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Public Safety and Emergency Management Communications Information Models Gap Analysis

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Executive Summary

This document reports on work done by the Institute for Defense Analyses (IDA) for the Office of the Program Manager, Information Sharing Environment (PM-ISE), Office of the Director of National Intelligence, and for the Office of the Deputy Chief Information Officer (DCIO) for Command, Control, Communications, and Computers and Information Infrastructure Capabilities (C4&IIC), Department of Defense (DoD) Chief Information Officer (CIO).

The overall objective of this work is to assess the current state of communications interoperability between DoD public safety and emergency management (PS/EM) entities and United States (U.S.) civilian PS/EM entities, and how that is likely to change as the next generation of public safety information systems is implemented across the nation. This paper addresses one aspect of this work – the analysis of gaps in the coverage of PS/EM communications data requirements by the National Information Exchange Model (NIEM), version 4.0.

The IDA team derived the PS/EM communications data requirements used as the basis for analysis in gaps in NIEM coverage from existing PS/EM communications data standards and from prominent PS/EM information exchange specifications. The team identified data requirements from formal PS/EM data standards in a related task under this project, and reported them in IDA Document D-8416, *Department of Defense Public Safety and Emergency Management Communications: Interoperability Data Requirements*, published in March 2017. In addition to PS/EM communications data requirements from NIEM, that document reviewed requirements from the following Emergency Data Exchange Language (EDXL) standards and the other following sources:

- EDXL-RM (Resource Messaging),
- EDXL-DE (Distribution Element),
- EDXL-HAVE (Hospital Availability Exchange),
- EDXL-CAP (Common Alerting Protocol),
- Emergency Incident Data Document (EIDD),
- Public Safety Communications Common Incident Types.

Thus, the data models of all of these standards are initial candidates for assessment of gaps in NIEM's coverage of PS/EM communications data requirements.

However, NIEM already includes the following complete standards from the Emergency Data Exchange Language (EDXL): EDXL-DE, EDXL-HAVE, and EDXL-CAP. In addition, NIEM incorporates some of the code lists from the EDXL-RM standard, as well as from the *Public Safety Communications Common Incident Types* standard developed by the Association for Public-Safety Communications Officials (APCO) and the National Emergency Numbers Association (NENA). Such incorporation of external standards and code lists by NIEM is part of its general strategy of re-using existing adopted standards rather than trying to replace them.

This paper describes gaps in the NIEM coverage of identified PS/EM data requirements for each of the following sources, which NIEM has not directly incorporated:

- Keystone/ Unified Incident Command and Decision Support System (UICDS),

- National Capital Region (NCR) CAD to CAD Data Exchange,

- EDXL-RM,

- Emergency Incident Data Document (EIDD).

For each of these, data requirements are identified that are partially covered by NIEM version 4.0, as well as those that have no coverage in this current version of NIEM. Recommendations are provided on how NIEM could incorporate coverage of each of the identified uncovered data requirements.

The schemas for Keystone / UICDS, the NCR Data Exchange, and the EIDD all use NIEM version 2. NIEM has evolved since version 2 was released in 2007.[1] The current version, 4.0 (released in July 2017), incorporates ways to express many of the emergency management data requirements these two systems had to define in their schemas, owing to their absence in version 2. In general, The IDA team found that most of the emergency management data requirements exist in NIEM 4.0. The team did find some missing and incompletely covered data requirements. Table 1-1 summarizes the number of these in each exchange specification for which no equivalent data requirement exists in NIEM 4.0. The EIDD had by far the largest number of elements not fully supported by NIEM 4.0.

Table 1-1 Summary of missing and incomplete data requirements

Source	Missing	Partially Covered
Keystone / UICDS	9	4
NCR Data Exchange	4	9
EDXL-RM	2	0
EIDD	27	32

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[1] For a NIEM timeline, see https://www.niem.gov/about-niem/history

Whenever possible, the IDA team recommends XML Schema Definition (XSD) elements and types that, if added to NIEM's Emergency Management domain, would eliminate the gaps. Limited by time and incomplete documentation of some of the sources, the team was not always able to formulate a suitable recommendation.

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1. Introduction

A. Background

1. Issues Addressed

Department of Defense (DoD) public safety and emergency management (PS/EM) entities and U.S. civilian PS/EM entities have critical needs to communicate effectively to coordinate responses to PS/EM incidents. Some DoD facilities depend upon U.S. civilian emergency services for response to PS/EM incidents. DoD public safety officials need to request support from civilian public safety responders when they lack the types of emergency services required and when their available services are overwhelmed. Civilian PS/EM entities may also need to request and coordinate with military PS/EM entities, especially when they are overwhelmed by major incidents, such as those requiring humanitarian assistance and disaster relief (HADR).

Coordination among DoD and civilian PS/EM entities can use many different communication modalities, such as automated interconnections among Computer Aided Dispatch (CAD) systems and shared websites, such as the DoD All Partners Access Network (APAN).[2] However, better understanding of these communications capabilities and requirements is needed, especially as we move into the next generation of public safety information systems, such as FirstNet[3] and Next-Generation 9-1-1.[4] PS/EM agencies, both civilian and military, need to better understand what the existing communication systems are, how interoperable they are, and what PS/EM information-sharing requirements they serve. Such an improved understanding can provide a foundation for migrating to next-generation systems that exceed current capabilities and meet future needs.

2. Project

To address the issues described, the Office of the Program Manager, Information Sharing Environment (PM-ISE) and the DoD Deputy Chief Information Officer (DCIO) for Command, Control, Communications, and Computers and Information Infrastructure Capabilities (C4&IIC) asked the Institute for Defense Analyses (IDA) to assess the current

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[2] See https://www.apan.org/ for details on APAN collaboration tools and applications.

[3] First Responder Network Authority (FirstNet), 2017. http://www.firstnet.gov/

[4] National Emergency Number Association (NENA), NG9-1-1 Project, 2017. http://www.nena.org/?NG911_Project

state of interoperability between DoD PS/EM entities and U.S. civilian PS/EM entities, and how that state is likely to change as the next generation of public safety information systems is implemented across the nation (especially FirstNet).

As part of these directed analyses, IDA completed an assessment of the types of data required to support information exchanges between DoD and U.S. civilian PS/EM entities.[5] It identifies a set of data requirements from PS/EM communications standards and specific exchange specifications that need to be considered for use in future DoD and U.S. civilian PS/EM communications systems, such as FirstNet. Subsequently, IDA developed a formal semantic model of the information exchanges and information content most relevant to information exchanges between DoD and U.S. civilian PS/EM entities.[6] Another part of this project surveyed civilian and DoD mass warning and notification systems to identify their commonalities and differences, including their use or neglect of national and international standards for information sharing. The results are reported in a separate document.[7]

This paper uses the prior analysis of PS/EM communications data requirements as a basis for assessing the coverage of those requirements by the National Information Exchange Model (NIEM). In particular, it focuses on identifying gaps in that coverage. A gap is defined as a data requirement in an existing PS/EM communication that cannot be expressed using only elements and types in NIEM.

B. Approach

NIEM is a documented best practice for sharing information recognized by the Federal CIO Council and used by U.S. State and local governments, as well as by most Federal agencies. The NIEM data standards include a specialized domain for Emergency Management information sharing, which directly addresses data requirements for PS/EM communications. NIEM also includes a number of independently developed data standards and standard code lists, several of which address specific PS/EM data sharing requirements. Although NIEM has established broad coverage of PS/EM data requirements, among others, it remains of interest to assess how well NIEM covers all the PS/EM communications data requirements identified by other standards or in use by PS/EM entities. That is the focus of this paper.

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[5] Institute for Defense Analyses, *Department of Defense Public Safety and Emergency Management Communications: Interoperability Data Requirements*, IDA Document D-8416, March 2017.

[6] Institute for Defense Analyses, *Public Safety and Emergency Management Communications Ontology,* IDA Document D-8583, May 2017.

[7] Institute for Defense Analyses, *A Survey of Mass Warning and Notification Systems,* IDA Document D-8388, March 2017.

The IDA team derived the PS/EM communications data requirements used as the basis for analysis in gaps in NIEM coverage from existing PS/EM communications data standards and from prominent PS/EM information exchange specifications. The team identified data requirements from formal PS/EM data standards in a related task under this project, and reported them in IDA Document D-8416 *Department of Defense Public Safety and Emergency Management Communications: Interoperability Data Requirements*, March 2017. In that document, the IDA team reviewed the data content defined by NIEM and the PS/EM communications data requirements of the following standards from the Emergency Data Exchange Language (EDXL) and the other standards listed:

- EDXL-RM (Resource Messaging),[8]
- EDXL-DE (Distribution Element),[9]
- EDXL-HAVE (Hospital Availability Exchange),[10]
- EDXL-CAP (Common Alerting Protocol),[11]
- Emergency Incident Data Document (EIDD),
- Public Safety Communications Common Incident Types.

Thus, the data models of all of these standards are initial candidates for assessment of gaps in NIEM's coverage of PS/EM communications data requirements.

However, NIEM already includes the following complete standards from the Emergency Data Exchange Language (EDXL):

- EDXL-DE (Distribution Element),
- EDXL-HAVE (Hospital Availability Exchange),
- EDXL-CAP (Common Alerting Protocol).[12]

In addition, NIEM incorporates some code lists from the EDXL-RM standard, as well as from the *Public Safety Communications Common Incident Types* standard developed by the Association for Public-Safety Communications Officials (APCO) and the National

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[8] *Emergency Data Exchange Language Resource Messaging (EDXL-RM) 1.0,* OASIS, May 2008. Available at http://docs.oasis-open.org/emergency/edxl-rm/v1.0/pr03/EDXL-RM-v1.0-PR03.html

[9] *Emergency Data Exchange Language (EDXL) Distribution Element, v. 1.0,* OASIS, May 2006. Available at http://docs.oasis-open.org/emergency/edxl-de/v1.0/EDXL-DE_Spec_v1.0.pdf

[10] *Emergency Data Exchange Language (EDXL) Hospital AVailability Exchange (HAVE) Version 1.0*, November 2008. Available at http://docs.oasis-open.org/emergency/edxl-have/os/emergency_edxl_have-1.0-spec-os.pdf

[11] OASIS, *Common Alerting Protocol Version 1.2*, July 2010. Available at http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.pdf

[12] NIEM includes CAP version 1.1. Version 1.2 was released in July 2010.

Emergency Numbers Association (NENA). Such incorporation of external standards and code lists by NIEM is part of its general strategy of re-using existing adopted standards rather than trying to replace them. As a result of such standards re-use within NIEM, it is unnecessary to assess NIEM coverage of any of the data elements of these included standards. NIEM explicitly includes them, using their original specifications. Thus, the only identified PS/EM communications data standards remaining that need review for the potential of inadequate coverage by NIEM are the EDXL-RM and EIDD standards.

In addition to reviewing recognized PS/EM information sharing standards, IDA's previous assessment of PS/EM communications data requirements sought out examples of PS/EM exchanges using data elements that were not covered by existing standards. Although some PS/EM entities have been reluctant to share existing information exchange specifications, the IDA team was able to identify the exchange standards of a DoD middleware system, Keystone, designed to support information sharing between otherwise incompatible PS/EM systems. Although Keystone defines exchange schemas using NIEM version 2.0, it includes many schema types and elements within its own namespaces for concepts not covered by that version of NIEM. Thus, the Keystone schemas are one source of data requirements that may not be covered by the current version, 4.0, of NIEM. These Keystone schemas include those of the parent system from which it was derived – the Unified Incident Command and Decision Support System (UICDS).[13]

Subsequent to completing IDA Document D-8416 on PS/EM communications data requirements, the IDA team learned of another PS/EM data exchange specification, which has been in wide use across the National Capital Region (NCR). The NCR Interoperability Program developed the NCR CAD to CAD (CAD2CAD) Data Exchange to support information sharing between county Computer Aided Dispatch (CAD) systems in the NCR. Although it too was developed using NIEM version 2.0, it also includes many data elements in its own namespace that were not covered by NIEM at the time of its development in 2010. Thus, the NCR CAD2CAD data exchange specifications are another source of PS/EM data requirements to check for coverage by the current NIEM 4.0. Hence, both Keystone and the NCR CAD2CAD data exchange specifications were included in the IDA team's analysis of potential gaps in NEIM coverage of PS/EM data requirements.

C. Overview

This paper discusses gaps in NIEM coverage of identified PS/EM data requirements for each of the following sources, which NIEM has not directly incorporated:

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[13] Science Applications International Corporation, *Unified Incident Command and Decision Support (UICDS) Getting Started Guide*, Arlington, VA, September 2010.

