an Underwriters Laboratory for CAD solutions—once conformance is demonstrated, it is merely a "plug and play" to share data with other CAD systems. Much like the i3 standard for NG911, you cannot allow everyone's own interpretation of the standard; it must be the case where one can say, "show me your conformance report from an independent lab test." Mr. Jarral added that it is "brilliantly simple"—you test and educate the consumers on why a confirmative product is in the best interest of their operational enterprise. The customer base, NENA, and APCO delivering the message as well, will have to drive this change in the industry.

4.4.4.3 Importance of Policy

Mr. Jarral emphasized that policy will be a critical factor in this being a success. Agencies must collaborate and develop memoranda of understanding (MOU) because the data alone is not the endgame. There must be commonly understood operational processes that go along with the data. Adding to the earlier statement, Mr. Jarral advised that there must be a policy lane to ensure success, that sharing standards-compliant data needs accompanying policies and processes; this is the baseline.

4.4.4.4 Concluding Remarks

Having been engaged in the CAD data interoperability discussion for a decade, Mr. Jarral stated that the U.S. needs to follow the Canadian model. The U.S. needs to march down the same path and IJIS is hoping that APCO and NENA follow suit. IJIS believes that if we build the standard, the vendors will come as they will have no choice. IJIS plans to build with them, working collectively.

The old way of doing business, build and customize, is over. There must be transparency across solutions, then we will see technical innovations and that the very innovative solutions will be low cost.

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[26] https://ijis.org/ijis-key-initiatives/rxcheck-hub/

Mr. Jarral added that we have a common mission: to enable data operability so that everyone can use the data.

4.5 Summary of Challenges and Perspectives

After speaking with the project participants, common themes emerged regarding the obstacles to data sharing:

- Resistance to change
- Lack of standards and standards enforcement
- Funding
- Lack of federal or state oversight to enforce standards
- Lack of a common language
- Unwillingness of some agencies to share data
- Unique operational requirements, policies, and procedures at ECCs
- Politics and jurisdictional differences
- Disparate CAD systems with disparate levels of functionality

The project participants did not align in some areas, which was driven by the solution providers' experiences in the CAD marketplace:

- Competing priorities among vendors
- Customer demand is not demonstrated
- Operational demands by clients are different for every CAD deployment
- HIPAA and CJIS information—some agencies and their legal advisors have varying interpretations on complying with HIPAA and CJIS; whether real or perceived, these interpretations can hinder seamless data exchange between jurisdictions

The sections that follow describe the elements of a successful and sustainable CAD-to-CAD initiative at the local or regional level. It is a recipe describing the key ingredients that have been found in successful interoperability solutions across the country. Each strategic initiative must be in place to ensure that CAD interoperability is both available and operationalized. These initiatives lend structure to how to measure national progress toward CAD interoperability.

5 Strategies to Advance CAD Interoperability

A wide spectrum of stakeholders met and collaborated with the Program during this project, many offering unique perspectives of what should be done holistically, at a national level, by solution providers or partner agencies to achieve greater data interoperability. The ECC stakeholders concurred with many of these holistic suggestions, yet, in the interim, they expressed a more immediate need to assist them in overcoming the challenges they face at a local level to gain traction and make headway, whether politically, operationally, or technologically, or in securing funding.

It is with these two perspectives in mind that a two-pronged approach—holistically (or national) and a local, grassroots methodology—was conceived to focus advancing CAD data interoperability on two fronts in parallel.

The sections that follow provide suggested strategies that highlight this two-pronged approach—top-down and bottom-up—to create a convergence of success, depicted in the following figure.

Figure 8: Top-down and Bottom-up Approach

6 Strategies to Success – Grassroots Level

When considering greater CAD interoperability, the first true measure of success is implementation at the grassroots level—CAD systems interfacing directly using a standard or a DEH to translate between disparate systems that do not conform to a single standard. Either model requires diligence and leadership at the grass roots, through ECC leadership, to pull all the components together to achieve success. The following sections address the role of leadership and those components to enable CAD interoperability between ECCs.

6.1 ECC Leadership

Overcoming challenges to data interoperability between ECCs requires leadership. That leadership must come from the grassroots level—the ECC stakeholders—those who will serve as the central gear in the engine to institute change, whether it be among themselves, with the vendor community, government organizations, or partner agencies (e.g., APCO, NENA, and NASNA). Without ECC practitioners leading the efforts to secure funding, establish governance, procure network connectivity, and develop interfaces and data-sharing capabilities, strategies alone will prove ineffective.

To alter the trajectory of CAD data interoperability from its current state to one of transformative change, the leadership of key stakeholders at the grassroots level is pivotal to drive the gears of any strategies proposed. A depiction of this concept is shown below and will be a recurring theme in the sections to follow.

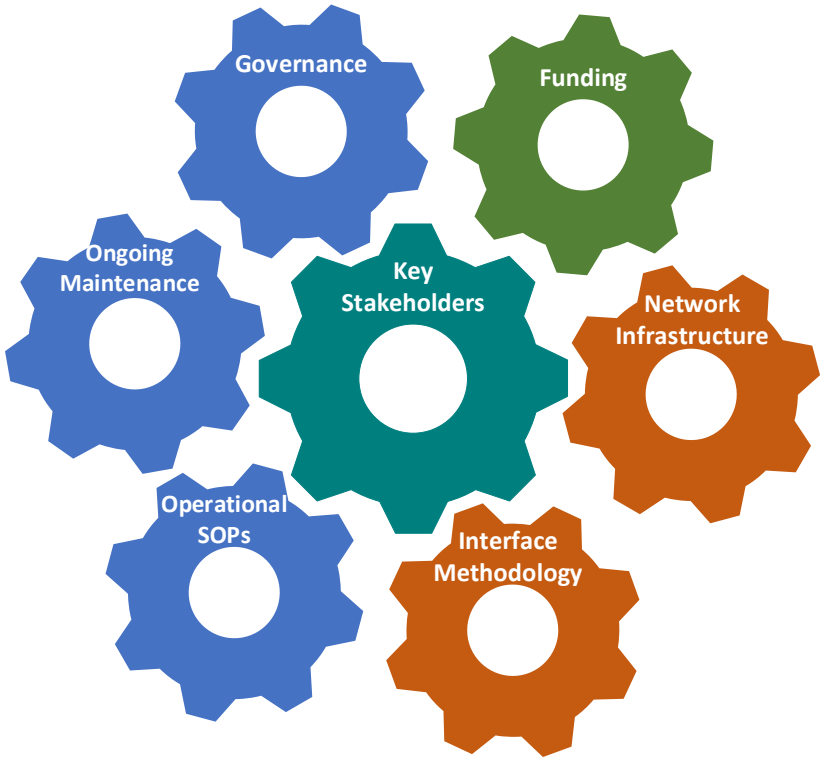

Figure 9: Central Gear of Leadership

6.2 Governance Structure

Local governance is a key component for successful implementation and administration of interoperable CAD systems and is often overlooked until a problem is experienced. Governance can be challenging due to the number of members, their independent business processes, and the variety of stakeholders involved (law enforcement, fire, EMS, information technology [IT], 911, and others). Governance allows stakeholders to:

