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# Proliferation of OASIS Common Alerting Protocol (CAP) Standard

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## Abstract

OASIS is an international standards development organization (SDO) committed to the development of open, international, interoperable markup language standards. The OASIS Emergency Management Technical Committee (EM-TC) has developed the Common Alerting Protocol (CAP) standard. CAP is a simple—but general—Extensible Markup Language (XML) format for exchanging all-hazard emergency alerts and public warnings over various kinds of networks. CAP allows a consistent warning message to be disseminated simultaneously over many different warning systems, increasing warning effectiveness while simplifying the warning process. CAP also facilitates the detection of emerging patterns in local warnings that might indicate an undetected hazard or hostile act. CAP provides a template for effective warning messages based on best practices identified through academic research and real-world experience.

Use of the CAP standard is becoming more prevalent in the United States Emergency Management (EM) community. Operational systems are adhering to the CAP standard. As more and more operational systems adopt the CAP standard, significant progress is being made toward seamless interoperability between EM systems.

The National Oceanic & Atmospheric Administration (NOAA) is currently developing and testing the HazCollect system, which is based on the CAP standard and will automate the distribution of messages from Emergency Managers in the field to National Weather Service (NWS) dissemination systems, including the NOAA Weather Radio (NWR), NOAA Weather Wire Service (NWWS), and the NWS Telecommunications Gateway (TG). HazCollect is targeted to be released in 2006.

As practitioners press on toward the NIMS vision of interoperability and compatibility, there are significant opportunities for the application of CAP. The OASIS EM-TC is developing the Emergency Data Exchange Language (EDXL), an integrating framework for a wide range of emergency data exchange standards to support operations, logistics, planning, and finance. The EM-TC is involved in the joint effort of developing these standards based on requirements gathered from the Department of Homeland Security (DHS) Disaster Management Program within a well-defined process. This collaborative process involves many agencies and practitioners. The first instance of EDXL is set to be a common routing-assertion element that can be used to envelop XML and other kinds of documents, including CAP messages.

The US EM community is rapidly embracing the CAP standard to resolve inter-system interoperability issues, but much work is needed to bridge the gap between the US EM community and the international EM community. The EM-TC is encouraging the use of international standards, such as CAP, to facilitate system interoperability across jurisdictional boundaries. The EM-TC consortium is motivated in this effort to mitigate such devastation and loss of life, as occurred in the 2004 tsunami.

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# 1. Common Alerting Protocol

The challenge of public warning is met through collaborative actions so that standards-based, all-media, all-hazards public warning is available to all societies, worldwide.

## The Common Alerting Protocol (CAP) standard:

- Offers one format for all hazard types; ready for sending across all kinds of communications devices
- Opens the door to new alerting systems and technical innovation

## 1.1. Background

In November 2000, the National Science and Technology Council's (NSTC) report on *Effective Disaster Warnings* recommended that "a standard method should be developed to collect and relay instantaneously and automatically all types of hazard warnings and reports locally, regionally and nationally for input into a wide variety of dissemination systems."

An international working group of emergency managers and information technology and telecommunications experts convened in 2001 and adopted the specific recommendations of the NSTC report as a point of departure for the design of a Common Alerting Protocol. Their draft went through several revisions and was tested in demonstrations and field trials in Virginia, Washington, D.C., Nevada, and California during 2002 and 2003.

In 2002, the CAP initiative was endorsed by the national non-profit Partnership for Public Warning, which sponsored its contribution in 2003 to the OASIS standards process. In 2004, CAP version 1.0 was adopted as an OASIS Standard. CAP version 1.1 was adopted as an OASIS international standard October 28, 2005.

## 1.2. Overview

OASIS is an international SDO committed to the development of open nonproprietary interoperable XML standards. The OASIS EM-TC has developed the CAP standard. CAP is a simple—but general—format for exchanging all-hazard emergency alerts and public warnings over various kinds of networks. CAP allows a consistent warning message to be disseminated simultaneously over many different warning systems, increasing warning effectiveness while simplifying the warning process. CAP also facilitates the detection of emerging patterns in local warnings that might indicate an undetected hazard or hostile act. CAP provides a template for effective warning messages based on best practices identified through academic research and real-world experience [[CAP1.1](#)].

Key benefits of CAP include reduction of costs and operational complexity by eliminating the need for multiple custom software interfaces to the many warning sources and dissemination systems involved in all-hazards warning. CAP is not dependent on a specific transport protocol making it transport agnostic. It can be transported through simple protocols such as Hypertext Transfer Protocol (HTTP) and Jabber®, as well as more structured software transport, such as Simple Object Access Protocol (SOAP) and Resource Description Framework (RDF) Site Summary (RSS). The CAP message format can be converted to and from the "native" formats of all kinds of sensor and alerting technologies, forming a basis for a technology-independent national and international "warning Internet."

CAP provides an open, non-proprietary digital message format standard for all types of alerts and notifications independent of any particular application or telecommunications method. CAP is compatible with emerging techniques, such as Web services, as well as existing formats including the Specific Area Message Encoding (SAME) used for the United States' NOAA Weather Radio, and the Emergency Alert System (EAS).

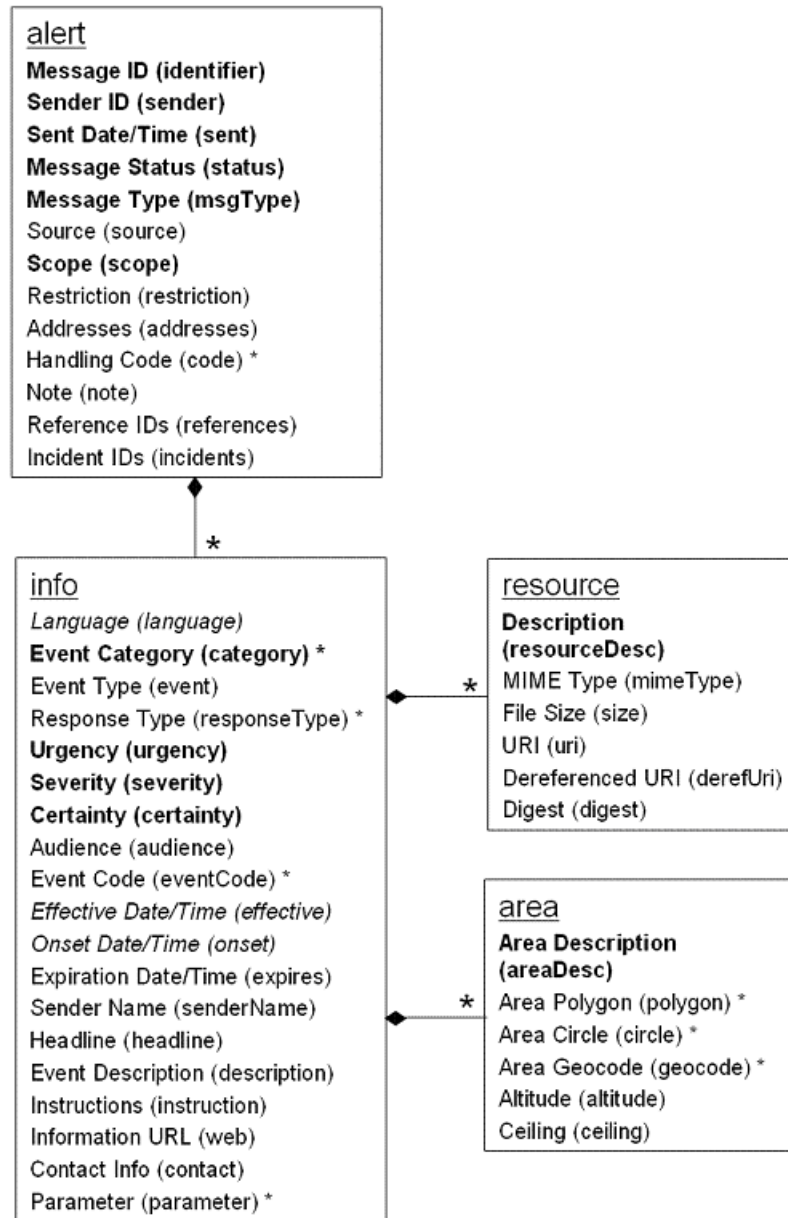
### Enhanced Capabilities Facilitated By CAP:

- Flexible, geographic targeting using latitude/longitude shapes and other geospatial representations in three dimensions

- Multi-lingual and multi-audience messaging
- Phased and delayed effective times and expirations
- Enhanced message update and cancellation features
- Template support for framing complete and effective warning messages
- Compatible with digital encryption and signature capability
- Facility for digital images and audio

### 1.3. Structure of the CAP Alert Message

Each CAP alert message consists of an *alert* element, which may contain one or more *info* elements. Each *info* element may contain one or more *resource* elements and one or more *area* elements. CAP messages with a *msgType* element value of “Alert” should include at least one *info* element as shown in [Figure 1](#)



**Figure 1. CAP Document Object Model**

*Elements in boldface are mandatory; elements in italics have default values that will be assumed if the element is not present; asterisks (\*) indicate that multiple instances are permitted.*

A sample CAP 1.1 Amber alert message is provided in [Example 1](#).

## Example 1. Amber Alert CAP Message

```

<?xml version = "1.0" encoding = "UTF-8"?>
<alert xmlns = "urn:oasis:names:tc:emergency:cap:1.1">
  <identifier>KAR0-0306112239-SW</identifier>
  <sender>KARO@CLETS.DDJ.CA.GOV</sender>
  <sent>2003-06-11T22:39:00-07:00</sent>
  <status>Actual</status>
  <msgType>Alert</msgType>
  <source>SW</source>
  <scope>Public</scope>
  <info>
    <category>Rescue</category>
    <event>Child Abduction</event>
    <urgency>Immediate</urgency>
    <severity>Severe</severity>
    <certainty>Likely</certainty>
    <eventCode>
      <valueName>SAME</valueName>
      <value>CAE</value>
    </eventCode>
    <senderName>LOS ANGELES POLICE DEPT - LAPD</senderName>
    <headline>AMBER ALERT</headline>
    <description>DATE/TIME:
      06/11/03, 1915 HRS.  VICTIM(S):
      KHAYRI DOE JR. M/B BLK/BRO 3'0", 40 LBS. LIGHT
      COMPLEXION.  DOB 06/24/01.  WEARING RED SHORTS,
      WHITE T-SHIRT, W/BLUE COLLAR.  LOCATION: 5721
      DOE ST., LOS ANGELES, CA.  SUSPECT(S): KHAYRI
      DOE SR.  DOB 04/18/71 M/B, BLK HAIR, BRO EYE.
      VEHICLE: 81' BUICK 2-DR, BLUE (4XXX000).
    </description>
    <contact>DET. SMITH, 77TH DIV, LOS ANGELES POLICE DEPT-LAPD
      AT 213 485-2389
    </contact>
    <area>
      <areaDesc>Los Angeles County</areaDesc>
      <geocode>
        <valueName>SAME</valueName>
        <value>006037</value>
      </geocode>
    </area>
  </info>
</alert>

```

## 2. CAP in Action

Use of the CAP standard is gaining ground in the US EM community as more operational systems adopt the CAP standard. Significant progress is being made toward seamless interoperability between EM systems.

## 2.1. United States Geological Survey

The United States Geological Survey (USGS) is implementing CAP to warn about earthquakes, volcanoes, landslides, wildlife diseases, and invasive species, as well as to work with other government agencies on hazards, such as tsunamis, wildfires, and floods.

As shown in [Table 1](#), tens of thousands of earthquakes occur in the world each year. The USGS Earthquake Hazards Program and Office of Communications offers a new service that provides CAP messages for reviewed reports of Earthquake events. CAP earthquake alerts are posted to <http://earthquake.usgs.gov/recenteqsw/catalogs/cap/>.

Magnitude	2000	2001	2002	2003	2004	2005
8.0 to 9.9	1	1	0	1	2	1
7.0 to 7.9	14	15	13	14	14	9
6.0 to 6.9	158	126	130	140	141	128
5.0 to 5.9	1345	1243	1218	1203	1515	1525
4.0 to 4.9	8045	8084	8584	8462	10888	12081
3.0 to 3.9	4784	6151	7005	7624	7932	7150
2.0 to 2.9	3758	4162	6419	7727	6316	3891
1.0 to 1.9	1026	944	1137	2506	1344	22
0.1 to 0.9	5	1	10	134	103	0
No Magnitude	3120	2938	2937	3608	2939	749
Total	22256	23534	27454	31419	31194	25556
Estimated Deaths	231	21357	1685	33819	284010	82322

**Table 1. Number of Earthquakes Worldwide for 2000 - 2005**

As illustrated in [Figure 2](#), CAP alerts can also be accessed from the USGS home page ([www.usgs.gov](http://www.usgs.gov) [<http://www.usgs.gov/>]).

### Science Features

[USGS Responds to Recent Hurricanes](#)

**In the Eye of the Storm, the HIF Keeps Ticking**  
 The USGS Hydrologic Instrumentation Facility (HIF) located near Bay St. Louis, Miss., was severely impacted by Hurricane Katrina, yet never closed its doors. HIF employees suffered personal losses, yet they worked through their difficulties, helped others, and were still able to meet all their normal requests. The dedicated employees at the HIF support USGS hydrologic data-collection activities. [Learn More](#)

**Protecting Communities from Landslides**  
 A new report jointly released with the American Planning Association highlights planning practices to protect communities from landslides. [Learn More](#)

**Birds of a Feather**  
 As the founding father of the North

### Science In Your State

**Select Your State**

or...