- Keystone/UICDS (Chapter 2),

- NCR CAD2CAD Data Exchange (Chapter 3),

- EDXL-RM (Resource Messaging) (Chapter 4),

- EIDD (Chapter 5).

Data requirements that are partially covered by NIEM version 4.0 are identified, as well as those that are not covered. Recommendations are provided on how NIEM could incorporate coverage of each of the identified uncovered data requirements. The recommendations are intended to be starting points for a change proposal. At the same time, they provide technical details that exemplify the form a change might take.

2.   Keystone / UICDS Gap Analysis

Keystone is a joint initiative to establish near real-time information sharing interfaces between otherwise incompatible systems that run force protection and emergency management applications.[14] The Keystone initiative aims to provide near real-time response. It establishes an infrastructure with which existing systems interact. It does not require or expect existing systems to alter their software or hardware configurations.

Keystone is based on the Unified Incident Command Decision Support (UICDS) system, an older system sharing many of the same goals.[15] UICDS provides 18 categories of services. Example of services are:

- Publishing a notification of an incident,

- Querying all incidents currently active,

- Tasking an organization to respond to an incident,

- Determining availability of resources necessary to respond to an incident.

The capability provided by a service is a kind of communicative act. Invoking a service results in an XML message being sent. Many of the services are invoked by Client system users. A client system is a system whose applications exist to satisfy operational needs; Computer Aided Dispatch (CAD) systems are examples of client systems. UICDS client systems send messages to UICDS Core systems. A core system is an intermediary in a UICDS-based communication. It receives a message, examines that message to determine its recipients, and passes the message along to those recipients, either directly or through other core systems. Furthermore:

- When a core system receives a message from a client system, it translates that message into a standard XML format conformant to a predefined set of schemas. All core systems use the same set of schemas.

- When a core system sends a message to a client system, it translates that message into whatever format the client system expects.

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[14] SSC Pacific, *EUCOM Keystone Product Reference Guide Revision 1.0*, San Diego, CA, September 2015.

[15] Science Applications International Corporation, *Unified Incident Command and Decision Support (UICDS) Getting Started Guide*, Arlington, VA, September 2010.

All UICDS Core systems have a common language in which to exchange information. They include translators for client systems – a precondition of client system integration – and thereby satisfy Keystone's mandate that client systems are not required to alter their configurations to interact with other Keystone-compatible systems.

The common language used by UICDS Core systems is the basis for NIEM gap analysis. If a message resulting from a UICDS service invocation cannot be expressed using NIEM elements and types, the IDA team asserts that NIEM lacks the ability to communicate information relevant to public safety and emergency communications. Messages created and exchanged by UICDS Core systems are partly NIEM-compliant: UICDS is based on version 2.0 of NIEM. That there are gaps is revealed by UICDS's extension of NIEM schemas. The additional elements in the UICDS schemas surely suggest that UICDS developers felt that NIEM elements and types did not express everything UICDS needed.

The following gap analysis is based on NIEM 4.0, which was released in July 2017.[16] Between NIEM 2.0 and NIEM 4.0, the Emergency Management domain has expanded considerably. It now includes many elements that UICDS schema defined that were not in version 2.0 These UICDS elements did not necessarily adhere to NIEM's strict naming and design rules.[17] Nevertheless, their presence in NIEM 4.0 means that a UICDS or Keystone message can be transformed automatically into NIEM 4.0 and vice versa. Differences in naming, and minor structural differences, are not considered gaps.

A. Missing Elements and Types

Table 2-1 shows the UICDS elements and types that appear to have no equivalent in NIEM 4.0.

Table 2-1. UICDS Elements and Types Not Found in NIEM 4.0

Schema	Element / Type
EDXL-RMCommitResources.xsd	AnticipatedFunction / AnticipatedFunctionType
EDXL-RMCommitResources.xsd	AssignmentInformation / (anonymous)
EDXL-RMCommitResources.xsd	Keyword / ValueListType
EDXL-RMCommitResources.xsd	PriceQuote / PriceQuoteType
EDXL-RMCommitResources.xsd	Resource / (anonymous)
EDXL-RMCommitResources.xsd	SpecialRequirements / SpecialRequirementsType

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[16] http://niem.github.io/niem-releases/

[17] NIEM Technical Architecture Committee, *National Information Exchange Model Naming and Design Rules Version 4.0beta1*, March 2017. Available at https://reference.niem.gov/niem/specification/naming-and-design-rules/4.0beta1/

Schema	Element / Type
IAPService.xsd	IncidentActionPlan / IncidentActionPlanType
TaskingService.xsd	dueDate / dateTime
TaskingService.xsd	id / anyURI

Of the nine rows, seven refer to an external schema, used by UICDS, that is from the Emergency Data Exchange Language (EDXL) Resource Management (RM) standard.[18] Chapter 4 discusses EDXL-RM. The following discussion pertains specifically to EDXL-RM entities used in Keystone/UICDS exchanges.

1. Anticipated Function / Anticipated Function Type

This element and its corresponding type are used to provide a textual description of the intended use of a resource. The type is an extension of XSD's primitive string type.

Recommendation: Extend NIEM's emergency management domain by adding type AnticipatedFunctionType and element AnticipatedFunction.

```
<xsd:complexType name="AnticipatedFunctionType">
 <xsd:simpleContent>
   <xsd:extension base="nc:TextType"/>
 </xsd:simpleContent>
</xsd:complexType>
<xsd:element name="AnticipatedFunction"
 type="em:AnticipatedFunctionType" nillable="true"/>
```

2. Assignment Information

AssignmentInformation is an element declared within an anonymous type describing resource information. Its type is an anonymous type.

Recommendation: Extend NIEM's emergency management domain by adding type AssignmentInformationType. The type references existing elements in the emergency management domain.

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[18] *Emergency Data Exchange Language (EDXL) Distribution Element Version 2.0*, OASIS, September 2013. Available at http://docs.oasis-open.org/emergency/edxl-de/v2.0/edxl-de-v2.0.html

```
<xsd:complexType name="AssignmentInformationType">
 <xsd:complexContent>
   <xsd:extension base="s:ObjectType">
     <xsd:sequence>
       <xsd:element ref="em:ResourceQuantity"
         minOccurs="0" maxOccurs="unbounded"/>
       <xsd:element ref="em:ResourceRestrictionsText"
         minOccurs="0" maxOccurs="unbounded"/>
       <xsd:element ref="em:AnticipatedFunction"
         minOccurs="0" maxOccurs="unbounded"/>
     </xsd:sequence>
 </xsd:complexContent>
 </xsd:complexType>
```

3. Keyword

Keyword is an element declared within an anonymous type describing a resource. Its type is ValueListType. NIEM 2.0 has no such type, but NIEM 4.0's ValueType can express the same information.

NIEM 4.0 does not have an element named Keyword, but it does have elements ResourceDispositionKeywordValue and ResourceStatusKeywordValue. Neither Keystone nor UICDS documentation describes the Keyword element and how it is to be used. Whether the NIEM keyword-related elements can cover the intention of the UICDS Keyword element is not known. Accordingly, no recommendation is made at this time.

4. Price Quote / PriceQuoteType

A PriceQuote element is sent in response to a request for a resource. The element is specified using an anonymous type that contains both a textual specification of quantity (a string) and a measured quantity, which is a composite structure containing an amount (a floating-point value) and an optional unit of measure.

In NIEM 4.0, the emergency management domain includes element ResourcePriceQuoteAmount. Although this element's name suggests a similar intent to the UICDS PriceQuote element, its type is NIEM Core's AmountType, which has a different structure than UICDS's anonymous type for PriceQuote. UICDS requires a textual statement of quantity; AmountType does not allow it. Furthermore, UICDS does not state the intent of the unit of measure element in a PriceQuote.

However, assuming that the UICDS PriceQuote optional unit of measure is simply a specification of the currency used in the quote, the IDA team recommends using the NIEM nc:CurrencyText or nc:CurrencyCode elements to capture this content. These elements are contained in nc:Amount which is the type of the em:ResourcePriceQuoteAmount element, so it should not need modification to cover this part of the UICDS PriceQuote element. But there is no element for textual statement of quantity, so, a new optional element for that could be added to NIEM Core's nc:AmountType.

Because the intended interpretation of PriceQuote needs clarification, no specific recommendation on whether to add price quoting-related elements to NIEM is made at this time.

5. Resource

A UICDS Resource element contains information on a resource, that is, something used as part of incident response activities. The element's type is anonymous. The Resource element is itself not global but is nested within the anonymous type of element ResourceInformation, as shown in Figure 2-1.

Figure 2-1. UICDS ResourceInformation Structure

NIEM 2.0 has this same essential structure (the difference accounts for conformance to NIEM's Naming and Design Rules: There are no anonymous types, and all elements are global), but the Resource element was deleted in NIEM 3.2. It is not in NIEM 4.0, where the corresponding ResourceInformationType has a different structure, which does not include a Resource element, although it contains numerous resource related elements. The corresponding ResourceInformation element is contained within the em:FirstResponderType, which also includes an em:ResourceID element. It seems that most, perhaps all, of the data requirements of the UICDS Resource element are found for first responder resources in the NIEM 4.0 em:FirstResponder element. However, the em:ResourceID element is not used elsewhere in NIEM 4.0, and it is not apparent how other types of Resource are identified.

No documentation on the rationale for the elimination of the Resource element has been found. It seems likely that the NIEM board determined a better way to express resource-related information, but until specific information can be located, no recommendations for changes are being made.

6. Special Requirements / SpecialRequirementsType

The SpecialRequirements element lets a message contain a textual statement of special requirements related to a resource. The UICDS documentation does not place any constraints on the kinds of requirements that may be expressed.

Recommendation: Extend NIEM's Emergency Management domain by adding element SpecialRequirements and type SpecialRequirementsType:

```
<xsd:element name="SpecialRequirements"
  type="em:SpecialRequirementsType" nillable="true"/>
<xsd:complexType name="SpecialRequirementsType">
  <xsd:simpleContent>
    <xsd:extension base="nc:TextType"/>
  </xsd:simpleContent>
</xsd:complexType>
```

7. IncidentActionPlan / IncidentActionPlanType

The UICDS element IncidentActionPlan is used to formulate an action plan appropriate for incident response. Its type, IncidentActionPlanType, is a complex type for describing a plan and its components. The type has elements whose names begin with "Document" (e.g., DocumentEffectiveDate), but it does not extend NIEM's DocumentType. In fact, NIEM's DocumentType can almost express what an IncidentActionPlanType can. It lacks the ability to describe the tasks that are part of an action plan.

Recommendation: Extend NIEM's Emergency Management domain by adding the following elements and types:

```
<xsd:complexType name="IncidentActionPlanType">
  <xsd:complexContent>
    <xsd:extension base="nc:DocumentType">
      <xsd:sequence>
        <xsd:element ref="em:IncidentIdentification"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="em:IncidentActionPlanComponent"
          minOccurs="0" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
<xsd:element name="IncidentActionPlan"
  type="em:IncidentActionPlanType" nillable="true"/>
<xsd:element name="IncidentIdentification"
  type="nc:IdentificationType" nillable="true"/>
<xsd:element name="IncidentActionPlanComponent"
  type="em:IncidentActionPlanComponentType" nillable="true"/>
```

```
<xsd:complexType name="IncidentActionPlanComponentType">
  <xsd:complexContent>
    <xsd:extension base="s:ComplexObjectType">
      <xsd:sequence>
        <xsd:element
          ref="em:IncidentActionPlanComponentIdentification"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element
  ref="em:IncidentActionPlanComponentCompletionTaskIdentification"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="IncidentActionPlanComponentDescriptionText"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="IncidentActionPlanComponentStatusText"
          minOccurs="0" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
<xsd:element
  name="IncidentActionPlanComponentIdentification"
  type="nc:IdentificationType"
  nillable="true"/>
<xsd:element
  name="IncidentActionPlanComponentCompletionTaskIdentification"
  type="nc:IdentificationType" nillable="true"/>
<xsd:element
  name="IncidentActionPlanComponentDescriptionText"
  type="em:IncidentActionPlantDescriptionTextType" nillable="true"/>
<xsd:complexType
  name="IncidentActionPlantDescriptionTextType">
  <xsd:simpleContent>
    <xsd:extension base="nc:TextType"/>
  </xsd:simpleContent>
</xsd:complexType>
<xsd:element
  name="IncidentActionPlanComponentStatusText"
  type="em: IncidentActionPlanComponentStatusTextType"
  nillable="true"/>
<xsd:complexType
    name="IncidentActionPlantCompoenntStatusTextType">
  <xsd:simpleContent>
    <xsd:extension base="nc:TextType"/>
  </xsd:simpleContent>
</xsd:complexType>
```

8. dueDate

The dueDate element is used in UICDS to state the due date of a task assignment. NIEM's type TaskType has a start and end date, but not a due date.