- Establish lines of authority
- Provide an effective means of communication
- Establish policies and procedures
- Manage system changes
- Establish fiscal responsibility
- Mitigate risk
- Encourage change and break down barriers to data sharing
- Overcome political barriers
- Clarify jurisdictional boundaries

To be effective, there must be a clearly defined vision and mission to assist leadership in the decision-making process. Policies, procedures, and processes need to be defined and enforced, and finances, risk, and change must be carefully managed.

All stakeholders should be represented through the various committees, subcommittees, and positions in the governance framework, and must be fully engaged in the governance process. At a minimum, the following committees or positions should include:

- Executive Committee
- Change Advisory Board
- Administrator (usually not a committee but one or two administrators)
- Fiduciary Agent
- Operational Committee
- Technical Committee
- Financial Committee
- Jurisdiction level subcommittees

The following is a sample project governance structure for a CAD-to-CAD project.

6.3 Local Funding Models

A CAD system can be costly to implement, operate, and maintain; however, since the cost is shared by multiple partners, the financial burden is shared by each participating agency. Participating agencies need to agree on a funding model. The Financial Committee under a governance structure develops the cost-sharing models, prepares budgets, and handles other financial matters as required. The Financial Committee works with the Executive Committee and Fiduciary Agent to help guide decision-making. Cost considerations for a CAD-to-CAD system include:

- Initial capital investment
- Maintenance
- Annual operating expenses
- Lifecycle funding (e.g., hardware refresh)
- Miscellaneous costs (e.g., professional services, etc.)

The Financial Committee should determine the correct funding model and set policies on financial commitments required from each entity. The funding model should be developed as soon as the budget for the project is known so that each entity understands their financial commitment. There are many funding models, including the following:

- Fixed Fee – Each entity contributes the same fixed amount annually
- Fixed Fee Plus a Metric-based Fee – A uniform base fee is established for each entity and then the additional cost is added based on the entity population, call volume, or other metric
- Metric(s)-based Fee – Fees vary from entity to entity and are based on a metric or several metrics (population, call volume, etc.)

6.4 Technology and Network Integration

To keep up with the changing means of communication (cell phones, text, etc.), the nation's ECCs are migrating to ESInets and implementing Next Generation Core Services (NGCS) applications to manage the data that is now part of a report of an emergency incident. While an ESInet and NGCS are not absolute prerequisites for CAD-to-CAD information sharing, they are ingredients that support, enable, and accelerate it. They are extremely important building blocks that overcome basic challenges to data exchange among ECCs. Thus, measuring their implementation can help to show foundational progress.

An ESInet and NGCS can also be used as independent variables, which will quantify how strongly they correlate with CAD-to-CAD implementations.

Core services—such as location services that an ECC can build upon an ESInet—facilitate the accurate location and unique identification of incidents, among other enhancements. It is likely that ECCs that have pursued NGCS have paved the way to better incident data sharing. Measures of progress on these technical elements will provide the Program with additional independent variables that will most likely correlate strongly with successful CAD interoperability initiatives.

It is important to note, as referenced above, while establishing ESInet and NCGS are valuable elements that would serve to accelerate CAD-to-CAD, they are not a pre-requisite. The following table provides an overview of the synergy between established ESInets and advanced GIS capabilities with CAD-to-CAD, but also demonstrates the independent nature of CAD-to-CAD data sharing from NG911 capabilities.

NG911 Foundational Component	Description	Necessary for Data Interoperability	Aids in Facilitating Data Interoperability
ESInet	Emergency services network	No. Secure network connections that are not designated ESInet are currently in use for CAD-to-CAD data exchanges now	Yes. ESInets that are established would serve as a CAD-to-CAD network backbone
NGCS	Software and databases necessary to route 911 calls	No. CAD data is not dependent on NG911 for routing to NG911 CHE	Possible application in the future, but not near term
NG911-compliant CHE	Call-handling software and associated equipment	No. Currently, 911 CHE and CAD are two disparate systems in the vast majority of ECCs	Possible future should CHE and CAD merge into a single software platform, not near term
GIS	Highly accurate GIS capabilities to route calls correctly	No. ECC CAD data sharing is not dependent on GIS routing capabilities as it utilizes the IP suite (TCP[27] /IP)	Yes. Provided NG911 capabilities are in place, more precise location data provides immediate benefits

6.5 Operational Procedures Development

In deploying data sharing between CAD systems, ECC must agree on operational guidelines (i.e., general rules that establish interagency response) and expectations regarding acknowledgement and response. These operational procedures provide the framework under which an agency can expand its resource pool beyond the emergency response units available within its jurisdiction. The following mutual aid scenarios provide examples of these procedures in practice.

6.5.1 Structure Fire Scenario A

A structure fire occurs within ECC #1's jurisdiction where an additional ladder truck and engine are required. ECC #1 ***initiates*** a request to ECC #2 requesting a ladder truck and engine. ECC #2 ***acknowledges*** the request. ECC #2 confirms availability of the nearest ladder truck and engine within its jurisdiction and creates a mutual aid CAD event using the original data provided by ECC #1. ECC #2 ***dispatches*** their units to ECC #1's jurisdiction and ECC #1 ***acknowledges*** units are en route and the data is then captured in the original CAD event at ECC #1.