### Real-Time Information

[Natural Hazards Support System](#)

**Earthquakes** XML ▶ CAP ▶

- [Recent Earthquakes](#)
- [Did You Feel It?](#)

[More real-time earthquake sites](#)

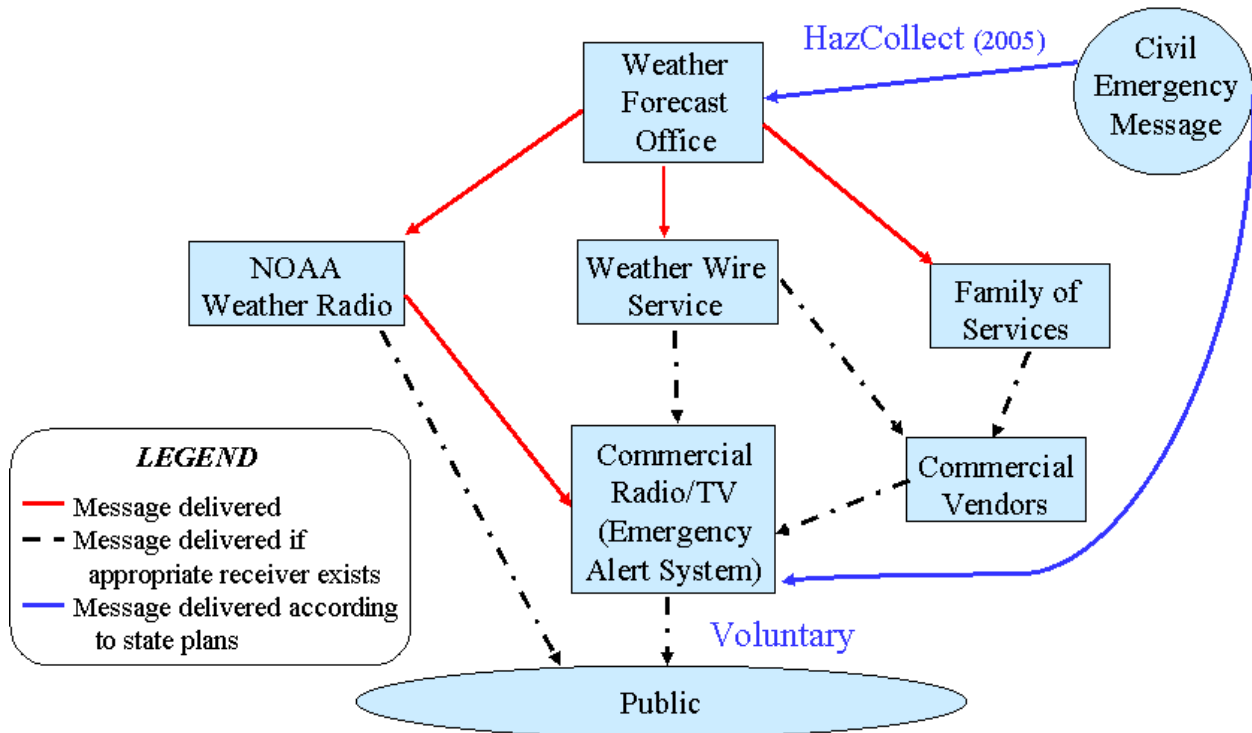
**Figure 2. USGS Website**

*The USGS Website features real-time earthquake CAP messages.*

## 2.2. National Oceanic & Atmospheric Administration

In FY 2004, NOAA began developing a capability to reduce the time it takes for an emergency manager to input a hazard warning into NOAA Weather Radio All Hazards and reduce the possibility of transcription errors. This system, known as HazCollect, will reduce the amount of time it takes to input a message into the system—from seven minutes to less than two minutes. This capability, will allow emergency managers direct access to the Emergency Alert System via NOAA Weather Radio All Hazards and is expected to be fully operational in FY 2006. HazCollect will use the CAP format for emergency messages. The NOAA message flow is captured in [Figure 3](#).





**Figure 3. HazCollect Message Flow**

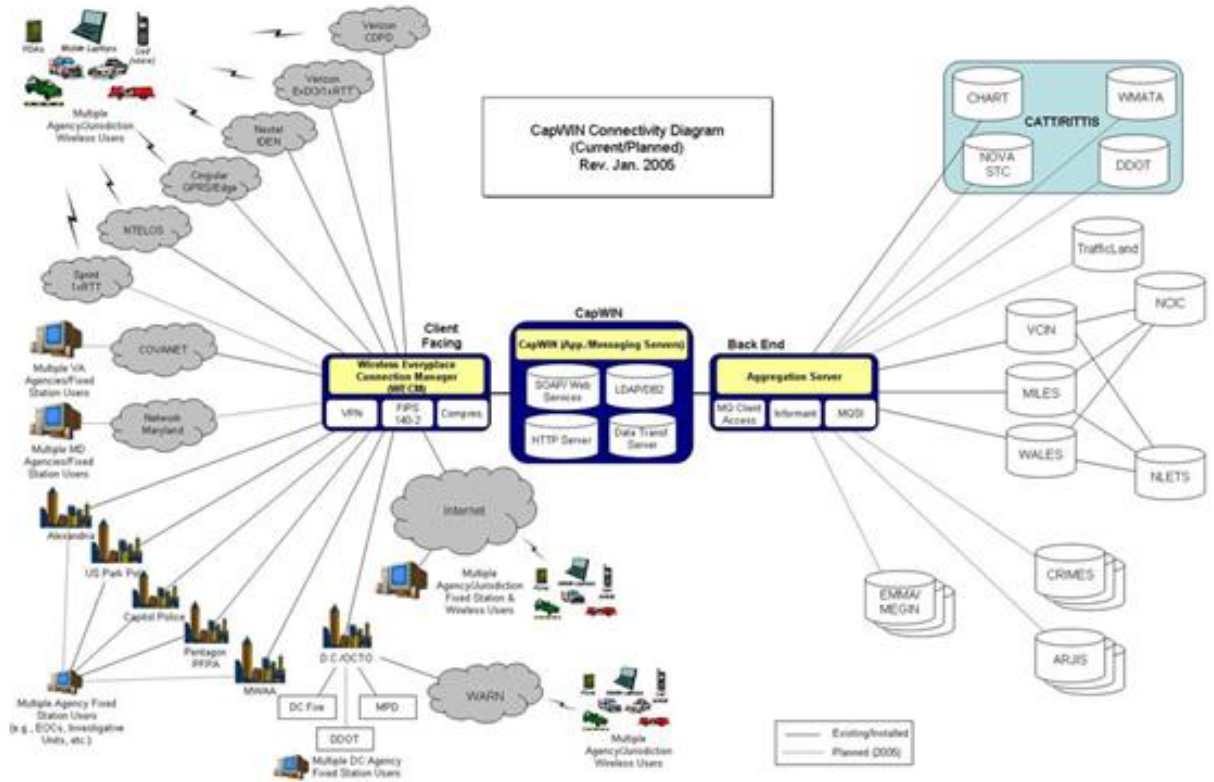
*HazCollect will plug into the NOAA message flow in late 2005.*

## 2.3. Department of Justice

The OASIS CAP is in use in the law enforcement community. The standards-based Capital Wireless Integrated Network (CapWIN) is a partnership between the States of Maryland and Virginia and the District of Columbia to develop an interoperable first responder data communication and information sharing network.

### CapWIN's application suite enables:

- Incident management and coordination across agencies, regions, and public safety and transportation disciplines
- Secure one-to-one and group public and private discussions
- A robust and searchable directory of individual first responders—a “411 Directory” for public safety and transportation agencies
- Access to operational data/resources, including multiple State and Federal law enforcement criminal databases



**Figure 4. CapWIN Connectivity Diagram**

*CapWIN connects local, State, and Federal law enforcement organizations in the National Capital Region.*

CapWIN was used at the request of the US Marine Corps to coordinate the activities of multiple first responder agencies supporting the annual Marine Corps Marathon in the District of Columbia and Arlington County, Virginia. Eighteen users from six agencies actively participated during the day-long incident.