Recommendation: Extend NIEM's Emergency Management domain by adding the following element:

```
<xsd:element name="TaskAssignmentDueDate">
  <xsd:simpleContent>
    <xsd:extension base="nc:DateType"/>
  </xsd:simpleContent>
</xsd:element>
```

9. id

The UCIDS id element refers specifically to an agent identifier. It is used to describe tasks assigned to, and accepted by, agents associated with incident response.

Recommendation: Extend NIEM's Emergency Management domain by adding the following elements and types:

```
<xsd:element name="AgentAssignmentDate"
  type="nc:DateType" nillable="true"/>
<xsd:element name="AgentAcceptedDate"
  type="nc:DateType" nillable="true"/>
<xml:complexType name="TaskAssignmentType">
  <xsd:complexContent>
    <xsd:extension base="s:ComplexObjectType">
      <xsd:sequence>
        <xsd:element ref="it:AgentIdentification"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="em:AgentAssignmentDate"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="em:AgentAcceptedDate"
          minOccurs="0" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexContent>
</xsd:complexType>
<xml:element name="TaskAssignedToTaskAssignmentType"
  type="em:TaskAssignmentType" nillable="true"/>
<xml:element name="TaskAssignedByTaskAssignmentType"
  type="em:TaskAssignmentType" nillable="true"/>
```

B. Partially Covered Elements and Types

The following UICDS elements and types can be partially expressed in NIEM 4.0

Table 2-2. UICDS Elements and Types Partially Covered in NIEM 4.0

Schema	Element / Type
EDXL-RMCommitResources.xsd	ContactInformation / ContactInformationType
EDXL-RMCommitResources.xsd	ResourceID / ResourceIDType
EDXL-RMCommonTypes.xsd	Radio / RadioInformationType
TaskingService.xsd	TaskId

Of the four rows, three refer to EDXL schemas. Chapter 4 discusses EDXL-RM. The following discussion pertains specifically to EDXL-RM entities used in Keystone/UICDS exchanges.

1. Contact Information / Contact Information Type

The UICDS ContactInformation element amalgamates the kinds of information appropriate to establishing contact in emergency response situations. These include elements for description, role, radio, location, and additional information The NIEM schema niem-core.xsd has type ContactInformationType; the only common element it has is description.

Recommendation: Extend the Emergency Management domain with the following elements and types:

```
<xsd:element name="ContactInformationAugmentation"
  type="em:ContactInformationAugmentationType" nillable="true"
  substitutionGroup="nc:ContactInformationAugmentationPoint"/>
<xsd:element name="ContactRole"
  type="nc:TextType" nillable="true"/>
<xsd:element name="ContactAdditionalInformation"
  type="xpil:PartyType" nillable="true"/>
<xsd:complexType name="ContactInformationAugmentationType">
  <xsd:complexContent>
    <xsd:extension base="s:AugmentationType">
      <xsd:sequence>
        <xsd:element ref="em:ContactRole"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="nc:ContactRadio"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="nc:Location"
          minOccurs="0" maxOccurs="unbounded"/>
        <xsd:element ref="ContactAdditionalInformation"
          minOccurs="0" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexType>
```

2. ResourceID / ResourceIDType

The UICDS ResourceID element uniquely identifies a resource. NIEM 4.0 includes the element em:ResourceID, which is defined as "*A credential class identifier that represents the resource.*" However, this identifier is only used by the em:FirstResponderType. It is not apparent how other types of resources are identified in NIEM 4.0.

Element ResourceID is nested within element Resource (of type ResourceType), which is nested within ResourceInformationType in UICDS (see Table 2-2). The changes to NIEM

that resulted in eliminating type ResourceType should be investigated before making a recommendation.

3. Radio / RadioInformationType

The UICDS type RadioInformationType is from the external schema for EDXL-RM. It includes two elements: RadioType and RadioChannel. In NIEM 4.0, schema niem-core.xsd has type ContactRadioType. The type's elements cover both radio type and channel. However, in the EDXL-RM schema, RadioType is a ValueListType (Uniform Resource Name (URN) and list of strings), whereas in niem-core.xsd the type is simply text.

Recommendation: Change niem-core.xsd as follows:

1. Add abstract element ContactRadioCategoryAbstract, and make ContactRadioCategoryText a substitution group element.

2. Change the content of type ContactRadioType to reference element ContactRadioCategory rather than ContactRadioCategoryText.

Extend the Emergency Management domain with the following element:

```
<xsd:element name="ContactRadioCategoryValueList"
  substitutionGroup="nc:ContactRadioCategoryAbstract"
  type="em:ValueType" nillable="true"/>
```

4. TaskId

The UICDS taskID element is part of type TaskType, and identifies a task. It is a URI. NIEM 4.0's type TaskType, in niem-core.xsd, references an element named TaskID, but that element is string-typed.

Recommendation: Change niem-core.xsd as follows:

1. Delete element TaskID.

2. Add abstract element TaskIdentifierAbstract:

```
<xsd:element name="TaskIdentifierAbstract" abstract="true"/>
```

3. Add element TaskIdentifierIdentification

```
<xsd:element name="TaskIdentifierIdentification"
  substituionGroup="nc:TaskIdentifierAbstract"
  type="nc:IdentificationType" nillable="true"/>
```

4. Extend the Emergency Management domain with the following element:

```
<xsd:element name="TaskIdentifier" type="niem-xs:anyURI"
  substitutionGroup="nc:TaskIdentifierAbstract" nillable="true"/>
```

3. National Capital Region Data Exchange

The NCR Data Exchange schemas are organized in multiple folders. Each folder contains schemas relevant to a particular service. Folders contain two schemas. One is named for the service provided by the schemas. The other is named extension.xsd. The former schema imports the latter, and furthermore contains a single element/type pair (some contain only the element). This element defines the schema for a complete message that provides, or is in response to, a service request.

NCR Data Exchange messages have a common format. A message consists of metadata and a payload. The payload format depends on the message type, whereas the metadata is largely independent of the payload.

NCR Data Exchange schemas repeat information. The extension.xsd schemas each define the same metadata elements, but define different payload data elements.

A. Missing Elements and Types

Table 3-1 shows elements and types in the NCR Data Exchange schemas that have no equivalent in NIEM 4.0.

Table 3-1. NCR Data Exchange Elements and Types Not Found in NIEM

Schema	Element / Type
IncidentDetail	Action / ActionType
ExchangeQuerLy, IncidentDetail, Notification, NotificationDetail, UnitDetail, RequestForResource, UnitStatusUpdate	MessaageSequenceNumber / IdentificationType
UnitDetail	OwnerServiceCallAssignedUnit / OwnerServiceCallAssignedUnitType
ExchangeQuery, IncidentDetail, Notification, NotificationDetail, UnitDetail, RequestForResource, UnitStatusUpdate	TerminalID / IdentificationType

The Schema column lists the service category. The names in the column refer to specific folders. Usually the elements and types in the Element/Type column are found in schema extension.xsd in that folder. As noted above, schemas duplicate definitions. For such definitions, the first column lists all schemas containing them.

The NCR Data Exchange schemas include support for exchange queries. Query-related elements not supported in NIEM 4.0 are deliberately excluded, as a rule, from Table 3-1. Augmenting NIEM with a few ad hoc elements and types to support queries does not adequately address the complexity of the subject area. A more comprehensive analysis than was possible, given the time constraints for this project, would need to be undertaken in order to propose a useful, general-purpose set of constructs to express queries.

1. Action / ActionType

The Action element is used in an NCR Data Exchange message to define valid actions related to an incident. It is an enumeration with six values.

Recommendation: Add to the Emergency Management domain the following element and type:

```
<xsd:element name="ActionCode" type="em:ActionCodeType"
  nillable="true"/>
<xsd:simpleType name="ActionCodeSimpleType">
  <xsd:restriction base="xsd:token">
    <xsd:enumeration value="CLOSE"/>
    <xsd:enumeration value="CREATE"/>
    <xsd:enumeration value="UPDATE"/>
    <xsd:enumeration value="VIEW"/>
    <xsd:enumeration value="TRANSFER"/>
    <xsd:enumeration value="TRANSFEROPEN"/>
  </xsd:restriction>
</xsd:simpleType>
<xsd:complexType name="ActionCodeType">
  <xsd:simpleContent>
    <xsd:extension base="em:ActionCodeSimpleType">
      <xsd:attributeGroup ref="s:SimpleObjectAttributeGroup"/>
    </xsd:extension>
  </xsd:simpleContent>
</xsd:complexType>
```

2. MessageSequenceNumber

Element MessageSequenceNumber is used in messages to correlate requests and response messages. Its type is not an integer but rather NIEM's IdentificationType. NIEM 4.0 has no element whose name indicates that it corresponds to this message sequence number. (Its element DocumentSequenceID, intended to sequence documents, is string-typed, whereas MessageSequenceNumber's type is IdentificationType.) NIEM 4.0 does, however, have type MessageHeaderType, whose content suggests the same intent as NCR Data Exchange metadata.

Recommendation: Change the Emergency Management domain as follows:

1. Add element MessageSequenceNumber:

```
<xsd:element name="MessageSequenceNumber"
  type="nc:IdentificationType" nillable="true"/>
```

2. Modify type MessageHeaderType by adding a reference to MessageSequenceNumber.

```
<xsd:complexType name="MessageHeaderType">
 <xsd:complexContent>
   <xsd:extension base="s:ObjectType">
    <xsd:sequence>
      …
      <xsd:element ref="em:MessageSequenceNumber"
        minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element ref="em:MessageHeaderAugmentationPoint"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
   </xsd:extension>
 </xsd:complexContent>
</xsd:complexType>
```

3. OwnerServiceCallAssignedUnit / OwnerServiceCallAssignedUnitType

The OwnerServiceCallAssignedUnit element relates an organization (the owner) and units assigned to a service call. NIEM 4.0 has types for both organizations and service call assigned units, but no type relating them.

Recommendation: Add the following elements and types to the Emergency Management domain:

```
<xsd:element name="Owner" type="nc:OrganizationType"
  nillable="true"/>
<xsd:complexType name="OwnerServiceCallAssignedUnitType">
 <xsd:complexContent>
   <xsd:extension base="s:ComplexObjectType">
    <xsd:sequence>
      <xsd:element ref="em:Owner"
        minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element ref="em:ServiceCallAssignedUnit"
        minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
   </xsd:extension>
 </xsd:complexContent>
</xsd:complexType>
```

4. TerminalID

In an NCR Data Exchange, a TerminalID element identifies a CAD system – a terminal node on an exchange. The TerminalID element's type is NIEM's IdentificationType. NIEM 4.0

has no element named TerminalID. The Intelligence domain has an element named SystemIdentification. Its type is SystemIdentificationType, which extends IdentificationType.

Recommendation: No change is necessary if SystemIdentification can be used instead of TerminalID. If TerminalID is deemed necessary, it can be added to the Emergency Management domain as an element of type SystemIdentificationType.

B. Partially Covered Elements and Types

Table 3-2 shows NCR Data Exchange elements and types that can be only partly expressed using NIEM 4.0 constructs.

Table 3-2. NCR Data Exchange Elements and Types Partially Covered in NIEM 4.0

Schema	Element / Type
UnitStatusUpdate	Agency / anyType
IncidentDetail, RequestForResources	ContactInformation / ContactInformationType
IncidentDetail, RequestForResources	CallTypeText / TextType
UnitStatusUpdate	DataOwnerMetadata / DataOwnerMetadataType
IncidentDetail	GlobalIdentifier / GlobalIdentifierType
IncidentDetail, UnitDetail, RequestForResource, UnitStatusUpdate	IncidentId / IncidentIdType
Notification, NotificationDetail	OperationalStatus / OperationalStatusType
IncidentDetail, RequestForResource, UnitStatusUpdate	Resource / ResourceType
Notification	Station / StationType

See Section A for an explanation of the columns.

1. Agency

The NCR Data Exchange schema includes an Agency element in the payload of a UnitStatusUpdate message. The element's definition is:

A division of a governmental or international body.