[27] Transmission Control Protocol

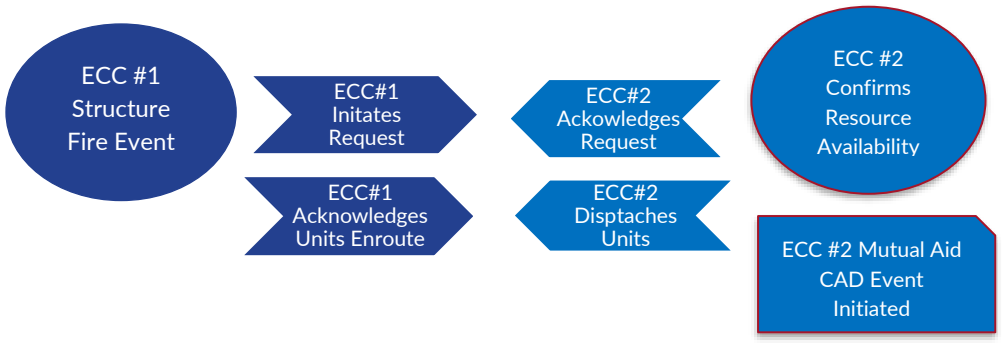

Figure 10: Structure Fire Scenario A

The above scenario illustrates the operational checks and balances (i.e., operational process flows) that must be in place between the two PSAPs to 1) initiate a request, 2) receive acknowledgement of the request, and 3) receive confirmation that the neighboring units have been dispatched. All these transactions are logged in both CAD systems to provide an accurate audit trail of the transactions as they unfold. The exact same incident could produce a markedly different scenario dependent on the operational procedures in place, configuration parameters of the data exchange, and authority granted to neighboring jurisdictions in a "borderless" utilization of resources.

6.5.2 Structure Fire Scenario B

A structure fire occurs within ECC #1's jurisdiction where an additional ladder truck and engine are required. ECC #1 can view availability of neighboring fire resources and identifies a ladder truck and engine in ECC #2's jurisdiction. ECC #1 then proceeds to assign the ladder truck and engine and a mutual aid CAD event is created in the ECC #2 CAD and the units are dispatched by ECC #2. The ECC #1 CAD event is automatically updated with the corresponding dispatch information.

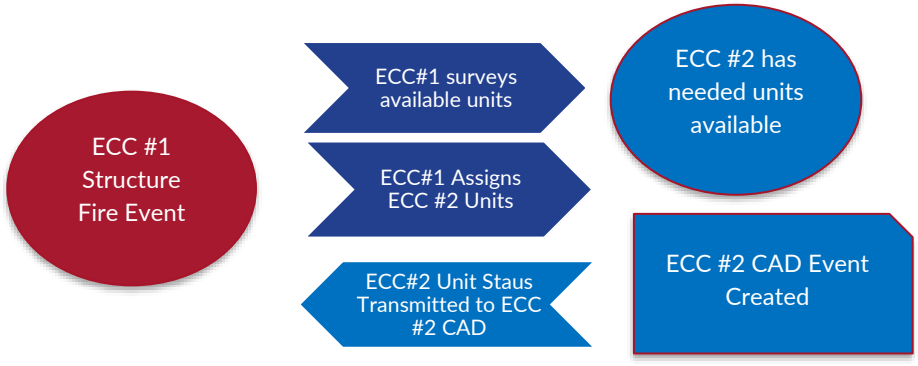

Figure 11: Structure Fire Scenario B

The above scenarios are intended to illustrate the procedures that must be established based on two disparate operational models realizing that the technology can be configured to function the way the agencies determine.

System configurations, to be referenced later, are determined by the operational procedures established between jurisdictions. In essence, the technology can be configured to perform the desired functionality in furtherance of the operational procedures established and codified by the partner jurisdictions.

6.6 Technical Configuration and Integration Operationalization

As referenced in the foregoing section, the technical configuration and eventual operationalization of a CAD-to-CAD integration will require operational policies to be solidified during the process. Decisions during the technical configuration of data exchange and how that data will be used operationally must be agreed upon. In other words, what data will be shared with a neighboring ECC, what acknowledgments of receipt are required, what are the responsibilities of the neighboring ECC, and what affirmative steps must be taken in response. The responses may vary depending on incident type, criticality, and other factors. These operational decisions are critical to how the technical data exchange is configured and, eventually, operationalized.

Like the examples provided previously, a request made by ECC #1 to ECC #2 for an engine to respond to ECC #1's jurisdiction may be straightforward. Yet, acknowledgement from the receiving ECC (CAD event received) and subsequent action taken (Engine 15 dispatched and en route) is of critical importance, as are time and date stamps, and an audit trail captured in both systems. Further, when considering law enforcement mutual aid, if ECC #1 requests multiple police units from ECC #2 to respond to a domestic in progress within ECC #1's jurisdiction, the appropriate mutual aid agreements and operational policies must be in place to authorize that response.

In alignment with the resource center strategy below, configuration material and operational policies can be shared that describe how ECC #1 and ECC #2 addressed the above in their jurisdictions. However, documentation alone will not suffice. Whether the practitioners of those ECCs make themselves available for questions or workgroup sessions are convened, further clarification will inevitably be necessary.

As several technologists from the non-CAD solution providers related, "technology is not the issue," complex data is exchanged every minute of the day over secure networks in this country. The larger issue is breaking through data-sharing barriers between certain jurisdictions, whether real or perceived, and overcoming operational hurdles where old school, parochial mentalities may still exist. In many regions of the country, the fire services have mutual aid agreements that are outstanding examples of resource sharing being a force multiplier for all communities in the region. This shared resources perspective benefits all for the greater good.

Using real-world examples, actual use case scenarios, and existing operational policies and procedures of proven CAD-to-CAD implementations may aid in convincing the "my jurisdiction, my resources" stalwarts that interdependence with partner agencies better serves their community than independence.

6.7 Maintenance and Administration

Continued care and maintenance of any system is paramount to ensuring it meets current operational needs and evolves over time. Day-to-day maintenance of a CAD-to-CAD data exchange is

straightforward—simply ensuring it continues to perform as designed. These duties are typically performed at the local level by CAD administrators with contracted vendor support. However, when new capabilities are sought by operations, a technical assessment is needed to determine whether the requested modifications can be implemented internally, through reconfiguration, or whether they will require software coding and vendor assistance. In the latter case, this is when governance steps in to assess the requested modifications, gauge the level of effort needed to deploy the changes, determine if additional funding is necessary to develop the modifications, and then plan the implementation of the changes. It is natural for end users of a system to request modifications to perform tasks more efficiently or add functionality to enhance service-level capabilities. ECC practitioners have advised that this is prevalent when CAD-to-CAD interoperability is first deployed and ECCs must be prepared to deal with these dynamics.

7 CAD Interoperability Resource Center Strategy

7.1 Resource Center Strategy

A national online CAD Data Interoperability Resource Center to assist ECCs seeking guidance to initiate or expand data exchange initiatives would be instrumental in advancing CAD interoperability, which requires information and education.