**Participating agencies included:**

- United States Marine Corps (Mobile Command)
- Arlington County, Virginia, Police Department (Mobile Command)
- District of Columbia Department of Transportation
- Virginia Department of Transportation
- United States Park Police
- Pentagon Force Protection Agency (PFPA) Field and Operations Command Center Staff
- CapWIN (Operations and Help Desk Support)

The design and development of the CapWIN system is being performed using open standards, wherever possible. As a system designed to enable data interoperability across multiple technical platforms, jurisdictions and public safety disciplines, CapWIN personnel are participating in the implementation and development of new data exchange standards at the Federal, State, and local levels. CapWIN connectivity is detailed in [Figure 4](#).

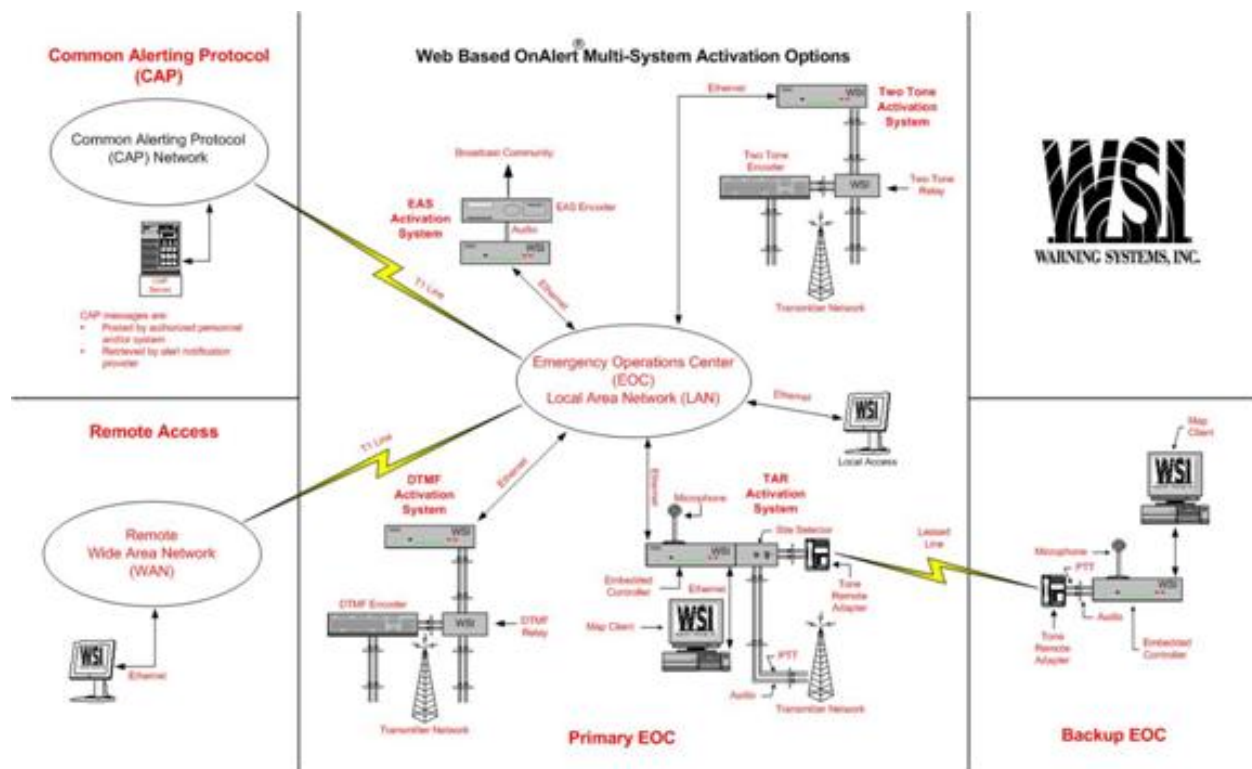
CapWIN is planning to add a dedicated transformation server to handle XML transactions that utilize a multitude of XML Data Dictionaries and Data Models including CAP and EDXL.

## 2.4. Sensor Networks

CAP's flexibility has fostered its extension to areas not intended for use. For example, sensor networking research and development at Sandia National Laboratory is utilizing CAP in its Chemical, Biological, Radiological, Nuclear, and high-yield Explosive (CBRNE) alerting framework.

## 2.5. Chemical Stockpile Emergency Preparedness Program

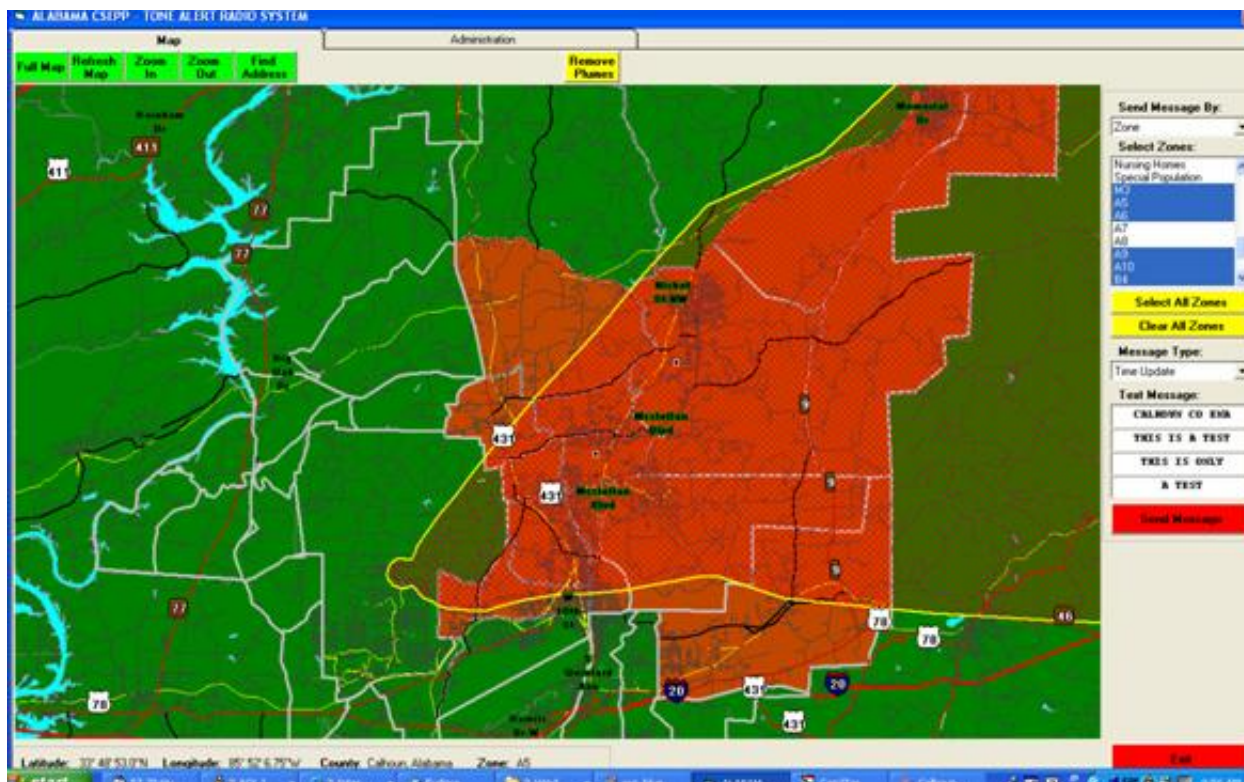
In 1985, the US Congress mandated that the nation's stockpile of unitary lethal chemical agents and munitions be destroyed. During the continued storage and ultimate disposal of these stockpiles, there is a remote possibility of an accidental release of agent that could threaten people and property on the Army installations and in the surrounding communities. The Chemical Stockpile Emergency Preparedness Program (CSEPP) has been tasked with mitigating the effects of such an event.



