An OASIS Emergency Management Technical Committee White Paper

A Modern Emergency Management Framework: The OASIS Distribution Element Revisited

A Proposal

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Date: 28 January 2019

This paper proposes a modern emergency management framework for demonstration, education, and validation of effective and efficient management and sharing of emergency information to save lives through interoperability and standardization. Recently, HL7 and OASIS have collaborated on key standards, including the Tracking of Emergency Patients (TEP), Hospital Availability (HaVE) and the Common Alert Protocol (CAP), that offer a real opportunity to improve emergency information distribution to save lives, if only there were a standard for effectively distributing this information using smart systems to those who need it based on their skills, roles and relationships. There are two missing pieces to enable this distribution system.

The first missing piece is a standardized way to package and address the emergency information. Fortunately, OASIS has just such a standard, the Distribution Element (DE). The DE serves two primary purposes: (1) the DE allows an organization to wrap important pieces of emergency information into a single easy-to-distribute XML "package", and (2) the DE allows an organization to "address" the package in flexible ways to support intelligent routing, including specifying recipients by role, by geographic area, or by keywords.

The second missing piece is an emergency management framework consisting of (1) key HL7, OASIS and other emergency standards; (2) an open-source software library with a set of standardized APIs for developers to use in their systems to interact with these standards; and (3) a sample reference implementation of an emergency management framework for demonstrating, educating, and validating the effective and efficient management and distribution of emergency information.

Fortunately, key emergency standards like TEP, HAVE and CAP exist, while initial sample open-source software libraries have been developed for standards like CAP, which could serve as models for extension to other standards. OASIS has begun a sample reference implementation of their standards, while other organizations have open-source demonstration systems as well. As these standards have been developed, major advances in rapid technology development and smart systems have occurred in the software development community, including DevOps, Containers, Microservices, Deep Learning, and Blockchains. Software developers are eager to utilize these advances in all areas, including emergency management.

Now is the time to revisit the Distribution Element and enable the open-source initiative to provide the needed software libraries and reference implementation leveraging these software advances. The authors recommend a collaborative, standards-based, open-source development process to include updating and modernizing the OASIS Distribution Element. The authors encourage industry, federal, state, and local government, academic and civilian participation and support as OASIS, HL7 and other standards organizations seek to lead this effort.

This white paper was produced and approved by the OASIS Emergency Management Technical Committee as a Committee Draft. It has not been reviewed and/or approved by the OASIS membership at-large.

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# Need

Emergency Management is both the macro and micro challenge of our age. As natural disasters plague our nation and the world, the floods, the hurricanes, the tornadoes, the earthquakes, the fires … we find we need to manage these disasters from both ends of a spectrum: the formal macro challenge (e.g. official, governmental, centralized, planned, funded, organized emergency assistance) and the informal micro challenge (e.g. local, community, individual, neighbor, decentralized, in-the-moment, unfunded, ad hoc emergency assistance). The dual challenge is to address the same needs for individual emergencies that plague us, our friends and our neighbors, including the local or individual impacts of natural disasters e.g. the neighbor who lost the house in the fire, as well as the individual emergencies, the car accident, the heart attack, the lost child or grandparent, or simply the traffic jam that may delay a parent from picking up a child.

Our day-to-day lives are filled with emergencies of all sorts and sizes and we need to be prepared. We need government to be prepared and responsive but we also want to be empowered as individuals and local organizations so we can help ourselves and others. We need solutions that scale effectively, from individual emergencies to global emergencies, on both ends of the spectrum: formal macro (e.g. many levels of government working together to address major needs) and informal micro (e.g. individuals and local organizations helping each other). We lead our individual lives with the aid of ties, relationships, tools and processes that bind us to our family, employer, church, charity, organization, city, county, and state; and yet, when an emergency threatens one of us, or many of us, we come together across all boundaries, rapidly forming new ties and families, to help each other in an emergency. Our challenge is to do this more effectively.

How do we address this challenge? What will the world be like if we do?

An Emergency Management Framework is designed to address both formal and informal needs. Formally, frameworks enforce and standardize solutions to problems. Informally, frameworks make these standardized solutions easy-to-use and empowering for individuals. A framework is liberating and empowering for the individual, yet leverages the more formal resources, support and best practices derived from our organizations.

The overall challenge of emergency management, to marry the formal resources and practices of our organizations with the agile informal empowerment of individuals, deserves to be addressed with an emergency management framework. The authors describe in this paper a proposed open source initiative for building this emergency management framework in partnership with the emergency management community. You and your organization are vital to the success of this initiative. We hope you will join, support and guide this initiative.