The Resource Center can serve as the gateway to facilitate the dissemination of necessary information to make it a reality. Undoubtedly, before CAD-to-CAD DEHs were established in the NCR, Denver, Portland, and other areas, research was conducted, intergovernmental agreements signed, specifications developed, and contracts executed. Following a similar script eases the journey for those that follow the early adopters. Access to an archive of compiled data—an "interoperability playbook"—will propel this initiative forward and allow practitioners to navigate a path clear of many impediments their predecessors may have encountered.

7.2 Resource Center Ownership

Many strategies proposed in this report require an entity that will manage the distribution of content—educational materials, governance samples, links to national standards, current funding opportunities, sample grant applications, best practices, system architecture designs, data mapping, and other tools. Education in advancing this initiative should go far beyond the "teach a person to fish" mindset; it must include the rod, reel, and lures to accomplish the task. Practitioners noted that there are materials on a variety of websites, yet most practitioners do not have the time to research, investigate, and gather all the necessary materials across multiple platforms. A resource center that provides sample RFP language for interoperability, governance agreement examples, and other materials should be established that is specifically targeted at promulgating a data interoperability roadmap and best practices. An example of such a resource center is included in the next section.

The Resource Center should be actively managed to provide the material and serve as a connection point for ECC practitioners to share information and network with others seeking to advance CAD data sharing. Connecting with other practitioners who may have been down the path before, who have experience and lessons learned to share, can prove invaluable to practitioners pursuing a CAD interoperability project.

7.3 Leadership by Example: An Exemplary Model of Data Interoperability Success

A model that had its roots in an initiative funded by the Bureau of Justice Assistance (BJA) and the Office of National Drug Control Policy (ONDCP) is the Prescription Drug Monitoring Program Information Exchange (PMIX). The PMIX National Architecture connects 49 disparate prescription drug applications exchanging data via one standard. The IJIS Institute notes on its website:

The primary goal of the Prescription Drug Monitoring Program Information Exchange (PMIX) is to establish a national interoperability architecture, specifications, and a reusable infrastructure for the secure, reliable, and sustainable interstate exchange of state prescription data.

The IJIS Institute piloted the secure information exchange of live data between Kentucky and Ohio that provided proof of concept and participated in the PMIX State Assistance Project to accelerate nationwide PMIX adoption across the U.S. Today, the developed architecture is in use across all 50 states.[28]

The PMIX was recently awarded a 2022 Best of NIEM award for "Upgrading the National Prescription Drug Monitoring Program's PMIX architecture, which uses NIEM 4.0 schema and allows for enhanced requestor identification and security of Electronic Health Record (EHR) exchange integrations."[29]

A significant contributor to the success of the PMIX is its ability to share information that assisted state prescription drug monitoring programs (PDMPs) in accessing data critical to the advancement of the initiative. The Prescription Drug Monitoring Program Training and Technical Assistance Center (PDMP TTAC) was established through BJA grant funding to provide "a comprehensive array of services, support, resources, and strategies to PMDPs ..." [30] The PDMP TTAC serves not only to educate; its focus is to "improve consistency among PDMPs, facilitate coordination between PDMPs and state and national stakeholders, increase PDMP efficiencies, measure performance and effectiveness, and promote best practices."[31]

[28] https://ijis.org/ijis-key-initiatives/prescription-drug-monitoring-program-pdmp/
[29] https://www.niem.gov/about-niem/news/2022-best-niem-award-winners-announced
[30] https://www.pdmpassist.org/
[31] Ibid.

Figure 12: PDMP TTAC Website[32]

CAD data is no more complex than patient information and that patient's prescription drug data. From the publication of the first PMIX architecture in April 2012[33], and with the first states live that same year, PMIX is now in use in all 50 states. Skeptics who claim that true seamless data interoperability cannot be achieved in the emergency communication realm or can only be achieved through a proverbial "moonshot" effort are misinformed. Not only can data inoperability be achieved, it can likely be implemented rapidly with the appropriate funding, national exposure, and ECC leadership equipped with the necessary resources to achieve success.

[32] Ibid.
[33] https://www.pdmpassist.org/pdf/PMIX%20National%20Architecture%20Document.pdf

8 National-Level Strategy to Success

The following sections offer national-level strategies to overcome the issues identified by study participants, particularly the ECC practitioners. Just as the ECC practitioners played a pivotal role in the symposiums conducted in January 2022 and March 2022, their active engagement moving forward is instrumental to success.

8.1 Establishment and Recognition of a National Governing Body

NENA has been at the forefront of the development of the EIDO standard for NG911 and is now expanding the standard to include CAD data elements. The Canadian Radio-Television and Telecommunications Commission has regulated that the standardized, industry-neutral format for data sharing in the NG911 environment is EIDO.

As the nation moves forward to improve emergency response for its citizens, there is no room for partisanship or infighting between organizations that claim tens of thousands of practitioners as members. Just as APCO and NENA came together to develop APCO/NENA 2.105.1-2017, *NG9-1-1 Emergency Incident Data Document (EIDD)*, the forerunner of EIDO, these two associations should come together to acknowledge the EIDO standard to increase awareness and propel national adoption. The U.S., lacking a governmental authority like Canada, would be well served if these organizations and others unified behind a national CAD data exchange standard. Collaboration and consensus-building among leading public safety practitioner organizations will drive recognition and adoption of standards by practitioners and solution providers alike. These organizations can jointly name an independent governing body, much like NENA did with its NG9-1-1 Interoperability Oversight Commission[34], to oversee the evolution of the standard, adherence by solution providers, and potentially recognition of independent labs to test standards compliance.

Leadership through consensus between 911 practitioner organizations has been achieved before and many practitioners and others acknowledge it is needed urgently. To realize substantial progress, advance the needs of telecommunicators, emergency responders and the public, and improve emergency outcomes, a good-faith effort to achieve consensus must be a priority. Many practitioners noted that progress in public safety is often glacially paced. The stark reality is that the longer the country takes to acknowledge and advance the standard, the slower the solution providers will respond to adopt the standard.