**Figure 5. CSEPP Community Interoperability**

### *Web-based on-alert multi-system activation options*

The CSEPP community is fostering interoperability between EM hardware and software, as illustrated in [Figure 5](#). A CAP message containing the chemical plume footprint, dosage contours, Protective Action Zones (PAZs), and Protective Action Recommendations (PARS) is generated by IEM's D2-Puff™ software. This message is used by WSI's activation system to set off Tone Alert Radios (TARs) and sirens and to activate EASs in the zones and geospatial area of the disaster. This system integration is displayed in [Figure 6](#).



**Figure 6. EM Software and Hardware Int**

*CAP makes integration of software and hardware systems seamless and cost-effective.*

## 3. The Road Ahead

CAP is just a first step in moving national and international EM Command, Control, Communication, and Computer (C4) systems toward interoperability, but the EM community still has a long way to go.

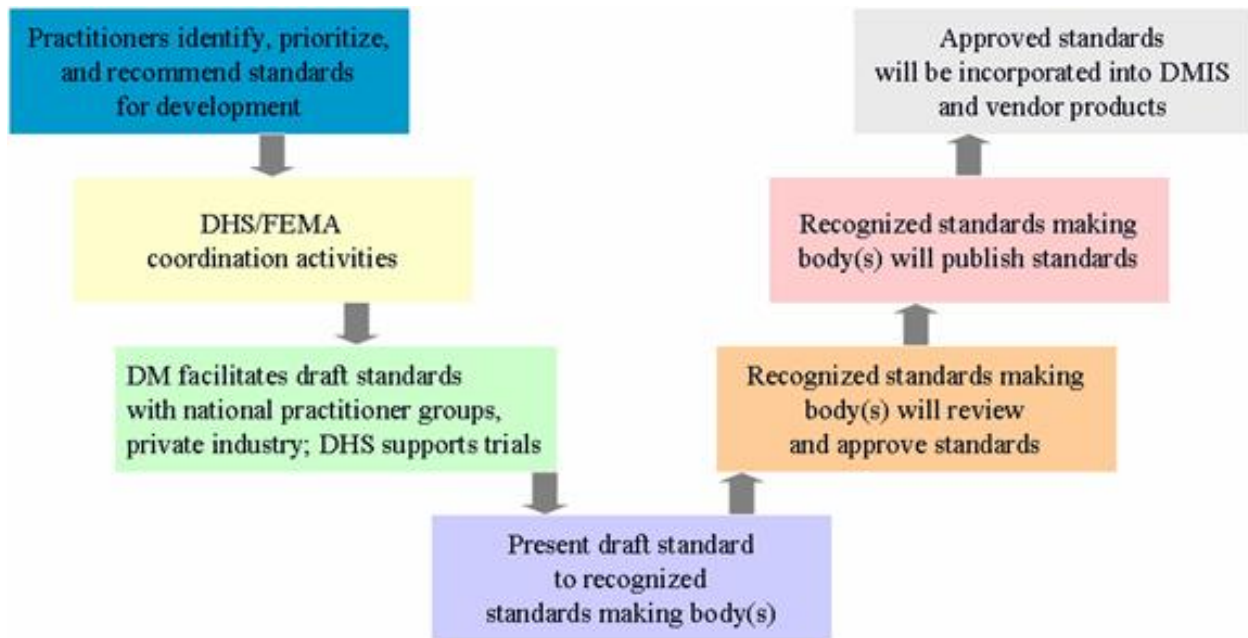
### 3.1. Emergency Interoperability Consortium

**The Emergency Interoperability Consortium (EIC)** is made up of organizations that share the same goals for interoperable emergency communications. The Executive Committee leads the consortium, which participates in educational and outreach activities to the public and Federal communities on incident and emergency management issues. Many EIC members participate in the [OASIS Emergency Management Technical Committee](http://www.oasis-open.org/committees/workgroup.php?wg_abbrev=emergency) [[http://www.oasis-open.org/committees/workgroup.php?wg\\_abbrev=emergency](http://www.oasis-open.org/committees/workgroup.php?wg_abbrev=emergency)].

**The Consortium's primary objectives are to:**

- Create a national approach for data interoperability through an industry-government consortium
- Promote the development of Web services/XML data interoperability standards necessary to support the timely and accurate exchange of incident information throughout the EM community
- Ensure every American has appropriate access to whatever information they require—when and how they need it

The standards development process employed is illustrated in [Figure 7](#).



**Figure 7. Collaborative Standards Development Process**

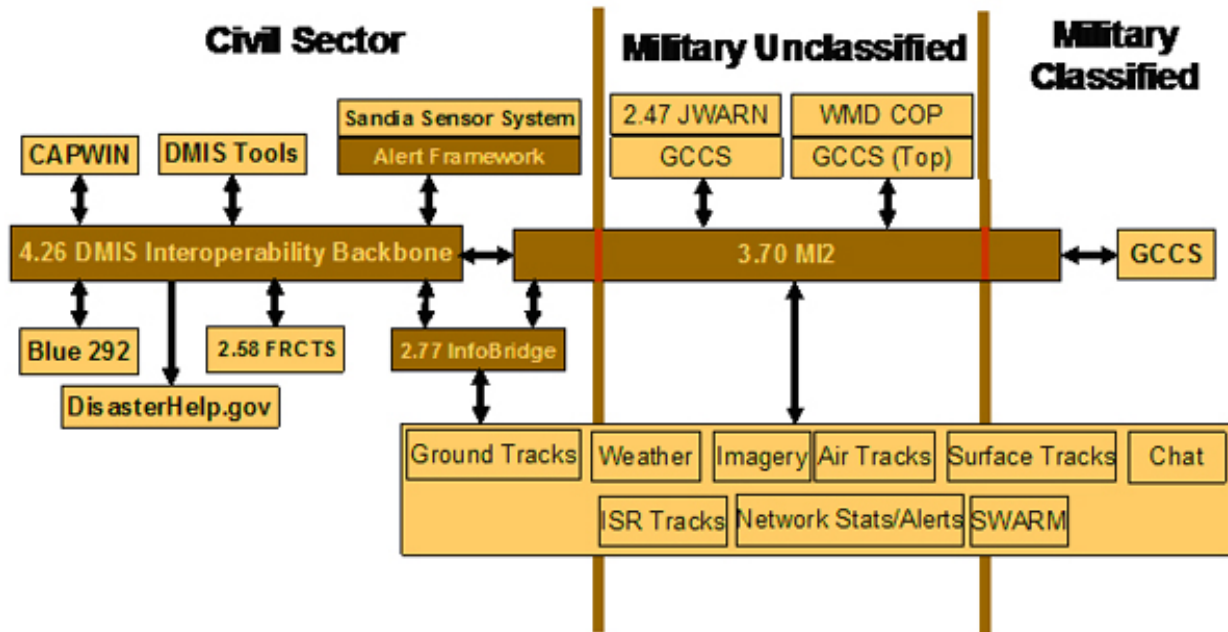
*The collaborative standards development process begins with requirements from the EM practitioner and ends with approved standards incorporated to the tools utilized by those practitioners.*