# Definitions

The envisioned Emergency Management Framework (EMF), perhaps better called the Emergency *Information* Management Framework, is software to enable management of emergency information across jurisdictional and organizational boundaries to empower individuals and organizations to organize themselves rapidly to address basic emergency challenges. The individuals who are organizing themselves may be known or unknown to each other before the emergency occurs. For this purpose, an emergency is any situation where individuals believe *important* actions need to be, or will need to be, taken *immediately*. Management means information needs to be created, retrieved, updated, deleted, or shared with others to address (prevent, avoid, lessen) the emergency. A framework is software enforcing standardized best practices, enabling ease-of-use of complex technology, and empowering individuals and organizations to use and tailor the technology for their own needs.

Note that a software “framework” includes but goes beyond a software “library.” For purposes of our discussion, a software library aggregates a set of software capabilities for a given domain with an application programmer interface (API) focused on helping developers more easily find and use the underlying complex technology; however, a framework goes further to aggregate software libraries for higher-level ease-of-use, more stand-alone, and more accessible to novices, often by providing needed contextual infrastructure such as a web server or a datastore, higher-level commands, command-line interfaces and/or graphical front-ends.

Basic emergency challenges include all phases of emergencies, including preparing, reacting, and recovering. Basic emergency challenges for preparation could include assembling information regarding an individual’s: health (medications, blood type, allergies); special needs (disability, language, dependents); pets and animals; resources available to help others (e.g. ability to house animals, ability to speak multiple languages); and contact information for other individuals in the group (family, friends, neighbors, organization). Basic information for reacting to an emergency could include alerting others of the emergency, requesting assistance, offering assistance, locating people, reporting status, informing authorities, sharing recommended actions and related information. Basic information for recovery could include people impacted, level of impact, immediate needs, location, status, and the schedule of next steps, activities, points of contact, and responsibilities and how that will be allocated and distributed.

# Purpose

1. The goal of the EMF initiative is to build a reference implementation of the EMF to demonstrate, evolve, test, and validate the EMF vision, i.e. that the use of information standards can be married with agile technologies to help solve the emergency management challenge. From such a reference implementation, industry partners could build a production version of the EMF.

Two challenges for emergency managers are (1) maintaining the attention and support of the broader community in between major emergencies; and (2) overcoming the general mindset that there is not much one can do to prepare to help themselves or others. These challenges are not easily addressed by solutions or systems which only support occasional mass emergencies and have no personal, day-to-day usefulness to the ordinary person. Any solution seeking wide adoption would benefit from recognizing that emergencies can be everyday, personal and local as well, and that the notion of an “emergency” requiring rapid information sharing and assistance is relative. Even large, mass emergencies break down into a collection of personal, local emergencies. The ideal framework would scale and support both local, personal emergencies that occur regularly day-to-day all the way to large, mass emergencies.

One vision of how the EDXL standards could support broad everyday use and adoption on the front end is described in a previous paper focusing on the integration of EDXL standards in smart devices. See https://www.oasis-open.org/committees/download.php/54960/EverydayEDXL\_ver\_1c.pdf. As described there,

*“From individual , local emergencies (e.g. a lost child , a heart attack, a car accident, a water main break) to large, global emergencies (e.g. an earthquake, a flood , a hurricane, an epidemic), … all of us are silent partners who support each other in one manner or another, directly and indirectly, every day as we prepare for, are victimized by , assist with, donate to, and manage emergencies. In this sense, we are neighbors. We should be ready to help each other in an emergency. …[EDXL] can be incorporated natively into smart devices to provide the scalable, immediate, organized, and structured support for integrating emergency support seamlessly from public officials to ordinary citizens.”*

The EMF would be the reference implementation of this capability, enabling the needed backend infrastructure as well.

# Principles

The Emergency Management Framework initiative is based on founding principles which guide the effort. Principles are fundamental truths or propositions that serve as the foundation of a system of belief or reasoning. Principles can be used to assess what capabilities need to be developed and to measure the value of particular solutions. The EMF components, architecture and technology should support these principles. When measuring success, an EMF implementation is more successful to the degree it satisfies these principles.

*Principle #1:* *Individuals should control their own data.*

Individuals should control how much of their data, if any, and the type of data shared in an emergency. Individuals should control with whom the data is shared, if anyone, and when the data is shared and for how long the data is shared. Access and use of the individual’s data should be audited and accessible to the individual.