Whether it takes a national symposium of officials representing emergency communications organizations or some other means, the establishment of a governing body with authority to enforce the EIDO standard is long overdue. It is only natural that CAD-to-CAD data exchange follows the same data standard that NG911 has adopted and is deploying; to do otherwise is counterproductive. CAD solution providers will not invest critical development funds on a moving target, as it would be against their commercial interests. To ask solution providers to adopt a standard or coerce them into doing so when emergency communications organizations have not embraced the standard is an untenable approach. It is in the best interest of national 911 and emergency communications leadership to get their own house

[34] https://www.nena.org/news/499073/NENA-Announces-Establishment-of-the-NG9-1-1-Interoperability-Oversight-Commission-N9OC.htm

in order regarding the adoption of one standard before actively promoting ECCs and CAD solution providers to get on board.

8.2 Standards-Compliant Solution Requirements

CAD solution providers in the Program's second symposium in March 2022 were quick to acknowledge that they are not providing standards-compliant solutions because the clients are not asking for it. This is understandable as many ECC practitioners are focused on solving their own CAD issues by acquiring a new system, not focusing on how the system may integrate with neighboring systems.

A concerted effort should be made to provide language, via the Resource Center, urging ECC practitioners to adopt language that would compel CAD providers to address interoperability requirements. RFPs for CAD systems almost universally require that solutions proposed are compliant with NG911 standards and can consume data from NG911 CHE. The same rationale must now be applied to CAD procurements with requirements for EIDO standards-based solutions. Just as an ECC would not want a new CAD system that is not NG911-compliant, it should not accept a CAD platform that will not seamlessly share data with neighboring ECCs in the future.

Suggested questions seeking vendor response and/or solutions that should be incorporated into CAD RFPs are as follows:

- Describe how your CAD solution currently outputs CAD event data to external CAD systems.
- Is your outbound CAD event data compliant with NIEM XML standards?
- Do you provide an open-source application programming interface (API) that allows third-party CAD vendors or a DEH solution to easily read your data schema?
- Have you mapped outgoing CAD data to the current EIDO standard?
- Will your statement of work include effort to assist the agency in performing data mapping?
- Have you converted XML data to JSON data object output for consumption by a third-party system that intakes JSON formatted data?
- Describe your company's roadmap to:
  - Format existing CAD event data to map to the EIDO standard
  - Transform existing CAD event data to the JSON data object standard

8.3 Strategic Partnership

It is no surprise to any informed reader of this report that there are many organizations with divergent opinions as to how CAD interoperability should be implemented nationwide. In fact, one representative of a partner agency advised that EIDO is the only way and that all CAD vendors should be outputting EIDO standardized data in JSON format as the only solution. Certainly, this would be ideal if achievable; unfortunately, it is not a feasible solution in the short term and it is likely that some vendors may never output JSON-compliant data.

Why were over 49 prescription drug software providers capable of mapping their data to a single prescription monitoring exchange? Quite simply, there was one target. As discussed earlier, leadership is vital to the widespread adoption of CAD interoperability standards, but the PDMP PMIX project proved

that it was synergistic leadership that solved the prescription drug conundrum. Implementing data interoperability needs such synergy to spearhead this effort. Rather than a competitive race between solutions to see who can get there first, a strategic partnership among key players should be sought, receive adequate funding, and endeavor to develop a solution that can be embraced by ECC practitioners and solution providers alike.

8.3.1 Strategic Collaboration

It may be apparent to an outside observer that collaboration among entities seeking similar ends should be a forgone conclusion. Collaboration to ensure that a neutral solution is developed without a commercial interest at stake may require external consultation—forming a strategic collaboration led by an external sponsor whose only stake in the outcome is vastly improved emergency outcomes for citizens and emergency services personnel.

In project management, a common theme in any large project or initiative is project sponsorship. While a project champion may be engaged in the day-to-day leadership of a project within an organization, a project sponsor takes leadership to a higher level. What is needed to advance CAD interoperability is the focus of a large, unbiased group similar to The Intersector Project at the Aspen Institute's Program on Philanthropy and Social Innovation.[35] Frank A. Weil, Founding Chair, described how The Intersector Project provides a model to solve big national problems that cannot be solved by a single group alone. He writes a synopsis of The Intersector Project's mission as though it were addressed specifically to the CAD interoperability conundrum faced by ECCs today.

> *The public sector may no longer be capable of solving big problems by itself. The nonprofit sector may want for authority and resources alike. And the private sector may be primarily motivated by profits. But in the end, their interests are intertwined, because the success of each, indeed, of the great American experiment itself, depends on finding new ways to address the many challenges before us.*[36]

In alignment with the type of leadership needed to advance CAD interoperability, The Intersector Project defines the role of "Sponsor" as follows.

> *Sponsors … while not usually involved in the day-to-day operations of the collaboration, provide prestige, access to networks, convening power, and can mobilize financial and non-financial resources to support the collaboration. The collaboration may enlist a sponsor to build perceptions of legitimacy and prestige, to develop relationships with constituencies or stakeholders that are key to the collaboration's goals, or to gain access to additional financial and/or non-financial resources.*[37]

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[35] https://intersector.com/about/the-intersector-project/
[36] The Intersector (brookings.edu)
[37] Recruit a Powerful Sponsor or Champion - The Intersector Project

9 Measuring Success

In implementing strategies to advance CAD interoperability, especially if those strategies receive external funding, it is likely that metrics to demonstrate progress would be in order. Measuring the nation's progress toward CAD interoperability should be based on a blended strategy, gathering self-reported information from ECCs and regions, and automating data feeds from source systems to provide depth and verification to the self-reported data. The Program's 911 DataPath pilot project has already employed both methodologies to capture critical data—first, by obtaining administrative data self-reported from ECC practitioners and, second, in collecting transactional 911 call and CAD incident data directly from computer systems. To clarify and expound upon these two approaches, a short synopsis of each is provided in the following sections.

9.1 Direct

Engaging ECC practitioners, state 911 authorities, CAD and non-CAD solution providers, and 911 partner agencies directly serves to promote the initiative and seek stakeholder involvement in becoming part of the solution. Direct engagement to collect data, compile lessons learned, answer surveys, and contribute to a resource center will not only create a foundation for the CAD interoperability initiative, it will legitimize the seriousness of the endeavor by acquiring information from the source. Too often, organizations that represent stakeholder groups develop agendas that may run contrary to sharing emergency data seamlessly in the best interest of the citizens. Just as the Program engaged ECC practitioners, CAD solution providers, partner agencies, and non-CAD solution providers directly in this project, that same spirit of collaboration and mutual commitment must continue in the journey ahead.

9.2 Indirect

The 911 DataPath pilot project has proven the ability to efficiently, and with little or no operational impact, collect detailed, incident-level data on a streaming basis. Compiling anonymized call for service and CAD incident data provides context and comparative statistics between ECCs.