## 3.2. Disaster Management eGovernment Initiative

The Disaster Management e-Government Initiative is one of 24 initiatives established by the President's Management Council. It is an integrated team of partner agencies and organizations that perform disaster management activities will accomplish program delivery. The Disaster Management e-Government Initiative currently focuses on providing information and services relating to the four pillars of all-hazards disaster management: preparedness, response, recovery, and mitigation. Later phases will incorporate delivery of integrated, cross-agency processes and services to citizens, governments, and non-governmental organizations with emphasis on first responder needs.

The Disaster Management e-Government Initiative supports a multitude of Federal agency missions, including the Federal Emergency Management Agency's (FEMA) mission to reduce the loss of life and property and protect American institutions from all hazards. The partnerships established support the Federal mission to provide the nation with a comprehensive, risk-based emergency management program of mitigation, preparedness, response, and recovery.

As detailed in [Figure 8](#), Disaster Management Interoperability Services (DMIS) provide an interoperability backbone for EM information exchange. DMIS provides CAP and EDXL Distribution Element (DE) interoperability services.



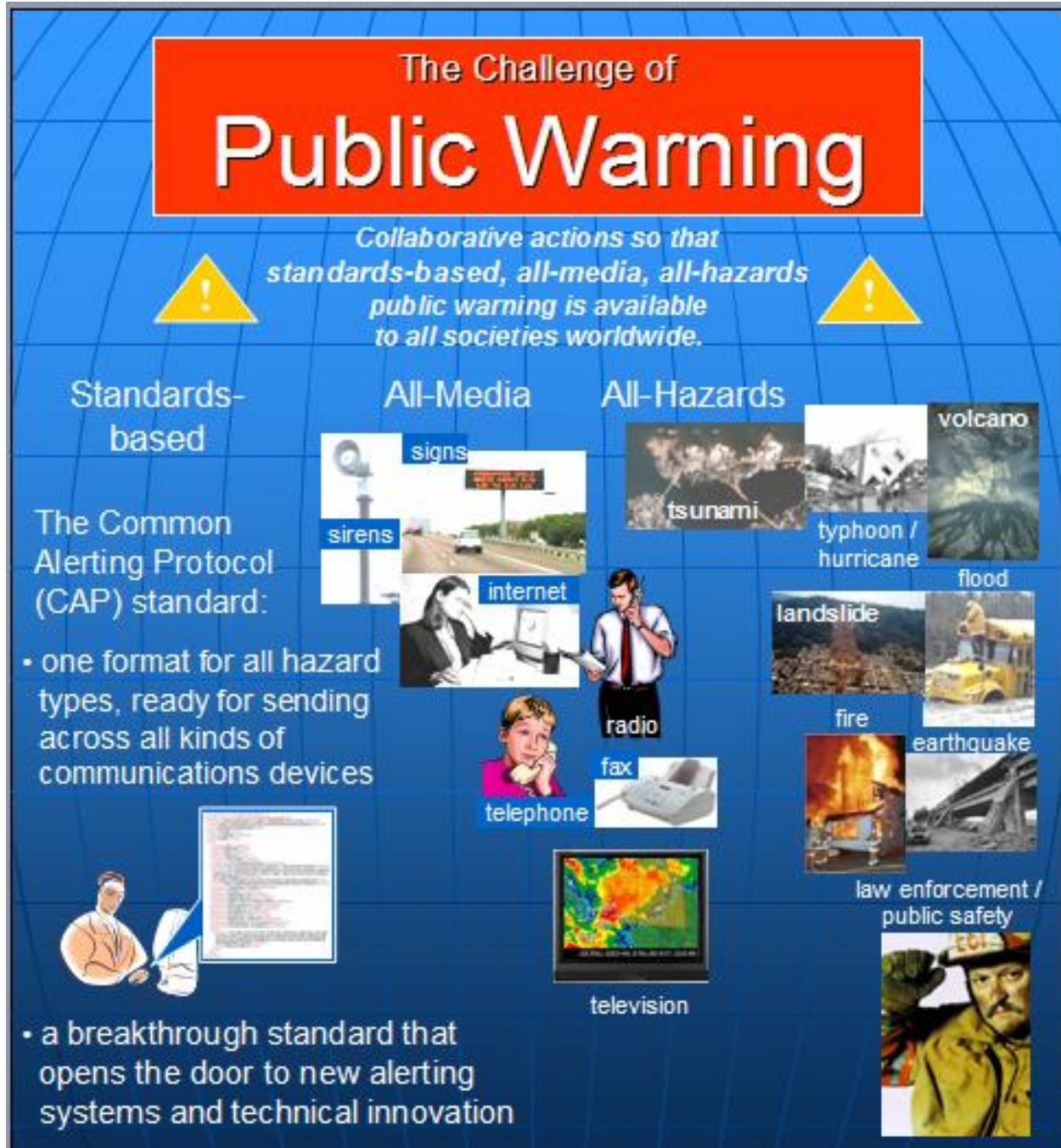
**Figure 8. Disaster Management Interoperability Services**

*DMIS provides the backbone for interoperation between civil and military systems.*

### 3.3. International Emergency Management Interoperability

Much needs to be done in bridging the gap with the international EM community. The EM-TC is encouraging the use of international standards, such as CAP, to facilitate system interoperability across jurisdictional boundaries. The EM-TC consortium is motivated in this effort to mitigate such devastation and loss of life, as occurred in the 2004 tsunami.

That poster shown in [Figure 9](#) is being presented simultaneously with XML 2005 at the World Summit on the Information Society (WSIS) to promote CAP use in the international space.



**Figure 9. Public Warning at World Summit on the Information Society (WSIS)**

*International collaborative efforts are addressing all-hazard/all-media aspects of alert and notification through CAP.*

### 3.4. The EDXL Family of Emergency Management Standards

As practitioners press on toward the NIMS vision of interoperability and compatibility, there are significant opportunities for the application of CAP. The OASIS EM-TC is developing the EDXL, an integrating framework for a wide range of emergency data exchange standards to support operations, logistics, planning, and finance. The EM-TC is

involved in the joint effort of developing these standards based on requirements gathered from the DHS Disaster Management Program within a well-defined process. This collaborative process involves many agencies and practitioners. The first instance of EDXL is set to be a common routing-assertion element that can be used to envelop other kinds of documents, including CAP messages.