This suggests that NIEM's Agency element, of type OrganizationType, could express an Agency. However, the NCR Data Exchange schema does not provide a type for the element, nor does it define any substitution group elements. NIEM 2.0, the version upon which the NCR Data Exchange schema is based, has element Agency. That the NCR Data Exchange schema does not use NIEM's Agency element further indicates its content is not

what is necessary for an NCR Data Exchange message to convey. In the absence of information about the element's intended use, it is not possible to state confidently that NIEM's Agency element or type OrganizationType adequately express the NCR Data Exchange concept of an agency.

2. ContactInformation

The contact information supported by the NCR Data Exchange schema is comparable to that used by UICDS, which is described above in Section 2.B.1.

Recommendation: Extend the Emergency Management domain with the elements and types proposed for ContactInformation in Section 2.B.1

3. CallTypeText

The CallTypeText element is used in a service call (specifically, type ServiceCallAugmentationType references it). The element's type is NIEM Core's TextType. Its definition is:

Call type. e.g., Alarm, Burglary, Fire, Accident.

The definition suggests that a call type value is a short string drawn from commonly accepted terms for call types. That the NCR Data Exchange schema does not define a list of enumerated values further suggests that call types are not sufficiently standardized to limit values to a fixed set. However, this is an assumption. In any case, it would be useful for schemas to allow for the possibility of future standardized lists of call type values.

Recommendation: Add the following elements and types to the Emergency Management domain:

```
<xsd:element name="CallTypeText" type="em:CallTypeTextType"
 nillable="true"/>
<xsd:complexType name="CallTypeTextType">
 <xsd:complexContent>
   <xsd:extension base="nc:TextType"/>
 </xsd:complexContent>
</xsd:complexType>
```

4. DataOwnerMetadata / DataOwnerMetadataType

The DataOwnerMetadata element provides information about the owner of a record transmitted in a message. Its type, DataOwnerMetadataType, references elements such as PersonFullName and OrganizationIdentification that are drawn from NIEM. Two, DataItemStatus and DataItemID, have no NIEM equivalent.

Recommendation: Add the following elements to the Emergency Management domain:

```
<xsd:element name="DataItemStatus" type="nc:TextType"
  nillable="true"/>
<xsd:element name="DataItemIdentification"
  type="nc:IdentificationType" nillable="true"/>
```

5.   GlobalIdentifier / GlobalIdentifierType

In an NCR Data Exchange, an incident is identified by an element of type IncidentIdType (Section 3.B.6). This type references both the IncidentIdentifier and GlobalIdentifier elements. The IncidentIdentifier is generated by the CAD system that creates an incident. If an incident is handled within a CAD system (does not require CAD2CAD communication), it is expressed using element LocalIdentifier; if the incident is transmitted from one CAD system to another, then it is expressed using element IncidentIdentifier. The GlobalIdentifier element, generated by a UICDS Core system, provides a global identifier for an incident in an NCR Data Exchange message.

NIEM has identifiers, but no elements designating the system that generates them, and no elements designating an identifier as global or local.

Recommendation: Add the following element to the Emergency Management domain:

```
<xsd:element name="GlobalIncidentIdentification"
  type="nc:IdentificationType" nillable="true"/>
```

6.   IncidentId / IncidentIdType

In an NCR Data Exchange message, an incident identifier is a complex object. Its components may include a global identifier (Section 3.B.5), which is not a NIEM concept. Furthermore, incident identification in an NCR Data Exchange message may include organization identification, which identifies the owner of the incident identifier.[19] No NIEM incident-related identification type includes such an organization identification for the owner of an identifier, although it does include an identifier for the owner of an incident.

Recommendation: Add the following to the Emergency Management domain:

```
<xsd:element name="IncidentIdentificationAugmentation"
  type="em:IdentificationAugmentationType" nillable="true"
  substitutionGroup="nc:IdentificationAugmentationPoint"/>
```

---

[19] Documentation in the schema says an IncidentIdType is "A structure containing information about an incident identifier and who owns it."

```
<xsd:complexType name="IdentificationAugmentationType">
 <xsd:complexContent>
   <xsd:extension base="s:AugmentationType">
     <xsd:sequence>
       <xsd:element ref="em:Owner" minOccurs="0"
         maxOccurs="unbounded"/>
     </xsd:sequence>
   </xsd:extension>
 </xsd:complexContent>
</xsd:complexType>
```

7.   OperationalStatus / OperationalStatusType

The NCR Data Exchange schemas define element OperationalStatus, and corresponding type OperationalStatusType, to express operational status codes. The type is an enumeration of three values. These entities were not present in NIEM 2.0. They have since been added – NIEM 4.0 contains element OperationalStatusCode and type OperationalStatusCodeType. The lexical forms of the enumerated values do not match exactly. For example, where the NCR Data Exchange schema defines "EMERGENCYOVERRIDE", NIEM 4.0 defines "Emergency Override."

Recommendation: Collaborate with NCR Data Exchange to establish shared standard values for these enumerated status values.

8.   Resource / ResourceType

The NCR Data Exchange schemas define element Resource as part of type ResourceInformationType. NIEM 4.0 includes type ResourceInformationType, which can more or less cover the content of the NCR Data Exchange schema ResourceType. The one missing piece of information is a resource's name: The NCR Data Exchange schemas allow a resource to be named, whereas NIEM 4.0's ResourceInformationType does not, except for persons who are first responder resources (of type em:PersonHumanResourceType) and who have suitable Person name elements from its base type nc:Person.

As Section 2.A.5 notes, NIEM's notion of expressing information on resources other than person resources, has changed since version 2.0. More study is needed before making a recommendation on how to accommodate all resource names in NIEM 4.0

9.   Station / StationType

An NCR Data Exchange can include a Station element in a Notification message. The Station element is part of a structure containing information on units being moved. It contains the owning organization and the station's location.

NIEM 4.0 contains an element named Station. Its type is NIEM Core's FacilityType, which can include location information. However, a FacilityType cannot express owning organization.

Recommendation: Modify the Emergency Management domain as follows:

1. Add the following type:

```
<xsd:complexType name="StationType">
 <xsd:complexContent>
   <xsd:extension base="nc:FacilityType">
     <xsd:sequence>
       <xsd:element ref="em:OwningOrganization" minOccurs="0"
         maxOccurs="unbounded"/>
     </xsd:sequence></xsd:extension>
 </xsd:complexContent>
</xsd:complexType>
```

2. Change the type of element Station from nc:FacilityType to em:StationType.

4. EDXL Resource Management

The EDXL Resource Management standard is part of the EDXL suite of standards for sharing emergency information.[20] The EDXL Resource Management (EDXL-RM) standard is targeted toward exchanging information about resources.

The EDXL-RM schema is included in the Keystone package, which is discussed in Chapter 2. Some gaps in that chapter concern EDXL-RM. They are placed in Chapter 2 because they also concern Keystone/UICDS-specific messaging needs. This chapter focuses on gaps independent of Keystone / UICDS.

This chapter suggests changes to the Emergency Management domain to cover things in EDXL-RM that are not in NIEM. NIEM 4.0 includes OASIS EDXL-DE and EDXL-HAVE as external schemas. An alternative to changing the Emergency Management domain is to make EDXL-RM another NIEM external schema.

A. Missing Elements and Types

Table 4-1. EDXL-RM Elements and Types Not Found in NIEM 4.0

Schema	Element / Type
EDXL-RMCommonTypes.xsd	ResponseType / ResponseTypeType
EDXL-RMCommonResources.xsd	ScheduleType / ScheduleTypeType

1. ResponseType / ResponseTypeType

Element ResponseType and its type ResponseTypeType provide an enumerated set of values "used to accept, decline, or provisionally accept a Request or Unsolicited Offer."[21] The enumeration consists of those three values. The element is part of a type used to characterize response information.

Recommendation: Add the following element and types to the Emergency Management domain:

---

[20] *Emergency Data Exchange Language Resource Messaging (EDXL-RM) 1.0,* OASIS, May 2008. Available at http://docs.oasis-open.org/emergency/edxl-rm/v1.0/pr03/EDXL-RM-v1.0-PR03.html

[21] *Emergency Data Exchange Language Resource Messaging (EDXL-RM) 1.0,* OASIS, May 2008. Available at http://docs.oasis-open.org/emergency/edxl-rm/v1.0/pr03/EDXL-RM-v1.0-PR03.html, Section 4.1.6.

```
<xsd:simpleType name="ResponseTypeCodeSimpleType">
  <xsd:restriction base="xsd:token">
    <xsd:enumeration value="Accept"/>
    <xsd:enumeration value="Decline"/>
    <xsd:enumeration value="Provisional"/>
  </xsd:restriction>
</xsd:simpleType>
<xsd:complexType name="ResponseTypeCodeType">
  <xsd:simpleContent>
    <xsd:extension base="em:ResponseTypeCodeSimpleType">
      <xsd:attributeGroup ref="s:SimpleObjectAttributeGroup"/>
    </xsd:extension>
  </xsd:simpleContent>
</xsd:complexType>
<xsd:element name="ResponseTypeCode" type="em:ResponseTypeCodeType"
  nillable="true"/>
```

2.   ScheduleType / ScheduleTypeType

Type ScheduleTypeType is an enumeration whose values describe schedule events related to resource arrival or departure. Many EDXL-RM schemas define elements whose name is ScheduleType and whose type is ScheduleTypeType.

Recommendation: Add the following element and types to the Emergency Management domain:

```
<xsd:simpleType name="ScheduleTypeCodeSimpleType">
  <xsd:restriction base="xsd:token">
    <xsd:enumeration value="RequestedArrival"/>
    <xsd:enumeration value="EstimatedArrival"/>
    <xsd:enumeration value="ActualArrival"/>
    <xsd:enumeration value="RequestedDeparture"/>
    <xsd:enumeration value="EstimatedDeparture"/>
    <xsd:enumeration value="ActualDeparture"/>
    <xsd:enumeration value="EstimatedReturnDeparture"/>
    <xsd:enumeration value="EstimatedReturnArrival"/>
    <xsd:enumeration value="ActualReturnArrival"/>
    <xsd:enumeration value="RequestedReturnDeparture"/>
    <xsd:enumeration value="RequestedReturnArrival"/>
    <xsd:enumeration value="ActualReturnDeparture"/>
    <xsd:enumeration value="BeginAvailable"/>
    <xsd:enumeration value="EndAvailable"/>
    <xsd:enumeration value="Committed"/>
    <xsd:enumeration value="Current"/>
    <xsd:enumeration value="ReportTo"/>
    <xsd:enumeration value="Route"/>
  </xsd:restriction>
</xsd:simpleType>
```

```xsd
<xsd:complexType name="ScheduleTypeCodeType">
  <xsd:simpleContent>
    <xsd:extension base="em:ScheduleTypeCodeSimpleType">
      <xsd:attributeGroup ref="s:SimpleObjectAttributeGroup"/>
    </xsd:extension>
  </xsd:simpleContent>
</xsd:complexType>
<xsd:element name="ScheduleTypeCode" type="em:ScheduleTypeCodeType"
  nillable="true"/>
```

B. Partially Covered Elements and Types

There are no partially covered elements and types in EDXL-RM.

5. Emergency Incident Data Document

The Emergency Incident Data Document (EIDD) is an international data standard that provides industry-neutral National Information Exchange Model (NIEM) conformant (XML-based) specifications for exchanging emergency incident information with agencies and regions that implement NG9-1-1 and Internet Protocol (IP)-based emergency communications systems.[22] It was developed by the Association for Public-Safety Communications Officials (APCO) International and the National Emergency Number Association (NENA), and approved by the American National Standards Institute (ANSI) on January 3, 2017.

A. Missing Elements and Types

The tables in this section list the EIDD elements that appear to have no comparable elements in NIEM 4.0. For the EIDD, the IDA team is able to include the definitions of elements in these tables because the EIDD documentation includes thorough definitions for all of its elements and types, unlike the UICDS and NCR schemas. These definitions clarify the intended interpretation of the elements to enable comparison with current NIEM content.

The EIDD schemas corresponding to the missing elements need not be listed in these tables because all of the elements that the EIDD introduces in its namespace are defined in a single schema file–EIDD.xsd, with the exception of the top-level EmergencyIncidentDataDocument element and its type, which are defined in the EmergencyIncidentDataDocument.xsd schema. Other elements in the EIDD are re-used from other standards, such as NIEM Core, whose schemas are imported.