DEH systems could be an additional source of transactional data. Hub solutions typically create logs of the data exchange transactions that pass through in CAD data-sharing projects. These logs would provide operational data to show the volume and patterns of CAD-to-CAD data exchange.

All indirect data collections require authorization in advance. In the 911 DataPath pilot, this takes the form of an interagency data-sharing agreement. A similar MOU agreement would guide collection of data-exchange log data.

9.3 Resource Center and Data Analytics

If a CAD Interoperability Resource Center is established, it would be the ideal environment to collect analytical data, commonly referred to as web analytics.[38] Undoubtedly, the PDMP TTAC used web

[38] https://en.wikipedia.org/wiki/Web_analytics

analytics to improve website usability to accommodate end user needs. Correspondingly, it would be beneficial for the administrator of the Resource Center to utilize web analytics to assess and improve the Resource Center website.

Contemporary data analytics tools can be utilized, such as Google Analytics, which is used by over 55% of websites worldwide. Users could set up a Resource Center account and would then be assigned a unique user identification (ID), which is used within Google Analytics without tracking personally identifiable information (PII) or IP addresses. Once logged into the website, users would have access to:

- Pre-recorded webinars and future events
- Project charter templates
- Sample governance agreements between jurisdictions
- Link to current EIDO standards
- Data mapping examples and tutorials
- Links to federal grants and state-specific funding opportunities
- Sample grant applications
- Links to emergency communications publications and digital media
- Frequently asked questions
- Community discussion board
- Active regional CAD data interoperability partnerships
- Certified EIDO-compliant solution providers

The above is a sampling of what information can be hosted and distributed through a single website dedicated solely to advancing CAD interoperability nationwide, just as the PDMP TTAC did for the PMIX initiative.

Using Google Analytics, as the federal government does to capture its websites' analytics (https://analytics.usa.gov/) the administrator of the Resource Center would have access to the number of registrants, their geographic location, when they access the site, how long they spent on the site along with:

- Document downloads
- All click activity, including clicks to redirecting hyperlinks
- Pages visited within the website
- Forms filled
- Community chat activity

Gathering Resource Center metrics to gauge user engagement and optimize the user experience will ensure it remains a viable tool for the ECC practitioner community.

9.4 Building on Current Data Collection Success

The Program's 911 DataPath initiative is used as a model, much like the PMIX model referenced earlier, to demonstrate that an existing platform can be employed to expand capabilities to include collecting CAD-to-CAD data. Expanding on the success of a neutral platform like the 911 DataPath to facilitate

data sharing and collect data on those successes can prove to be a natural evolution in gauging success. The 911 DataPath can be configured to collect responses from ECC practitioners to the following prompts:

- Is the CAD capable and provisioned for open standards-based CAD-to-CAD data exchange? (Yes / No)
- Is the CAD interconnected to another ECC, network, or ESInet to share data to include open standards-based and proprietary-based systems. (Yes / No)
- Describe the manner and type of exchange of the CAD data between the agency and other agencies such as ESInet and EIDO; local network with proprietary interface; or third-party data exchange to include if it is full or limited data; two-way or one-way data exchange.
- How many specific ECCs and entities CAD systems is the data shared with?
- Is CAD-to-CAD interconnected to other ECCs or ESInets?
- How is CAD interconnected?
- Number of ECCs that CAD-to-CAD data is shared with.
- Is standards-based CAD-to-CAD implemented?

Recognizing that an important aspect of CAD interoperability is vendor- and technology-agnostic standards for data exchange, a two-fold expansion of the current 911 DataPath capabilities could include the following:

1) The extent of EIDO standards adoption within the CAD vendor and ECC community
2) DEHs that may not have adopted the standard but are exchanging data through a DEH that performs the necessary data translations.

9.4.1 Expanding Self-Reported Data: 911 DataPath EIDO Standards Enhancement

The following set of survey questions could be added to the 911 DataPath to track progress toward full EIDO-based, bi-directional information sharing:

1) Stages of CAD-to-CAD data exchange
    a) Are you sharing CAD data electronically for call transfers?
    b) Are you sharing CAD data electronically to enact mutual aid requests?
    c) What aspects of CAD-to-CAD data sharing are implemented:
        i) Incident data at the time of call transfer
        ii) Sending incident data when making a mutual aid request
        iii) Acknowledgement/response message from the receiving CAD system
        iv) Resource availability and the ability to request another jurisdiction's resources
2) Levels of standards adoption
    a) CAD systems can send incident data using a proprietary format
    b) CAD systems can ingest data transmitted to them formatted in a proprietary format

c) CAD systems map code values to the EIDO's code registries rather than proprietary code lists

d) CAD systems can send incident data using the EIDO standard

e) CAD systems can ingest data transmitted to them formatted in the EIDO standard

9.4.2 Expanding Automated Data: Include DEHs as a DataPath Data Source

The 911 DataPath project should consider DEH solutions as they have, nearly exclusively, been the solution to integrate disparate CAD solutions and may continue to play a pivotal role moving forward until widespread adoption of the EIDO standard is realized. The DEH systems' transactional logs would provide operational data to show the volume and patterns of each CAD-to-CAD data exchange. Specific data to be collected from DEH solutions could include:

1) Counts of call transfers, mutual aid requests, etc. (This could come from CAD systems to the extent that CAD vendors include those data fields in their databases, and ECCs routinely enter the data into their CAD)

2) Requests for assistance sent to a partner CAD. Data elements could include:

   a) Originating Agency Identifier (ORI)

   b) Receiving ORI(s)

   c) Call nature (law enforcement, fire, EMS)

   d) Priority

   e) Resource requested if any

3) Response messages from the receiving CAD system, sent back to the initiator of the request

4) Error messages (e.g., transactions that fail validation at the hub or fail to be received and processed by the recipient CAD system)

Like the CHE data currently being collected in the 911 DataPath pilot, a portal could display graphics and trends for an individual DEH implementation compared to a program-wide average of all data provided on CAD-to-CAD exchanges. Public safety stakeholders would be able to assess trends such as the increase or decrease in data exchanges over time by region, by call type, nature, or even seasonal or weather-related variations.

Public safety stakeholders would be able to plot CAD-to-CAD exchange data geographically and gain a picture of the importance of CAD system interoperability in responding to major traffic events, mutual aid across jurisdictions, re-directed 911 calls, and other relevant data sets.