### 3.4.1. EDXL-DE

The Disaster Management Initiative has formed a partnership with industry members of the EIC to cooperate in the development of emergency standards. EIC members participated in the development of the EDXL-DE requirements.

EDXL is a standard XML-based message distribution framework for data sharing among emergency information systems. This format may be used over any data transmission system, including but not limited to the SOAP HTTP binding.

The primary purpose of the DE is to facilitate the routing of any emergency message to recipients. The DE payload can be any type of message or document including XML, Word, Shape Files, Excel, etc. The DE may be thought of as a “container.” It provides the information to route “payload” message sets, such as Alerts or Resource Messages, by including key routing information such as distribution type, geography, incident, and sender/recipient IDs.

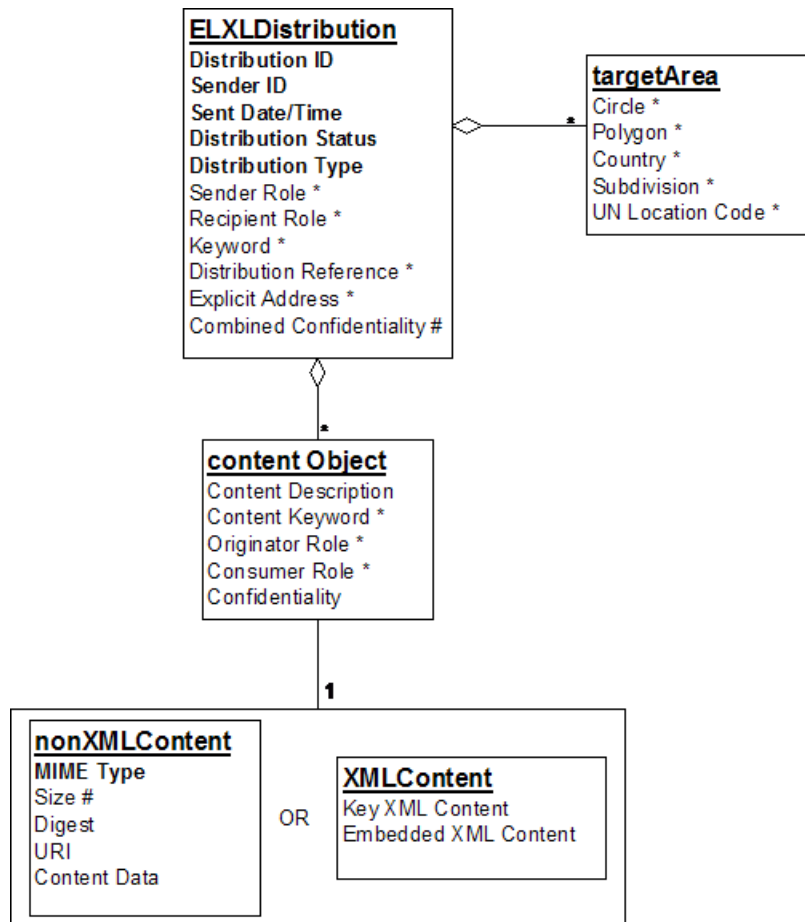
The goal of the EDXL project is to facilitate emergency information sharing and data exchange across the local, State, tribal, national, international, and non-governmental organizations of different professions that provide emergency response and management services. EDXL accomplishes this goal by focusing on the standardization of specific messaging interfaces to facilitate emergency communication and coordination particularly when more than one profession is involved.

The draft DE specification was first trialed by a number of EIC members in October 2004. In November 2004, EIC formally submitted the draft to the OASIS Emergency Management Technical Committee for standardization. EDXL-DE 1.0 is expected to be adopted as an international standard by the end of 2005. [[EDXL-DE1.0](#)]

### 3.4.2. Structure of the EDXL-DE

The EDXL-DE comprises an *EDXLDistribution* element, an optional set of *targetArea* elements describing geospatial or political target area for message delivery, and a set of *contentObject* elements each containing specific information regarding a particular item of content. The included content may be any XML or other content type or a Uniform Resource Identifier (URI) to access the content. The *EDXLDistribution* element may be used without a *contentObject* element to form the body of a routing query to, or response from, a directory service. The EDXL-DE object model is provided in [Figure 10](#).





**Figure 10. EDXL Distribution Element**

*Elements in boldface are mandatory; elements in italics have default values that will be assumed if the element is not present; asterisks (\*) indicate that multiple instances are permitted.*

### 3.4.3. Example EDXL Code

A sample EDXL-DE message with a CAP payload is shown in [Example 2](#).