*Principle #2:* *Individuals should be empowered to organize themselves and share information to support each other in an emergency.*

Individuals should be supported with information sharing and command & control capability to organize themselves, accept tasks/responsibilities, work together and support themselves in an emergency, independent of any third party organization.

*Principle #3: Smart solutions should enable rapid sharing of emergency information with those who need it independent of organizational or governmental affiliation.*

Emergencies don’t respect government or organizational boundaries. For example, an auditing policy (to enable after-the-fact review and accountability) may be favored over Permission-based access because it enables more flexible and rapid information sharing. Pre-planned smart routing rules are recommended.

*Principle #4: Any and all levels of “emergency” should be supported, from large scale national emergencies to regional/state emergencies to neighborhood/family emergencies and individuals should be able to extend and define their own types/levels of emergency.*

Emergencies can be small or large and even large emergencies have a disparate impact, where some individuals or communities are majorly impacted, while other individuals or communities are unscathed. Eventually, all emergencies are local and individual. For an EMF to be relevant, familiar, and empowering to a specific individual in a specific emergency, it should be relevant, familiar and empowering across a broad range of emergencies to that individual on a day-to-day basis. (Think of a telephone as opposed to a fire extinguisher. I use a telephone every day for many purposes, including minor personal “emergencies”, I am familiar with its use, and I’m empowered by it. A fire extinguisher I never use, it’s use is limited to small fire emergencies, I’m not very familiar with how to use it (since I’ve never used one), and it doesn’t empower me day-to-day. )

*Principle #5: All phases of an emergency should be supported, including planning, situation awareness, action, assessment and recovery.*

All phases of an emergency are inter-connected and important for complete recovery, for building trust, and for being prepared to respond quickly and effectively to immediate needs. Action needs preparation. One cannot take quick and effective action without being prepared to do so. Action is ineffective without recovery. A quick and effective response is temporary and futile if the victims are left stranded and abandoned in the recovery effort.

*Principle #6: Smart devices should speak a common emergency language that is interoperable, flexible and extensible to meet basic emergency needs.*

The EMF should use machine-understandable formats for representing information for sharing and management with smart devices among individuals, organizations and governments.

*Principle #7: The EMF should include working software, including both front-end clients running on smart devices and back-end support services, providing a working example of how to represent, manage and share information to address basic emergency needs.*

The EMF should provide working software as a framework, in the form of a reference implementation, enabling a **common emergency language** (machine-understandable), a **smart information routing** capability to support sharing, and a **basic management capability** to support common emergency needs, such as alerting, organizing, situation reporting, locations of victims/patients, and information and resource sharing.

*Principle #8: The EMF should be an open-source, community effort, supported by, but independent of, any third party organization or government.*

Open-source software is code released under a license in which the copyright holder grants users the right to use, study, change and distribute to anyone for any purpose. Open-source initiatives are collaborative development efforts between multiple independent contributors which increases the scope of design perspective. Open-source efforts can lower the total cost of ownership, improve the quality of software, enforce modern software development practices, avoid vendor lock-in, improve security, allow greater control than proprietary systems since you have the code and the ability to patch, provide a force multiplier with more developers, users and use cases explored, more modular, attracting more talent and more awareness. See <https://opensource.com/life/15/12/why-open-source> Open-source efforts are particularly useful when the initiative, like the EMF, is by its nature cross-organizational, i.e. when there is no one governmental entity or organization responsible for the problem being addressed. All major technical organizations participate in open source efforts. In most open-source efforts, users are treated as co-developers, early releases are encouraged, code changes should be integrated often and automatically, with a dynamic decision-making structure. Open-source offers the opportunity for more flexible technology and quicker innovation. See <https://en.wikipedia.org/wiki/Open-source_software>.

*Principle #9: The EMF should provide an open architecture, e.g. open formats, APIs and plug-in capabilities, to enable individual users, organizations, third party developers and industry partners to expand, support, and extend basic EMF capabilities, including data formats, emergency types/levels, information packages and routing rules, and to leverage existing capabilities, e.g. social media, and facilitating public service initiatives, e.g. NIEM, FirstNet.*

The EMF is foundational software enabling basic emergency information management. The capabilities enabled by the EMF are intended to be expanded and extended by other efforts. The EMF capabilities should be accessible and EMF information and services should interoperate with existing capabilities and emerging public service initiatives. In this manner, the EMF is not an alternative approach, competing with other initiatives, but instead a basic foundation, interacting with and supporting other initiatives.