10 Conclusion

Failure of imagination is often described as the inability to see what is beyond the current state of affairs or status quo. William Golding is credited with coining the term in his 1954 novel Lord of the Flies. Phil McKinney, retired chief technical officer (CTO) at Hewlett-Packard (HP), cites the novel on his website:

> *In the book, Golding argues that the biggest problem with society is that people cannot imagine alternatives to the way things are currently. He says that this lack of imagination leads to conformism and results in people blindly following the status quo.*[39]

Most certainly this would apply to those in the emergency responder community that resist data sharing across jurisdictions or cite prohibitions against doing so. ECC practitioners must deal with the most troubling events—both human and natural—daily. There is no lack of imagination in this community to improvise and adopt new operational methods to get the job done.

The strategies outlined in this report are not intended to be all-encompassing; undoubtedly, there are or will be others. The strategies herein are presented to the emergency communications and CAD vendor communities, as well as partner organizations and non-CAD solution providers, to target an objective—CAD system interoperability resulting in seamless data exchange between ECCs. Strategies have a much better chance of succeeding when they are targeted, when all stakeholders are working toward a common objective, this concept is depicted in Figure 13.

[39] https://philmckinney.com/preparing-for-a-failure-of-imagination/

Figure 13: Targeted Strategies Approach for CAD Interoperability

The need to share critical emergency data with fellow ECC practitioners has existed since first being captured in computer systems. The national effort to deploy 911, E911, and NG911 has taken center stage for over two decades and has transformed emergency communications. The national 911 system enables a caller with an emergency to reach the ECC within geographic proximity to render emergency assistance. A 911 call, before being answered, cannot instruct emergency services of the nature of the event, its criticality, the services needed, or other essential elements that may be critical to the life safety of responders or citizens. The 911 system solved the first half of the equation—a national effort is now needed to solve the second half.

Acronym Dictionary

Some definitions provided are from NENA's Master Glossary.[40]

Acronym	Term	Definition
ALI	Automatic Location Identification	Tabular reference for the current 911 system. Defines destination PSAP for every landline telephone number and cellular tower.
APCO	Association of Public-Safety Communications Officials	APCO (Association of Public Safety Communications Officials) is the world's oldest and largest not-for-profit professional organization dedicated to the enhancement of public safety communications.
ASAP	Automated Secure Alarm Protocol	The Automated Secure Alarm Protocol (ASAP) is a national service that is the next generation for the processing of information from alarm monitoring stations needing emergency dispatch.
ATI	Advanced Technology International	Solution provider for CAD Interoperability Current Status of Required Entities and Issues
BJA	Bureau of Justice Assistance	Provides leadership and services in grant administration and criminal justice policy development to support state, local, and tribal justice strategies to achieve safer communities.
CAD	Computer-Aided Dispatch	A computer-based system that aids PSAP telecommunicators by automating selected dispatching and record-keeping activities.
Cal OES	California Office of Emergency Services	Cal OES serves as the state's leadership hub during all major emergencies and disasters.
CHE	Call-Handling Equipment	Equipment used for call handling, which is a functional element concerned with the details of the management of calls. It handles all communication from the caller. It includes the interfaces, devices and applications utilized by the Agents to handle the call.
CJIS	Criminal Justice Information Services	CJIS (Criminal Justice Information Services) serves as the focal point and central repository for criminal justice information services in the FBI. Programs initially consolidated under the CJIS Division included the NCIC (National Crime Information Center), UCR (Uniform Crime Reporting), and Fingerprint Identification. In addition, responsibility for several ongoing technological initiatives was transferred to the CJIS Division, including the IAFIA (Integrated Automated Fingerprint Identification System), NCIC 2000, and the NIBRS (National Incident-Based Reporting System).
DEHs	Data Exchange Hubs	A center to exchange data that is supported by data science, data engineering, and data warehouse technologies to interact with endpoints such as applications and algorithms
E911	Enhanced 911	A telephone system that includes network switching, database, and PSAP premise elements capable of providing automatic location identification data, selective routing, selective transfer, fixed transfer, and a call back number

[40] https://kb.nena.org/wiki/Category:Glossary

Acronym	Term	Definition
ECC	Emergency Communications Center	ECC is a facility designated to receive and process requests for emergency assistance, which may include 9-1-1 calls, determine the appropriate emergency response based on available resources, and coordinate the emergency response according to a specific operational policy.
ECRF	Emergency Call Routing Function	A functional element in an ESInet. The ECRF is a Location to Service Translation (LoST) protocol server where location information (either civic address or geo-coordinates) and a Service Uniform Resource Name (Service URN) serve as input to a mapping function that returns a Uniform Resource Identifier (URI) used to route an emergency call toward the appropriate PSAP for the caller's location or toward a responder agency.
EDC	Emerging Digital Concepts	Solution provider for CAD Interoperability Current Status of Required Entities and Issues . Emerging Digital Concepts (EDC) is a privately held company founded in 1997 by two former IBM system engineers: Chris Wiseman, and Greg Crider
EDX	Emergency Data Exchange	Cloud-based solution with powerful features that digitize the integrated response of neighboring first response agencies enabling interoperability through automated data sharing.
EHR	Electronic Health Record	A digital version of a patient's paper chart.
EIDO	Emergency Incident Data Object	An EIDO (Emergency Incident Data Object) is a JSON-based (JavaScript Object Notation) object that is used to share emergency incident information between and among authorized entities and systems. NENA has adopted the JSON-based EIDO (Emergency Incident Data Object) for sharing incident information among authorized NG9-1-1 entities and systems.
EMS	Emergency Medical Services	EMS is a service providing out-of-hospital acute care and transport to definitive care, to patients with illnesses and injuries which the patient believes constitute a medical emergency.
ESInet	Emergency Services IP Network	Managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG911 services.
FBI	Federal Bureau of Investigation	The FBI is an intelligence-driven and threat-focused national security organization with both intelligence and law enforcement responsibilities.
GIS	Geographic Information System	A system for capturing, storing, displaying, analyzing, and managing data and associated attributes which are spatially referenced.
HIPAA	Health Insurance Portability and Accountability Act	HIPAA (Health Insurance Portability and Accountability Act) is a federal law that amended the Internal Revenue Code of 1986 to improve portability and continuity of health insurance coverage in group and individual markets, to combat waste, fraud, and abuse in health insurance and health care delivery, to promote the use of medical savings accounts, to improve access to long-term care services and coverage, to simplify the administration of health insurance, and for other purposes.
iCERT	Industry Council for Emergency Response Technologies	iCERT-is the only industry trade association focused exclusively on emergency response technologies and related equipment, systems, and services. iCERT is dedicated to improving public safety through innovation.