**Example 2. EDXL-DE Message With CAP Payload**

```

<EDXLDistribution xmlns="urn:oasis:names:tc:emergency:EDXL:DE:1.0">
  <distributionID>ieam_e3_2</distributionID>
  <senderID>XML2005</senderID>
  <dateTimeSent>2005-11-15T16:53:00-05:00</dateTimeSent>
  <distributionStatus>Exercise</distributionStatus>
  <distributionType>Update</distributionType>
  <keyword>
    <valueListURN>http://www.niem.gov/EventTypeList</valueListURN>
    <value>Explosion</value>
  </keyword>
  <targetArea>
    <polygon>33.4745,-112.1174 33.4745,-112.0238 33.4238,-112.0238
      33.4238,-112.1174 33.4745,-112.1174
    </polygon>
  </targetArea>
  <contentObject>
    <contentDescription>CAP message from DOT advising best
      alternate Routes
    </contentDescription>
    <xmlContent>
      <embeddedXMLContent>
        <alert xmlns = "urn:oasis:names:tc:emergency:cap:1.1">
          <identifier>Vendor generated</identifier>
          <sender>AZ DOT</sender>
          <sent>2005-11-15T16:58:00-05:00</sent>
          <status>Exercise</status>
          <msgType>Update</msgType>
          <scope>Public</scope>
          <info>
            <category>Transport</category>
            <event>Traffic Routes</event>
            <urgency>Immediate</urgency>
            <severity>Moderate</severity>
            <certainty>Likely</certainty>
            <description>Traffic adjustments ensure clear routes
              to St. Josephs Hospital and Phoenix
              Childrens Hospital on Thomas Rd.
            </description>
            <area>
              <areaDesc>Best Routes</areaDesc>
              <polygon>38.91655012246089,-77.02016267943407
                38.91655012246089,-77.0117098391165
                38.907662564641285,-77.0117098391165
                38.907662564641285,-77.02016267943407
                38.91655012246089,-77.02016267943407
              </polygon>
            </area>
          </info>
        </alert>
      </embeddedXMLContent>
    </xmlContent>
  </contentObject>
</EDXLDistribution>

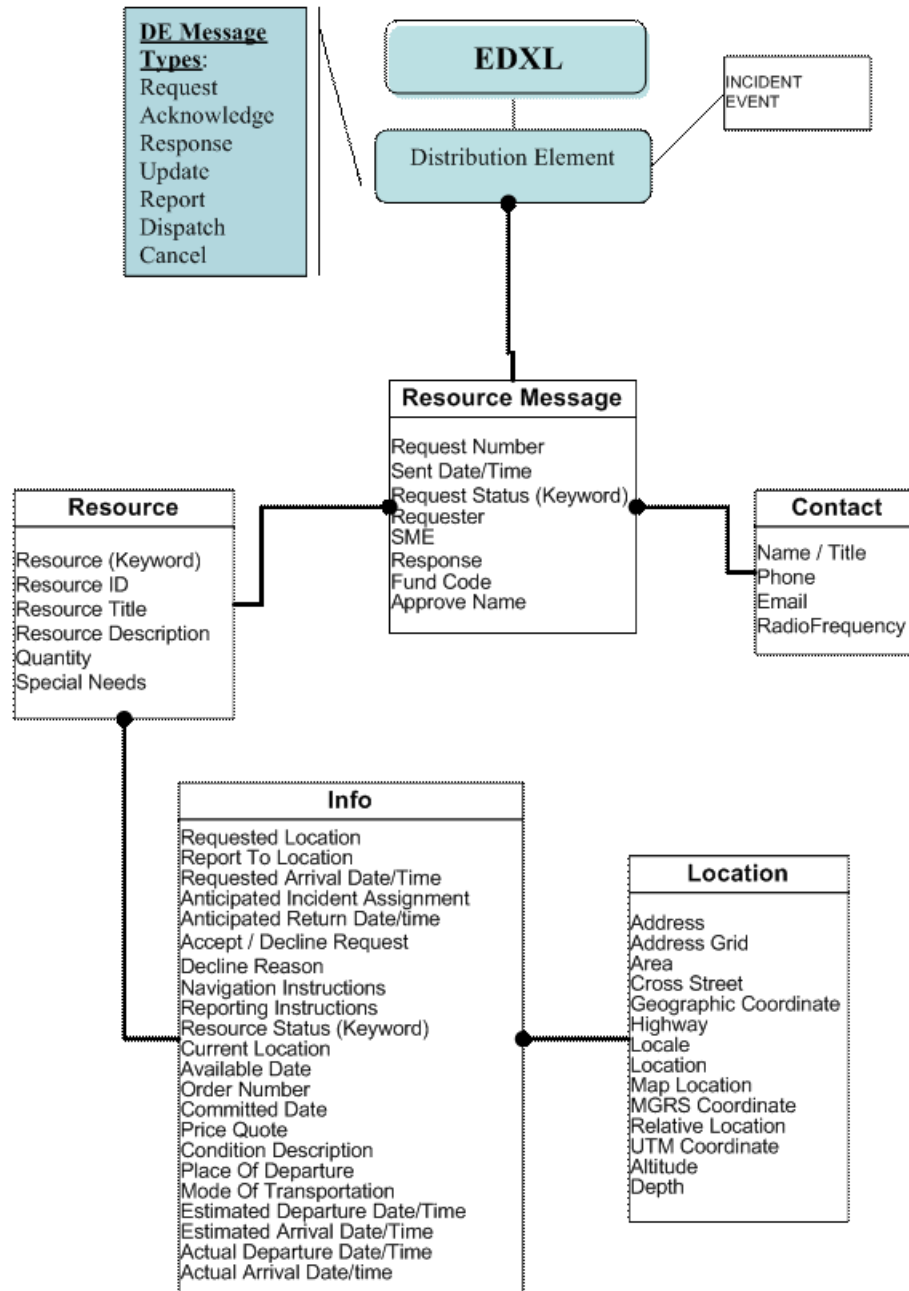
```

```
</contentObject>  
</EDXLDistribution
```

### 3.5. Next Steps in EDXL Development

The Disaster Management (DM) Program sponsored a Standards Working Group (SWG) meeting on June 21, 2005 to review and validate DM's current standards-related efforts and to evaluate requirements for resource messaging standards. Participants included end user practitioners, industry, incident response agencies and associations, along with other Federal standards efforts. During the meeting, decisions were made about future collaboration and the DM standards development process.

One key lesson-learned from hurricanes Ivan and Katrina is the inability of the EM community in general to effectively manage resources during emergency response. The DM-SWG has worked with EM practitioners to compile requirements for an EDXL resource management protocol (EDXL-RM). The EM-TC is initiating work on the EDXL-RM standard. An initial draft of the EDXL-RM object model is provided in [Figure 11](#).



**Figure 11. EDXL Resource Management**

*This initial draft of the EDXL-RM is the next step in development of the EDXL suite of EM interoperability standards.*

## Acknowledgements

The authors would like to express appreciation to the following individuals and organizations for contribution and support in this effort: OASIS; OASIS EM-TC; The DHS Disaster Management Program; EIC; NOAA; Christian Elliot,

USGS; Tom Merkle, CapWIN; David Ellis, Sandia National Laboratory; Gary Ham, DMIS; and Art Botterell, Incident.com.

## Bibliography

[CAP1.1] *Common Alerting Protocol, v. 1.1 Committee Specification, 11 August 2005.*

[EDXL-DE1.0] *Emergency Data Exchange Language (EDXL) Distribution Element, v. 1.0 Committee Draft, 19 August 2005.*

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## Biography

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Dr. Patti Iles Aymond is a Senior Scientist for IEM, Inc. (IEM). She has guided the design, development, and use of large-scale simulation systems, such as IEM's revolutionary integrated protective action simulation system, QEM-World™. The design basis of QEM-World™ is Dr. Aymond's specialized general search tree that yields unparalleled storage and search performance. She also designed the simulation control object of the QEM-World™ traffic simulation model. Dr. Aymond served as Design Coordinator for Phase I of IEM's D2-Puff™ — a chemical weapons dispersion model that IEM is extending with enhanced capability for the Soldier Biological and Chemical Command (SBCCOM). In addition, Dr. Aymond developed the plan for bringing D2-Puff™ into Department of Defense (DoD) High Level Architecture (HLA) compliance. Dr. Aymond was the Project Leader for a Defense Threat Reduction Agency (DTRA) project to develop an automated tool for updating global population information in an effort to reduce collateral effects of military actions. Dr. Aymond was the Senior Design Architect for an analysis support tool developed as part of IEM's Chemical and Biological Warfare Defense Study, which was conducted for DTRA. She designed the architecture, prototype, functional design specifications, and database for IEM's Domestic Anthrax Model. Dr. Aymond holds both a PhD and a BS in Computer Science from Louisiana State University. She is a member of the Organization for the Advancement of Structured Information Standards (OASIS) Emergency Management Technical Committee, the Institute of Electrical and Electronics Engineers (IEEE), and the Society for Industrial and Applied Mathematics (SIAM).

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Ms. Elysa Jones is the Engineering Program Manager for Warning Systems, Inc. (WSI). She has more than 25 years experience in engineering program management, software development, and product design and development. She has been with WSI since 1998 and has been instrumental in the successful design and development of new products and installation of major radio warning systems. She also served on the board of trustees for the Partnership for Public Warning and is committed to the work of improving public warning in our country and throughout the world. She is the current Chair of the OASIS Emergency Management Technical Committee. Through those efforts, Ms. Jones works diligently to further standards development to support all aspect of Emergency Management. Through this work, she monitors the development of the National Incident Management System (NIMS), the National Response Plan (NRP), and other emergency management initiatives to ensure that WSI product development is aligned with changes in the field.