Although the EIDD defines practically all of its content in a single schema file, that content is divided up into a group of distinct components, which compose it, as shown in Figure 5-1. This figure shows an EIDD as composed of an *EIDD Header*, which decomposes into numerous other EIDD data components, such as *Agent Information*, I*ncident Information*, and *Dispatch Information*. Each of the links between components in this figure indicates that one component (at the end of the arrow head) is part of the other

---

[22] APCO/NENA 2.105.1-2017, *NG9-1-1 Emergency Incident Data Document (EIDD)*, p. 2. https://www.apcointl.org/doc/911-resources/apco-standards/694-apco-nena-2-105-1-2017-ng9-1-1-emergency-incident-data-document-eidd/file.html

component. Some components are required, while others are optional, although that status is not indicated by the diagram.
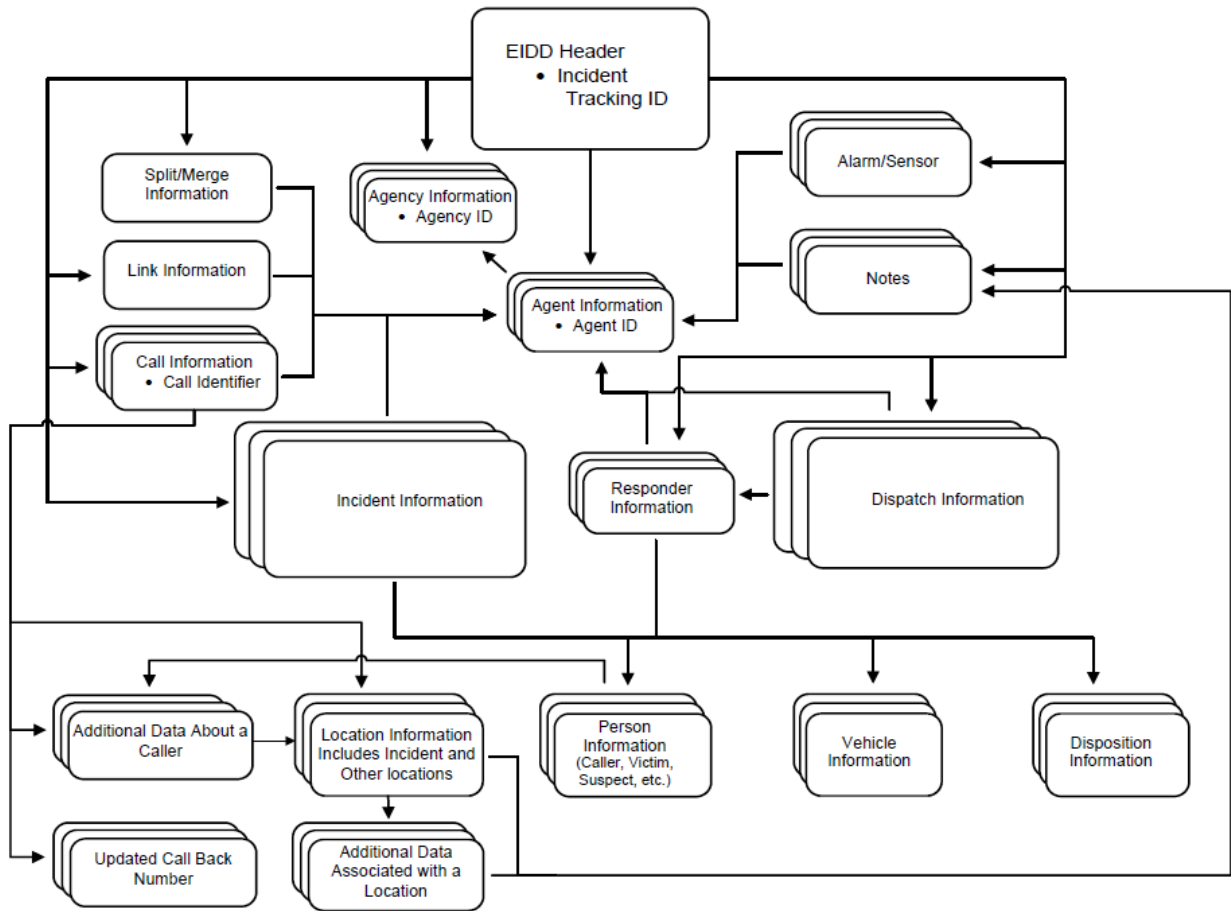
Figure 5-1. EIDD Message Component Structure[23]

In this section on the EIDD, separate tables of unsupported data elements are provided for different EIDD components to better organize them when there are many gaps in NIEM for a component. The element names in the tables include the component name, where warranted, in order to place them in context. Including the component name for elements also enables distinguishing different meanings of the same element and different mappings to NIEM depending on which component is using it. This allows tailoring the recommended mappings of EIDD elements to NIEM based on the components in which they are used. Each table listing the EIDD component elements missing from NIEM is followed by subsections that describe their potential mappings to NIEM and that usually

---

[23] APCO/NENA 2.105.1-2017, *NG9-1-1 Emergency Incident Data Document (EIDD)*, p. 16.

make recommendations on how NIEM 4.0 could be supplemented to fully support each of the missing elements.

Table 5-1. EIDD Agent Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
Agent/ AgentWorkstationPosition Identification/ nc:IdentificationID	Identifies the workstation position ID within the agency of the agent or device. Example: position12@psap.allegheny.pa.us.
Agent/ AgentDeviceRoleRegistry Text	Identifies the Role of the Agent or device – dispatcher, call taker, responding emergency resources, IMR, etc. Role includes position information such as call taker/patrolman, as well as temporary incident-related role information such as incident commander. Shall only contain values contained in the role registry (AgentRoles) specified in NENA-NENA-STA-010. Valid roles include: Dispatching, Dispatched, CallReceiving, and TransferredTo.

1. AgentWorkstationPositionIdentification

The AgentWorkstationPositionIdentification element, whose type is NIEM Core's IdentificationType, occurs within the Agent element and provides a workstation position – a string or structure that is unique. It may refer to the position of a physical workstation, relative to other workstations, in an installation, or it may describe the assignment of a person to a workstation.

NIEM has no element whose purpose suggests position identification of something that can be either a person or a device.

Recommendation: Add to the Emergency Management domain an element named AgentWorkstationPositionIdentification, of type nc:IdentificationType. Include the restriction annotation from the EIDD explanation that it "Shall only contain values contained in the role registry (AgentRoles) specified in NENA-STA-010." Include this element as an optional element contained in em:AgentType and em:IncidentAuthorType.

2. AgentDeviceRoleRegistryText

The closest match is NIEM's em:NotifierRoleDescriptionText element. That element is viable only if the EIDD role registry is expressed as a URN, which as of this writing is not guaranteed. Furthermore, the NIEM element is nested within Notification, which is intended for notification of "written or printed announcement to inform a specific audience of a message." The element is intended to provide the role of the individual who writes or prints an announcement of a message, not the agent or device that sends a message.

Recommendation: Add to the Emergency Management domain an element named em:AgentDeviceRoleRegistryText, of type nc:TextType. Include the restriction annotation from the EIDD explanation that it "Shall only contain values contained in the role registry (AgentRoles) specified in NENA-STA-010." Include this element as an optional element contained in em:AgentType and em:IncidentAuthorType.

Table 5-2. EIDD Agency Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
Agency/ AgencyContactInfo	Contact information for an agency.
Agency/ IncidentOwningAgency Indicator	Enables updating of incident ownership information. Boolean data element that, if true, indicates that the agency associated with the Agency ID contained in this data component owns; or, if false does not own, the incident associated with the incident tracking ID in the EIDD Header data component.

3. AgencyContactInfo

The content of element eidd:AgencyContactInfo is required to be an XML representation of a vCard (xCard). NIEM limits its support for xCard to a single enumerated type, TelephoneCategoryCodeType.

Recommendation: Add element em:AgencyContactInformation to the Emergency Management domain as an element of em:Agency with the type of a vCard. Add EIDD's vCard.xsd schema as a NIEM external schema. Add an adapter to NIEM for xCards.

4. OwningAgencyIndicator

Nothing is found in NIEM for such a Boolean indicator. Although this could be represented by an association between the EIDD as an item and the Agency as an owner using nc:ItemOwnerAssociation, that would not provide a means of explicitly stating that the Agency is no longer the owner.

Recommendation: Add em:IncidentOwningAgencyIndicator to the newly created em:AgencyType as a boolean valued element with the EIDD definition.

Table 5-3. EIDD MergeInformation Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
MergeInformation	An optional data component used to indicate the existence of a merged Incident Tracking ID or to split an incident. The presence of a Split/Merge Information data component indicates that another Incident Tracking ID has been merged with, or is being split from the Incident Tracking ID contained in the EIDD header.
MergeInformation/Incident TrackingIdentifier/ nc:IdentificationID	Identifies the Incident Tracking Identifier that is being merged or split. See Incident Split/Merge Indicator to determine the direction of the merge/split.
MergeInformation/ IncidentMergeDirectionCode	Indicates the direction of the merge/split and which incident tracking identifier survives a merge operation. If the value of the Split/Merge Indicator is: - "REPLACED" the Incident Tracking Identifier in this data component contains the old Incident Tracking IdentifierOnly applies to a merge operation. -"REPLACING" the Incident Tracking Identifier in this data component contains the new incident Tracking Identifier. Only applies to a merge operation. - "SPLIT" The Incident Tracking Identifier contained in this data component is split from the Incident Tracking Identifier contained in the EIDD Header data component. The other data components contained in the EIDD contain the data elements of the split incident. Semantic Definition: A code for a direction of a merge or split.
MergeInformation/ Agent	Identifies the agent and agency that completed the merge/split operation.

5.   MergeInformation

NIEM contains em:ChildIncident to represent a child split from an Incident and an em:ParentIncident to represent the parent of an incident that was split. But, NIEM does not appear to directly support merging one reported incident into another. The em:RelatedIncident element, which can be used to relate different incidents, does not identify the type of relationship, which is critical for merged incidents. It also includes the whole incident, whereas this requires only its identifier. Hence these related NIEM concepts are inadequate for this element.

Recommendation: Add a new element em:MergeInformation of a new complex type em:MergeInformationType to the em:EMMessageType, as an optional element. Include the eidd:MergeInformation elements as contained in this new type.

6. MergeInformation/IncidentTrackingIdentifier

This use of IncidentTrackingIdentifier in the MergeInformation component of an EIDD refers to the Incident Tracking Identifier of the incident that is being merged with, or split from, the incident represented by the Incident Tracking Identifier contained in the EIDD Header. Hence, these are different uses of this element, which would require different representations in NIEM.

Recommendation: In addition to adding an em:IncidentTrackingIdentifier to the em:EMMessageType, the IDA team recommends adding em:IncidentTrackingIdentifier element as an element of a newly defined em:MergeInformationType recommended in Section 5.A.5. The team also recommends clarifying the definitions in NIEM of em:ChildIncident and em:ParentIncident in NIEM to better describe what the parent-child relationship means. Is this a decomposition relationship wherein the child incident represents some part of the parent incident, or is it a temporal relationship wherein the child incident follows and is a consequence of the parent incident, or is it merely that a child tracking ID is intended to replace an identifier for an incident where multiple identifiers have been used from different sources?

7. MergeInformation/IncidentMergeDirectionCode

Nothing corresponds directly to this in NIEM.

Recommendation: Add a new element em:IncidentMergeDirectionCode to em:MergeInformationType to identify this direction of a merge/split operation. Add the allowed values to an enumeration for this coded element.

8. MergeInformation/Agent

The agent that completes a merge/split operation can be different from the agent cited in the header of an EIDD. Hence, a copy of the em:Agent element is needed in em:MergeInformationType.

Recommendation: Add an instance of em:Agent as an element of the new em:MergeInformationType, using the same new em:Agent element which is used throughout an EIDD message

Table 5-4. EIDD Incident Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
Incident/ IncidentPriorityInternalText	Priority of the incident as alphanumeric text. This value may only be meaningful to the local agency providing the information and other closely cooperating agencies. Note, that different responding agencies may assign different priorities to same incident; for example a high priority fire incident may be a medium priority law enforcement incident.
Incident/ IncidentCommonPriority Number	Globally understood numeric incident priority. The Internal Priority, described above, should be mapped to this (Common Priority) data element so that all involved and interested agencies can determine the relative priority of the incident.
Incident/ BeatOrDispatchGroupText	The beat or dispatch group that contains the incident. Note that each agency involved in the incident may have its own beat or dispatch group.

9. Incident/IncidentPriorityInternalText

Although NIEM has elements whose name contains the string "Priority," none are targeted to incident priority. Moreover, many are code values, not arbitrary alphanumeric text.

Recommendation: Add to the Emergency Management domain an element IncidentPriorityInternalText, of type nc:TextType.

10. Incident/IncidentCommonPriorityNumber

Although NIEM has elements whose name contains the string "Priority," none are targeted to incident priority. Moreover, many are code values, not a non-negative integer.