Acronym	Term	Definition
IDX	Incident Data eXchange	DX (Incident Data eXchange) is a Functional Element that facilitates the exchange of Emergency Incident Data Objects (EIDOs) among other Functional Elements both within and external to an agency. (Previously called "IDE".)
IJIS	Integrated Justice Information Systems Institute	IJIS (Integrated Justice Information Systems Institute) is a nonprofit corporation representing industry's leading companies who collaborate with local, state, tribal, and federal agencies to provide technical assistance, training, and support services for information exchange and technology initiatives.
IP	Internet Protocol	The method by which data is sent from one computer to another on the ESInet, Internet, or other networks.
IT	Information Technology	The use of any computers, storage, networking, and other physical devices, infrastructure, and processes to create, process, store, secure, and exchange all forms of electronic data.
JSON	JavaScript Object Notation	JSON (JavaScript Object Notation) is a text-based, human-readable data interchange format used to exchange data between web clients and web servers
LNG	Legacy Network Gateway	NG (Legacy Network Gateway) is an NG9-1-1 Functional Element that provides an interface between a non-IP originating network and a Next Generation Core Services (NGCS) enabled network.
LVF	Location Validation Function	A functional element in an NGCS that is a LoST protocol server where civic location information is validated against the authoritative GIS database information.
MLTS	Multi-Line Telephone System	Communications equipment comprised of common control unit(s), telephone sets, control hardware and software, and adjunct systems used typically in enterprise settings such as hotels, government agencies, commercial offices, and campuses.
MOU	Memorandum of Understanding	A document written between parties to cooperatively work together on an agreed upon project or meet an agreed upon objective.
NASNA	National Association of State 911 Administrators	NASNA is the voice of the states on public policy issues impacting 911. State 911 leaders' expertise can assist industry associations, public policymakers, the private sector, and emergency communications professionals at all levels of government as they address complex issues surrounding the evolution of emergency communications. An association that represents state 911 programs in the field of emergency communications.
NCR	National Capital Region	The National Capital Region (NCR) was created pursuant to the National Capital Planning Act of 1952 (40 U.S.C. § 71). The Act defined the NCR as the District of Columbia; Montgomery and Prince George's Counties of Maryland; Arlington, Fairfax, Loudoun, and Prince William Counties of Virginia; and all cities now or hereafter existing in Maryland or Virginia within the geographic area bounded by the outer boundaries of the combined area of said counties.
NENA	National Emergency Number Association	Standards body for 911 and NG911.
NHTSA	National Highway Traffic Safety Administration	The Federal Government agency tasked with transportation-related education, research, safety standards, and enforcement. Is also the home of the National 911 Program, under the Office of Emergency Medical Services.

Acronym	Term	Definition
NG911	Next Generation 911	NG911 refers to an initiative aimed at updating the 911 service infrastructure in the United States and Canada to improve public emergency communications services in a growingly wireless mobile society.
NGCS	Next Generation Core Services	The base set of services needed to process a 911 call on an ESInet. Includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services, and typical IP services such as DNS and DHCP. The term NGCS includes the services and not the network on which they operate.
NIBRS	National Incident-Based Reporting System	Implemented to improve the overall quality of crime data collected by law enforcement, NIBRS captures details on each single crime incident—as well as on separate offenses within the same incident—including information on victims, known offenders, relationships between victims and offenders, arrestees, and property involved in crimes.
NIEM	National Information Exchange Model	NIEM (National Information Exchange Model) is a common vocabulary that enables efficient information exchange across diverse public and private organizations.
OEMS	Office of Emergency Medical Services	The Office of Emergency Medical Services (OEMS) is responsible for planning and coordinating an effective and efficient statewide EMS system
ONDCP	Office of National Drug Control Policy	ONDCP leads and coordinates the nation's drug policy so that it improves the health and lives of the American people.
PDMPs	Prescription Drug Monitoring Programs	An electronic database that tracks controlled substance prescriptions in a state.
PDMP TTAC	Prescription Drug Monitoring Program Training and Technical Assistance Center	Provides a comprehensive array of services, support, resources, and strategies to PDMPs, federal partners and other stakeholders to further the efforts and effectiveness of PDMPs in combating the misuse and diversion of prescription drugs.
PII	Personally Identifiable Information	Any representation of information that permits the identity of an individual to whom the information applies to be reasonably inferred by either direct or indirect means.
PMIX	Prescription Monitoring Information Exchange	The Prescription Monitoring Information eXchange National Architecture (PMIX) is an information exchange standard that enables information sharing and interoperability between systems for PDMP data.
PSAP	Public Safety Answering Point	The entity responsible for receiving 911 calls and processing those calls according to a specific operational policy.
Rave	Rave Mobile Safety	Solution provider for CAD Interoperability Current Status of Required Entities and Issues
REST	Representational State Transfer	An interface that transmits domain-specific data over HTTP without an additional messaging layer such as SOPA or session tracking via HTTP cookies.
RFP	Request for Proposal	RFP (Request for Proposal) is a standardized document for requesting negotiated bids. In more general terms, it is an announcement from a customer or funding source that is seeking proposals for a specific program, project, or work effort.

Acronym	Term	Definition
RMS	Records Management System	Public safety RMS are often interfaced to public safety communication centers. RMSs are sometimes accessed directly through computer systems deployed within communication centers for research and analysis purposes.
SaaS	Software as a Service	A method of software delivery and licensing in which software is accessed online via a subscription, rather than bought and installed on individual computers.
SME	Subject Matter Expert	Somebody with specialized knowledge or talent that is needed by the Team; this includes SMEs on the product, the environment, development practices, and so on. The term usually refers to SMEs that are 'outside' the Team, but not always
SNO911	Snohomish County 911	Consolidated 911 dispatch center providing emergency response services to all of Snohomish County, WA
SOAP	Simple Object Access Protocol	SOAP is a messaging protocol specification for exchanging structured information in the implementation of web services in computer networks.
USDOT	U.S. Department of Transportation	The top priorities at DOT are to keep the traveling public safe and secure, increase their mobility, and have our transportation system contribute to the nation's economic growth.
XML	Extensible Markup Language	Extensible Markup Language (XML) is a markup language designed as a standard way to encode documents and data.