Recommendation: Add to the Emergency Management domain an element IncidentCommonPriorityNumber, of type niem-xs:nonNegativeInteger.

11. Incident/BeatOrDispatchGroupText

NIEM has two elements for describing beats. The EIDD specification does not prescribe the content of the BeatOrDispatchGroup element, so perhaps one of NIEM's elements could be used. However, neither is intended to describe a dispatch group, and NIEM has no element for that.

Recommendation: In the absence of certainty about whether NIEM's elements can be used, the safest approach is to add to the Emergency Management domain an element named BeatOrDispatchGroupText, of type nc:TextType.

Table 5-5. EIDD Location Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
Location/ LocationTypeDescription RegistryText	A code for a location type (Caller's, Initial, Current, Staging, Investigation, Tower Location, Other, etc.).
Location/ LocationByValue	Indicates the location of the incident without the need to dereference it. Although implementation must support all PIDF-LO data elements, many of these elements may not be present in an EIDD.
Location/ LocationByReferenceURL	A URL that can be dereferenced to obtain the location of the indicated location type. This is particularly useful for indicating the location of moving devices such as callers in moving vehicles. The current location of the device can be de-referenced and inserted into the incident record.

12. LocationTypeDescriptionRegistryText

The EIDD element LocationType, whose type is nc:TextType, is an enumeration of eight values. NIEM has some APCO codes in its set of codes schemas in codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element LocationTypeCode, and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

13. LocationByValue

The element LocationByValue is used to transmit location data according to the Presence Information Data Format Location Object (PIDF-LO) standard.[24] The location is that of a call or an incident. NIEM 4.0 does not support the PIDF-LO standard.

Recommendation: Add PIDF-LO to NIEM's set of external schema, and add element LocationPIDF to NIEM's Emergency Management domain.

14. LocationByReferenceURL

The element LocationByReferenceURL provides the URL of a document that contains a location in PIDF-LO format (see Section 5.A.13). The location is that of a call or an incident. NIEM 4.0 has some elements that specify locations as URIs (e.g., nc:DocumentLocationURI), but their names do not suggest that they should be used for a call or an incident.

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[24] H. Sugano et al., *Presence Information Data Format,* RFC 3863 (August 2004). Available at https://datatracker.ietf.org/doc/rfc3863/

Recommendation: Add element LocationPIDFURI to NIEM's Emergency Management domain.

Table 5-6. EIDD Alarm Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
CSAAAlarmInformation	Central Station Alarm Association (CSAA) data associated with an incident. Restricted to the XML structure specified in the APCO/CSAA ANS (APCO/CSAA ANS 2.101.2-2014).
AlarmURL	Link to the automated alarm data that initiated the incident. Enables the receiving agency to dereference and obtain the original alarm information that triggered the incident.

15. CSAAAlarmInformation

The CSAAAlarmInformation element is embedded within an incident-related message to enable "tracking the original automated alarm data that triggered the creation of the incident." Its type is nc:TextType, although its content is XML, as specified in APCO/CSSA ANS 2.101.2-2014.[25] EIDD includes that specification's schema in folder ExternalAlarmInterface/schema/apco-alarm/3.1/external-alarm.xsd.

NIEM has no equivalent to the detail found in the external-alarm.xsd schema. Its element em:AlarmEvent can express information about an event caused by an alarm; however, details about the alarm itself are minimal. The alarm's location can be stated (element em:AlarmEventLocation). NIEM includes the APCO codes for alarm event categories (see type AlarmEventCategoryCodeSimpleType, in the EIDD schema codes/apco_event/4.0/apco_event.xsd).

16. AlarmURL

The AlarmURL element provides an alternate means to specify alarm information (Section 5.A.15). In a message, its content is a URL that, when dereferenced, yields XML conformant to APCO/CSSA ANS 2.101.2-2014.

NIEM's type niem-xsd:anyURI provides a type for specifying URIs, of which a URL is one kind. However, NIEM does not have an element whose name or documentation suggests that it should be used for stating the URL of an alarm. Elements whose type is niem-xsd:anyURI have names such as AuthorURI and PersonBiometricURI.

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[25] APCO/CSAA ANS 2.101.2-2014 Alarm Monitoring Company to Public Safety Answering Point (PSAP) Computer-Aided Dispatch (CAD) Automated Secure Alarm Protocol (ASAP). Available at https://www.apcointl.org/doc/911-resources/apco-standards/527-alarm-monitoring-company-to-psap-cad-automated-secure-alarm-protocol-asap.html

Recommendation: Add to the Emergency Management domain element AlarmURL, of type niem-xsd:anyURI.

Table 5-7. EIDD Other Elements and Types Not Found in NIEM 4.0

Element	EIDD Definition
EmergencyResourceTypeCommon RegistryText	A standard code for an emergency resource type (fire truck, police vehicle, etc.).
ResourceAttributeRegistryText	Identifies the skills and equipment available to or possessed by emergency resources (e.g., jaws of life, basic life support, advanced life support, dive team member, Spanish speaking, etc.). May be multiple in situations where a single emergency resource can perform several emergency response functions or has multiple skills.
PrimaryUnitStatusRegistryText	The common, globally unique, status that sets the emergency resource's ability to be assigned to an emergency incident.
SecondaryUnitStatusRegistryText	Common, globally unique, statuses that supplement the Primary Unit Status-Common by providing more detail about the associated Primary status.
Notes	Contains notes and comments related to the status of an emergency responder (e.g., time that status is expected to change, etc.).
AdditionalData	Contains Additional Data associated with a location that arrives with a call or is retrieved from an Additional Data Repository.
AdditionalDataURL	This is a link to the Additional Data that arrives with the Call or is obtained from an Additional Data Repository. The contents and format of the Additional Data retrieved from the URL are defined in NENA-STA-012.2-2015 and https://tools.ietf.org/html/rfc7852.
AdditionalDataDetail	Additional data associated with a call. If the Additional Data is sent by value, these fields contain the information.
VehicleIncidentRelationship RegistryText	A code for a type of relationship (victim, accident, suspect, etc.) between a vehicle and an incident.
PersonIncidentRoleRegistryText	Describes the role (Caller, Victim, suspect, etc.) of a person to the incident. Note that there could be multiple relationships as when the reporting party is also the victim.
DispositionCommonRegistryText	An agency assigns a disposition to an incident when its participation in the incident ends. The disposition code indicates whether follow-up reports are necessary and

Element	EIDD Definition
	other information about the incident such as whether it resulted from a false or actual alarm. The disposition codes are drawn from a registry containing common disposition codes for Police, Fire, and EMS disciplines.

17. EmergencyResourceTypeCommonRegistryText

The EmergencyResourceTypeCommonRegistryText element, whose type is nc:TextType, is actually an enumeration of about 100 values. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element EmergencyResourceTypeCommonRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

18. ResourceAttributeRegistryText

The ResourceAttributeRegistryText element, whose type is nc:TextType, is an enumeration of several hundred values. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element ResourceAttributeRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

19. PrimaryUnitStatusRegistryText

The PrimaryUnitStatusRegistryText element, whose type is nc:TextType, is an enumeration of three values: Available, ConditionallyAvailable, and NotAvailable. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element PrimaryUnitStatusRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

20. SecondaryUnitStatusRegistryText

The SecondaryUnitStatusRegistryText element, whose type is nc:TextType, is an enumeration of 41 values. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element SecondaryUnitStatusRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

21. Notes

The eidd:Notes element, despite its name suggesting simple text, is actually a complex structure. It contains a text field (the notes), and also a timestamp and a reference to the agent who made the notes. The element's documentation states that notes are associated with an incident, and so they are, not but not necessarily directly. Notes may be included in an emergency incident data document or nested in additional data about an incident, location of an incident, or a resource for use in an incident.

Recommendation: Add element Notes and type NotesType to the Emergency Management domain.

22. AdditionalData

The AdditionalData element is a complex type and is referenced with EIDD's LocationInformationType. It consists of either a URL to additional data (Section 5.A.23) or a nested detail element (Section 5.A.24). It may also include notes (Section 5.A.21). NIEM 4.0 has no type that amalgamates these elements. Because AdditionalData is referenced only within LocationInformationType, it would make sense to extend NIEM using LocationAugmentationPoint.

Recommendation: Add to the Emergency Management domain an element named LocationAdditionalData that is in the substitution group of the NIEM element nc:LocationAugmentationPoint, and whose type provides the structure of EIDD's typeAdditionalDataType.

23. AdditionalDataURL

The AdditionalDataURL element's content is a URL that, when dereferenced, provides data in the format of Additional Data Detail (Section 5.A.24). NIEM 4.0 has no such element.

Recommendation: Add an element AdditionalDataURL to the Emergency Management domain.

24. AdditionalDataDetail

The AdditionalDataDetail element, as its name implies, provides additional data, in particular on location data. The element's type references elements defined in external schemas. NIEM 4.0 does not include any of these schemas.

Recommendation: Add the external schemas to NIEM, and add to the Emergency Management domain an element named AdditionalDataDetail. Its type should be a complex type referencing the elements in the newly added schemas, as per the references in EIDD.

25. VehicleIncidentRelationshipRegistryText

The VehicleIncidentRelationshipRegistryText element, whose type is nc:TextType, is an enumeration of five values. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element VehicleIncidentRelationshipRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

26. PersonIncidentRoleRegistryText

The PersonIncidentRoleRegistryText element, whose type is nc:TextType, is an enumeration of 11 values. NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element PersonRoleRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

27. DispositionCommonRegistryText

The DispositionCommonRegistryText element, whose type is nc:TextType, is an enumeration of 45 values specified in *Public Safety Communications Common Disposition Codes for Data Exchange,* APCO ANS 1.111.1-2013, November 2013.[26] NIEM has some APCO codes in its schema codes/apco_event/4.0/apco_event.xsd, but it does not include this one.

Recommendation: Add element DispositionCommonRegistryCode and corresponding types (one complex, the other an enumeration) to the Emergency Management domain.

B. Partially Covered Elements and Types

The tables in this section list the EIDD elements that can be only partially expressed using NIEM 4.0. These tables include the names of these elements in context of their EIDD component and their definitions of elements. These definitions clarify the intended interpretation of the elements to enable comparison with current NIEM content. The subsections that follow each table describe potential mappings to NIEM and usually make recommendations on how NIEM 4.0 could be supplemented to fully support each of the listed elements.

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[26] *Public Safety Communications Common Disposition Codes for Data Exchange,* APCO ANS 1.111.1-2013, November 2013. Available at https://www.apcointl.org/doc/911-resources/apco-standards/472-apco-ans-1-111-1-2013-disposition-codes.html

Table 5-8. EIDD Header Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
EmergencyIncidentDataDocument	An information exchange containing emergency incident-related data.
EmergencyIncidentDataDocument/ IncidentTrackingIdentification/ nc:IdentificationID	An identifier assigned by the first element in the ESInet. Incident Tracking Identifiers are globally unique and are associated with a single emergency incident. The Incident Tracking Identifier can be associated with one or more emergency calls. It is carried through to any incident resulting from an emergency call. It may or may not be the same as the local incident ID.
EmergencyIncidentDataDocument/ ReasonForIssueRegistryText	One or more members of a registry identifying why the EIDD was created including: New Call, Incident Update, Incident Merged, Incident Closed, Emergency Resources Dispatched, etc.
EmergencyIncidentDataDocument/ IssuingElementIdentification	An Identifier of a functional element that created the EIDD instance.
EmergencyIncidentDataDocument/ nc:DocumentSequenceID	Each EIDD generated by a functional element for a unique incident tracking identifier shall be assigned a globally unique sequence number. Sequence numbers shall be incremented and EIDDs created whenever the state of the incident as perceived by the issuing element changes.
EmergencyIncidentDataDocument/ IncidentCollaborationURL	URL reference to multi-media collaboration information associated with the Incident. Enables agencies working an incident to communicate using multi-media collaboration sessions.

1. EmergencyIncidentDataDocument/Type

The EmergencyIncidentDataDocument element and type identify the encompassing top-level element and corresponding type that specify and define an Emergency Incident Data Document message. This element could be captured in different ways using NIEM, although not all of its components or elements are fully supported. One approach to representing this concept is to extend the em:EMMessageType to create an em:EmergencyIncidentDataDocumentType and element. However, that should be unnecessary since an EIDD can be created as an instance of the em:EMMessage, where em:EmergencyIncident is substituted for the em:EMMessageDetailAbstract element of em:EMMessageType. Such an instance of em:EMMessage can be distinguished as being a type of EIDD by adding a suitable enumeration value (e.g., "EIDD") to the definition of em:EMMessageSubCategoryCodeSimpleType, and using the enumeration value "Message" for the em:EMMessageCategoryCodeSimple.

Use of em:EMMessage to define an EIDD will require augmenting parts of its child elements with the additional information that an EIDD requires. This could be accomplished by using the appropriate AugmentationPoint elements that are defined for the elements already defined as part of an em:EMMessage, or they could be added as optional elements.

Recommendation: Do not create any special element/type for this with the expectation that the em:EMMessage element can be used with either appropriate augmentations for it or additions to it.

2. IncidentTrackingIdentifier

This identifier could be represented by the existing identifier for an em:Incident, which is derived from the nc:ActivityIdentification/nc:IdenificationID. However, the unique constraints on this ID that it be both global and comply with the format defined for an Incident Tracking Identifier in NENA-STA-010 indicate a need for a new element.

Recommendation: Create a new element em:IncidentTrackingIdentifier of type nc:IdentificationType with the constraint of complying with the format defined for an Incident Tracking Identifier in NENA-STA-010.

3. EmergencyIncidentDataDocument/ReasonForIssueRegistryText

The AlertReasonText could cover the reason for an EIDD functioning as an alert instance, but not for all types of EIDD instances. It also does not use the APCO NENA values required by EIDD.

Recommendation: Add an element to NIEM Core (e.g., nc:ReasonforMessageText) to cover reasons for sending a NIEM-compliant message and extend it in the Emergency Management domain with the element em:ReasonForIssueRegistryText for sending incident reports, supporting the APCO NG 9-1-1 values as used in the EIDD. Either add this directly to emEmergencyIncident or add it as a substitution element for the em:EmergencyIncidentAugmentationPoint.

4. EmergencyIncidentDataDocument/IssuingElementIdentification

The closest match to this element appears to be em:AlarmDispatchAgencyID. However, a dispatch agency is only one type of element that could create an EIDD instance. A data element is needed that can cover all types of agencies issuing an EIDD. Incidents are not usually alarms, so the em:AlarmDispatchAgencyID is not suitable in most cases.

Recommendation: Extend the NIEM nc:IdentificationType with separate types consistent with these NENA formats for an Element and for an Agent. Create em:IssuingElementIdentification with the type em:IssuingElementIdentificationType, which extends nc:IdentifitcationType.

5.   EmergencyIncidentDataDocument/nc:DocumentSequenceID

Although NIEM Core includes nc:DocumentSequenceID, it is not included in the em:EMMessage element, which is the best correspondence to an EIDD message. Nor is it part of an em:EmergencyIncident, which includes most of the EIDD data elements. This nc:DocumentSequenceID element could be added to em:EMMessageType or could just be used directly in any schema defined for an EIDD.

6.   EmergencyIncidentDataDocument/IncidentCollaborationURL

NIEM Core has an element nc:CrisisURLID. However, it is defined as "An URL identifier for information about a crisis," but does not indicate its use for collaboration using multi-media, unlike the eidd:IncidentCollaborationURL.

Recommendation: Add a new element to either em:EmergencyIncidentType or to em:IncidentNotificationType specifically for this Collaboration URL.

Table 5-9. EIDD Agent Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
Agent	Information about agents (e.g., call takers, dispatchers, supervisors, responding emergency resources, etc.) and automated systems acting as agents that are involved in an incident.
Agent/AgentIdentification/ nc:IdentificationID	Used to identify the agent creating an EIDD and agents that contributed information contained in an EIDD. The Agent may be a person or an automaton such as an IMR. For more information on naming conventions see NENA-STA-010[3.1]. Example: tom.jones@psap.allegheny.pa.us imr101@psap.allegheny.pa.us
Agent/Agency	Identifies the agency employing or contracting with the agent that performed the action associated with the parent data component and the agency's role in the incident.

7.   Agent/AgentType

The Agent element and type are used in EIDD messages to provide information about agents, and automated systems acting as agents, that are involved in an incident. The EIDD schema gives as examples of agents "call takers, dispatchers, supervisors, responding

emergency resources, etc."[27] An agent can be involved at any stage of an incident, including being the individual who creates an incident message.

NIEM has no exactly corresponding element or type. The International Trade domain has element Agent and associated type AgentType, but this kind of agent exists to provide "additional information about a party authorized to act on behalf of another person, organization or thing."[28] NIEM's Emergency Management domain has element Author and type IncidentAuthorType, which would cover an individual who authors an incident message, but not automated systems acting as agents.

Furthermore, NIEM has no type that can be either (but only) a person or an automated system. Its element Entity and corresponding type EntityType can be both. The definition of Entity is "A person, organization, or thing capable of bearing legal rights and responsibilities." However, it is unreasonable to assume that a simple automated system, such as a CAD system that might issue an EIDD, is capable of bearing legal rights and responsibilities. No suitable basis for the EIDD Agent is found in NIEM.

Recommendation: Extend the Emergency Management domain as follows:

Create an em:Agent element of type em:AgentType, which can be used for Agent information at multiple points throughout an EIDD message. Define em:AgentType to contain all the eidd:Agent elements as its elements, i.e.,

> em:AgentIdentification
>
> em:AgentDeviceRoleRegistryText,
>
> em:NotifierRoleDescriptionText
>
> em:Agency.

Add em:Agent element to em:EMMessage.

8.   Agent/AgentIdentification/nc:IdentificationID

NIEM does not have an Agent type that includes Person and automaton, as required for this element.

Recommendation: Create a new em:AgentIdentificationType, which extends nc:IdentificationType. Create em:AgentIdentification with the type em:AgentIdentificationType. Include a general definition for an agent involved in an em:EmergencyIncident, whose role is identified by em:Agent/em:NotifierRoleDescriptionText.

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[27] See EIDD schema xsd/EIDD.xsd, element Agent.

[28] See NIEM schema domains/internationalTrade/4.0/internationalTrade.xsd, element Agent.

9. Agent/Agency

NIEM nc:Agency can identify an agency, but NIEM does not have an element for the agency of an Agent or Author of an Incident document or message. The NIEM nc:AgencyType also lacks the elements required by eidd:Agency.

Recommendation: Create a new element em:Agency of type em:AgencyType, which is a complex type that includes all of the eidd:Agency elements and extends nc:AgencyType. Add em:Agency as an optional element to em:IncidentAuthorType to identify the Agency of such an author. Also add em:Agency as an optional element to the newly defined em:AgentType.

Table 5-10. EIDD Agency Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
Agency/ nc:OrganizationIdentification/ nc:IdentificationID	Identifies the agency creating the EIDD and the agencies employing agents involved in the incident, or tracks incident ownership. Agencies include private and public providers. Agencies are globally unique. If the agency type is required, it can be looked up in the agency locator defined in NENA-STA-010.
Agency/AgencyRoleDescription RegistryText	Identifies the role of the agency in relation to the incident. Valid roles are available in an EIDD registry and include: Dispatching, Dispatched, CallReceiving, and TransferredTo.
Agency/ AgencyContactURL	The URL is a link to contact information in the form of an xCard for the agency and is normally available in the agency locator database.

10. Agency/nc:OrganizationIdentification/nc:IdentificationID

This EIDD element includes the restriction that it shall comply with the format defined for an agency in NENA-STA-010. The closest corresponding NIEM element is nc:Agency/nc:OrganizationIdentification/nc:IdentificationID, which does not have this restriction on format.

Recommendation: This identifier could be represented by the existing identifier for an nc:Agency if the restriction of compliance with the format defined for an agency in NENA-STA-010 were described in the nc:IdentificationCategoryDescriptionText. Alternatively, a new simple identifier ID could be added to em:Agency with a definition that includes this restriction.

11. Agency/AgencyRoleDescriptionRegistryText

This EIDD element includes the restriction that it shall contain only values available in the "Agency Role" registry specified in Section 4.2 of the EIDD document. The closest corresponding NIEM element is em:NotifierRoleDescriptionText, which does not enforce the required restrictions, and it is not specific to the Agency in relation to the incident.

Recommendation: Add an optional element em:AgentDeviceRoleRegistryText as an element of the em:AgencyType. Restrict it to the roles specified in Section 4.2 of the EIDD document.

12. Agency/AgencyContactURL

The closest corresponding NIEM element is nc:ContactWebsiteURI, which is not necessarily linked to information in the form of an xCard, as required by the eidd:AgencyContactURL.

Recommendation: Add an optional element AgencyContactURL as an element of the em:AgencyType and restrict this element to link to contact information in the form of an xCard for the agency.

Table 5-11. EIDD Link Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
LinkInformation	Contains link information related to the incident. Used to link two or more incidents to each other.
LinkInformation/ IncidentTrackingIdentifier/ nc:IdentificationID	The Incident Tracking Identifier of the incident that is being linked to the incident represented by the Incident Tracking Identifier contained in the EIDD Header. The nature of the link is defined by the link Indicator.
LinkInformation/ ansi-nist:TransactionReasonText	Free format narrative description of the reason for the link.
LinkInformation/LinkDirectionCode	A code for a kind of link performed. Identifies the nature and direction of the link. If the value of the Link Indicator is: • "PARENT" – The Incident Tracking Identifier contained in this data component shall be the parent of the Incident Tracking Identifier contained in the EIDD header. • "CHILD" – The Incident Tracking Identifier contained in this data component shall be the child of the Incident Tracking Identifier in the EIDD header. • "RELATED" – The Incident Tracking Identifier contained in this data component shall be related to

Element	EIDD Definition
	the Incident Tracking Identifier in the EIDD header, without any parent-child relationship. • "UNLINK" – The Incident Tracking Identifier contained in this data component shall be unlinked from the Incident Tracking Identifier contained in the EIDD Header.
LinkInformation/Agent	Identifies the agent and agency that completed the link operation.

13. LinkInformation

NIEM contains em:ChildIncident to represent a child split from an Incident, an em:ParentIncident to represent the parent of an incident that was split, and the em:RelatedIncident element to identify a related incident. But, it does not support the "UNLINK" type of linkage also required by eidd:LinkInformation or the Reason for Action text of eidd:LinkInformation. An em:UnlinkIncident could be added to em:IncidentType, but would still not support a Reason for Action association with any of these.

Recommendation: One option is to change the type of em:ChildIncident, em:ParentIncident, and em:RelatedIncident to something new like em:LinkIncidentType, which extends em:EmergencyIncidentType and includes an additional element for Reason for Action and another element for the Agent that completed the link operation. Then, if an em:UnlinkIncident element were defined as of this new type, that would cover all the requirements of eidd:LinkInformation once this element was added as an optional element to em:EmergencyIncident.

Alternatively, one could just create em:LinkInformationType and add the corresponding element em:LinkInformation to em:EmergencyMessageType and include the required elements from eidd:LinkInformation in em:LinkInformationType.

14. LinkInformation/IncidentTrackingIdentifier

As noted above for eidd:LinkInformation, this could be added directly to em:LinkInformationType if it is created. Alternatively, it would be included in the identifiers for em:ChildIncident, em:ParentIncident, and em:RelatedIncident, and a new em:UnlinkIncident.

Recommendation: If em:LinkInformationType is created, then add em:IncidentTrackingIdentifier/nc:IdentificationID to it.

15. LinkInformation/ansi-nist:TransactionReasonText

As noted above for eidd:LinkInformation, a corresponding element could be added directly to em:LinkInformationType if it is created. Alternatively, it could be added to a new

type – em:LinkIncidentType – that is then used as the type of em:ChildIncident, em:ParentIncident, and em:RelatedIncident, and a new em:UnlinkIncident.

Recommendation: If em:LinkInformationType is created, then add element biom:TransactionReasonText to it.

16. LinkInformation/LinkDirectionCode

As noted above for eidd:LinkInformation, a corresponding element could be added directly to em:LinkInformationType if it is created. Alternatively, it would be implicit in the use of em:ChildIncident, em:ParentIncident, em:RelatedIncident, and a new em:UnlinkIncident elements of em:EmergencyIncidentType.

Recommendation: If em:LinkInformationType is created, then add element em:LinkDirectionCode to it.

17. LinkInformation/Agent

As noted above for LinkInformation, a corresponding element could be added directly to em:LinkInformationType if it is created. Alternatively, it could be added to a new type – em:LinkIncidentType – that is then used as the type of em:ChildIncident, em:ParentIncident, and em:RelatedIncident, and a new em:UnlinkIncident.

Recommendation: If em:LinkInformationType is created, then add element em:LinkDirectionCode to it.

Table 5-12. EIDD Incident Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
EmergencyIncidentDataDocument/ Incident	A data component that contains general information about an incident.
EmergencyIncidentDataDocument/ Incident/Agent	Identifies the agent (could be either an agent in a communication center or a responding emergency resource) that entered information contained in this (Incident) data component.
Incident	A data component that contains general information about an incident.
Incident/Agent	Identifies the agent (could be either an agent in a communication center or a responding emergency resource) that entered information contained in this (Incident) data component.
Incident/Location	A location associated with an incident.

Element	EIDD Definition
Incident/Person	Information about a person associated with an incident.
Incident/Vehicle	Information about a vehicle associated with an incident.
Incident/Disposition	Incident disposition information entered or updated by a dispatch agent and/or a responding emergency resource.

18. Incident

The em:EmergencyIncident covers many of the data requirements for this element. It needs to be supplemented with additional elements as needed to cover some of its constituent elements.

Recommendation: Use em:EmergencyIncident for this element with those supplemental elements that are needed for the eidd:Incident elements.

19. Incident/Agent

The em:Author covers many of the data requirements for this element. It needs to be supplemented with additional elements as needed to cover some of its constituent elements.

Recommendation: Add the following elements to the em:AuthorType definition: em:AgentWorkstationPositionIdentification; em:NotifierRoleDescriptionText; and em:Agency, as defined for the newly created em:AgentType.

20. Incident/Location

The nc:IncidentLocation element covers many of the data requirements for this element. It needs to be supplemented with additional elements as needed to cover some of its constituent elements.

Recommendation: The nc:IncidentLocation element in em:EmergencyIncident will cover this requirement when it is supplemented with the required additional eidd:Location elements (LocationTypeCode, LocationPIDF, and LocationPIDFURI) described elsewhere.

21. Incident/Person

The eidd:Person element is a top-level element addressed below. Once the nc:PersonType is augmented as described with em:PersonRoleRegistryCode, then the nc:Person element should be added to em:EmergencyIncident to cover its usage in eidd:Incident.

Recommendation: Add the nc:Person element to em:EmergencyIncidentType to cover its usage in eidd:Incident.

22. Incident/Vehicle

The eidd:Vehicle element is a top-level element addressed below. Once the nc:VehicleType is augmented with an em:VehicleIncidentRelationshipRegistryCode, then the nc:Vehicle element should be added to em:EmergencyIncident to cover its usage in eidd:Incident.

Recommendation: Add the nc:Vehicle element to em:EmergencyIncidentType to cover its usage in eidd:Incident.

23. Incident/Disposition

The eidd:Disposition element can be represented in NIEM by the nc:Disposition element when the nc:DispositionType is augmented with a couple of missing elements, as described below in the discussion of eidd:Disposition.

Recommendation: Add the nc:Disposition element to em:EmergencyIncident Type once its type is augmented as described.

Table 5-13. EIDD Location Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
Location/ LocationByValue	The nearest cross-street to an incident's location in PIDF-LO format.
Location/ LocationByReferenceURL	A URL that can be dereferenced to obtain the nearest cross street(s).
Location/CellTowerSectorID	Text field contain the id of the nearest cell tower and the sector/face of the tower receiving the call. This is especially important for maritime locations. May be used with the "Provided By" field of the PIDF-LO to identify the carrier if carrier specific data is needed.

24. Location/LocationByValue

The element eidd LocationByValue is used to specify cross streets of a location. The specification uses the PIDF-LO standard, which NIEM 4.0 does not support. NIEM does have a type for representing cross streets (nc:CrossStreetType) that could be augmented to include PIDF-LO data.

Recommendation: Add an augmentation for nc:CrossStreetAugmentationPoint to the Emergency Management domain, and add the PIDF standard to NIEM's external schema.

25. Location/LocationByReferenceURL

The LocationByReferenceURL element contains the URL of a document that, when dereferenced, yields the content of eidd:LocationByValue. It is part of location information. NIEM 4.0 has some elements that can specify location by URI (e.g., nc:DocumentLocationURL), but they are specific to things other than cross streets.

Recommendation: Add to the Emergency Management domain an augmentation for nc:CrossStreetAugmentationPoint that supports representing a URL of a cross street.

26. Location/CellTowerSectorID

The CellTowerSectorID element provides, as text, two kinds of information: An identifier for a cell tower and the sector in which the tower is located. The EIDD specification does not prescribe a syntax for expressing these two values together.

NIEM's Emergency Management domain contains corresponding elements. Element CellSectorIDText identifies a cell sector, and element CellIDText identifies a tower. It should be possible to transform the NIEM elements into EIDD. However, until the acceptable syntax for EIDD's CellSectorID element is known, there is no way to know whether the element's string content can always be parsed sufficiently to identify, unambiguously, the two components. No recommendation on whether NIEM extensions are necessary can be made at this time.

Table 5-14. EIDD Vehicle/Person Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
NIEM Person Components	Used to store and exchange detailed information on about a person.
Vehicle	Used to store and exchange detailed information about a vehicle involved in the incident.

27. Person

The eidd:Person element and its corresponding type PersonInformationType store information about a person associated with an incident. The information consists of Person Role and a reference to NIEM's nc:Person element.

Recommendation: Place element em:PersonRoleRegistryCode (addressed with the non-covered EIDD elements) in the substitution group of the NIEM Core element PersonAugmentationPoint, and make PersonRoleRegistryCode's corresponding complex type extend s:AugmentationType.

28. Vehicle

The eidd:Vehicle element and its corresponding type VehicleInformationType store information about a vehicle associated with an incident. The information consists of Vehicle Relationship Type (Section 5.A.25) and a reference to NIEM's Vehicle element.

Recommendation: Place element em:VehicleIncidentRelationshipRegistryCode (addressed with the non-covered EIDD elements) into the substitution group of the NIEM Core element VehicleAugmentationPoint, and make VehicleIncidentRelationshipRegistryCode's corresponding complex type extend s:AugmentationType.

Table 5-15. EIDD Disposition Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
Disposition/DispositionType	Incident disposition information entered or updated by a dispatch agent and/or a responding emergency resource.
Disposition/ DispositionPrimaryIndicator	A designation of whether the common disposition code is the primary disposition code for the incident. Note that multiple primary codes are allowed but some systems may not be able handle more than one primary common disposition code. It is possible that no codes are marked as primary.

29. Disposition

EIDD's Disposition element, of type DispositionType, bundles a Common Disposition Code (Section 5.A.27), a Disposition Code Type (Section 5.B.29) and two elements from NIEM Core: DispositionCategoryText and DispositionDescriptionText. It would be better expressed in NIEM using augmentation.

Recommendation: Add to the Emergency Management domain an element DispositionAugmentation, in the substitution group of nc:DispositionAugmentationPoint, whose type is a complex type that bundles DispositionCategoryText and DispositionDescriptionText.

30. Disposition/DispositionPrimaryIndicator

The DispositionPrimaryIndicatory element designates whether the common disposition code in an EIDD Disposition element is the primary disposition code for an incident. NIEM has no directly analogous element. However, NIEM's DispositionType references element DispositionCategoryAbstract. This element is, as its name implies, a placeholder for representing different kinds of disposition categories, and as such is a generalization of EIDD's DispositionPrimaryIndicator element.

Recommendation: Add element DispositionPrimaryIndicator to NIEM's Emergency Management domain. Its type should be xs:Boolean, and it should be in the substitution group of element nc:DispositionCategoryAbstract.

Table 5-16. EIDD Dispatch Elements Partially Covered in NIEM 4.0

Element	EIDD Definition
Dispatch/DispatchInformationType	Dispatch information related to an incident.
Dispatch/EmergencyResource	Contains information about emergency responders assigned (dispatched) to the incident, as well as their status and location updates.

31. Dispatch/DispatchInformationType

The Dispatch element is a top-level element in an EIDD message. It contains dispatch-related information. It bundles a NIEM OrganizationIdentification element along with an EIDD Agent element and an arbitrary number of EIDD Emergency Resource elements. NIEM has no element or type that bundles these items.

Recommendation: Add to the Emergency Management domain an element named Dispatch and a corresponding complex type DispatchType. The type contains a sequence referencing nc:OrganizationIdentification, nc:Entity, and em:EmergencyResource. See Section 5.B.7 for details on expressing agents, and Section 5.B.32 for details on expressing emergency resource information.

32. Dispatch/EmergencyResource

The eidd:EmergencyResource element bundles information on resources to be used during incident response. Its type, EmergencyResourceType, references elements in NIEM Core and the Justice domain, as well as 12 EIDD elements. NIEM has no corresponding element. Element ResourceInformation in the Emergency Management domain is named similarly, but its type does not reference elements that overlap with those in EIDD's EmergencyResourceType.

Recommendation: Add to the Emergency Management domain an element named EmergencyResource and a complex type named EmergencyResourceType. The type's structure is a sequence of element references that are either ones specified in this document or in elements in NIEM Core and the Justice domain. See the definition of EmergencyResourceType for details on the list of elements.

6. Summary

This paper describes gaps in the NIEM coverage of identified PS/EM data requirements for each of the following PS/EM information exchange sources, none of which has been directly incorporated into NIEM (unlike some of the EDXL standards):

- Keystone/ Unified Incident Command and Decision Support System (UICDS),

- National Capital Region (NCR) CAD to CAD Data Exchange,

- EDXL-RM,

- Emergency Incident Data Document (EIDD).

For each of these, the IDA team identified data requirements that are partially covered by NIEM version 4.0, as well as those that are not. Where feasible, recommendations were provided on how NIEM could incorporate coverage of each of the identified uncovered data requirements. In some cases, the information that was readily available on the mappings between these sources and NIEM was insufficient for a recommendation.

In general, the IDA team found that most of the PS/EM data requirements of the examined information sharing schemas already exist in NIEM 4.0. However, the team found substantial examples of missing and incompletely covered data requirements, especially those from the EIDD. Table 1-1 summarizes the number of data requirements in each exchange specification for which no equivalent data requirement exists in NIEM 4.0. The EIDD has by far the largest number of elements not fully supported by NIEM 4.0.

Table 6-1 Summary of Missing and Incomplete Data Requirements

Source	Missing	Partially Covered
Keystone / UICDS	9	4
NCR Data Exchange	4	9
EDXL-RM	2	0
EIDD	27	32

Whenever possible, the IDA team recommended XSD elements and types that, if added to NIEM's Emergency Management domain, would eliminate the gaps. Limited by time and incomplete documentation of some of the sources, the team was not always able to formulate a suitable recommendation.

Acronyms and Abbreviations

ANSI	American National Standards Institute
APAN	All Partners Access Network
APCO	Association for Public-Safety Communications Officials
C4&IIC	Command, Control, Communications, and Computers and Information Infrastructure Capabilities
CAD	Computer Aided Dispatch
CIO	Chief Information Officer
DCIO	Deputy Chief Information Officer
DoD	Department of Defense
EDXL	Emergency Data Exchange Language
EDXL-CAP	Emergency Data Exchange Language-Common Alerting Protocol
EDXL-DE	Emergency Data Exchange Language-Distribution Element
EDXL-HAVE	Emergency Data Exchange Language-Hospital AVailability Exchange
EDXL-RM	Emergency Data Exchange Language-Resource Messaging
EIDD	Emergency Incident Data Document
EM	Emergency Management
HADR	Humanitarian Assistance and Disaster Relief
IDA	Institute for Defense Analyses
NCR	National Capital Region
NIEM	National Information Exchange Model
PM-ISE	Program Manager, Information Sharing Environment
PS/EM	Public Safety / Emergency Management
PSAP	Public Safety Answering Point
RM	Resource Management
URL	Uniform Resource Locator

URN	Uniform Resource Name
UICDS	Unified Incident Command Decision Support
XML	Exchange Markup Language
XSD	XML Schema Definition

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14. ABSTRACT

This document reports on work done by the Institute for Defense Analyses (IDA) for the Office of the Program Manager, Information Sharing Environment (PM-ISE), Office of the Director of National Intelligence and Deputy Chief Information Officer (DCIO) for Command, Control, Communications, and Computers and Information Infrastructure Capabilities (C4&IIC), Department of Defense (DoD) Chief Information Officer (CIO). The objective of this project is to assess the current state of communications interoperability between DoD public safety and emergency management (PS/EM) entities and U.S. civilian PS/EM entities and how that is likely to change as the next generation of public safety information systems is implemented across the nation. This white paper is the analysis of gaps in the coverage of PS/EM communications data requirements by the National Information Exchange Model (NIEM), version 4.0.

15. SUBJECT TERMS

Public safety and emergency management communications; data requirements; National Information Exchange Model; gap analysis

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