*Principle #10: The EMF should be freely available to all at no cost.*

Together, these principles amount to converting the familiar, proprietary, centralized and monetized information sharing solutions which we use everyday on our smart devices for our own individual non-emergency purposes -- and harnessing a similar capability but in a non-proprietary, free, democratic manner to empower individuals (as well as organizations) to organize themselves and share information in an emergency, i.e. for an important, temporary, specific purpose that needs to be accomplished now.

# Status

An Emergency Management Framework needs modern information sharing technology and the formal grounding that comes from standards that ensure clarity and rigor in our communication. Let’s consider for a moment the state of emergency standards.

The emergency management community, including our local, regional, state, tribal and federal authorities, along with industry partners and charitable organizations, work each day individually and together to build emergency management systems, standards, and processes for guiding people, organizing resources, and sharing information in an emergency. Recently, OASIS, in collaboration with the HL7 community, updated key standards in the Tracking of Emergency Patients (TEP) and Hospital Availability (HAVe). OASIS and partnering organizations focus on understanding and standardizing the emergency information which drives emergency management, including situational awareness reports, alerts, resource requests, location of people, and hospital status. See <https://www.youtube.com/watch?v=7eoV5XwZVO8&t=5s>. These standards address the basic questions we all have in an emergency. What is happening? Who is threatened? What should we do? Where should we go? Where are my neighbors and loved ones? Who needs help? Where can I get assistance? How can I help?

One important EDXL standard is about to be revisited and tailored as part of the initiative to build the Emergency Management Framework: the Distribution Element (DE). The DE is a standard designed to package and route emergency information. For a quick overview of the DE, see <https://www.oasis-open.org/committees/download.php/49303>. The DE packages both formal and informal emergency information, from situation reports and alerts to pictures, links, and text, enabling support for both organizations and individuals to ensure they can flexibly package any information needed to be shared in an emergency. Information is the lifeblood which must flow effectively and efficiently wherever it is needed. The DE is designed to optimize this information flow by providing the hooks, the metadata, needed to enable an emergency management framework to work successfully. It’s appropriate that OASIS and the emergency community revisit and update the DE as part of the development of the EMF, since the DE can support and enable EMF smart routing.

Advancements in hardware/software technologies and frameworks will also support the EMF initiative. Smart phones with sensors, audio/video capture, apps, social media sites, cloud platforms, mesh networks, containers, microservices, blockchains, open source platforms … all of these advances can contribute to improved routing and sharing of emergency information. The EMF initiative can learn from and leverage other examples of successful framework initiatives in the software industry for web services, big data and machine learning.

An example of a useful emergency software library is the Common Alerting Protocol (CAP) Library (see <https://github.com/google/cap-library> ). This library is software that enables developers to create, parse and validate CAP, one of the family of EDXL emergency messages. Such a library makes these tasks easier for developers, but at the same time enforces the standardized format. The library leverages existing formats, e.g. KML, JSON, XML, as well as existing industry capability to enhance flexibility, e.g. Google Protocol Buffers. The beginnings of using this library in a framework are demonstrated by the CAP Library initiative at the validation site (see <http://cap-validator.appspot.com/validate#r> ). Here one can see a web-based graphical interface, leveraging existing industry mapping and data representation capability, e.g. Google Maps and Protocol Buffers, where a standardized CAP message can be selected (or pasted in) and if valid, the message is displayed on a map enabling situational awareness for ordinary users. The excellent work done with the CAP software library and validation site helps to inspire and motivate the EMF, which would enable a software library (or libraries), and extend the framework concepts, for the complete suite of basic emergency capabilities and for the further implementation consistent with the EMF purpose and principles.

OASIS plans to contribute its own initial software, the EDXL Framework Toolkit, to the EMF initiative. (See <https://www.oasis-open.org/events/sites/oasis-open.org.events/files/2.2%20EDXL%20Framework%20Toolkit.pdf> ) The EDXL Framework Toolkit is intended to include a software library for creating, reading, and validating the complete suite of EDXL messages, with graphical interface components for visualizing, creating and editing EDXL messages. The Toolkit components provide examples of how to create, visualize, persist, and query emergency information in standardized formats to handle basic emergency needs.

There are many other important emergency stakeholders and initiatives underway, all of which provide guidance and can be leveraged to expand, extend or support the EMF vision and capability. Such initiatives include: Emergency Incident Data Document (EIDD), a standard for emergency dispatch; VirtualUSA, a program designed to facilitate the exchange of datasets across jurisdictional boundaries in support of emergency management; DHS SAFECOM, a program organizing public safety working groups and publishing recommendations and guidance; FirstNet, an independent authority within the U.S. Department of Commerce, developing, building and operating a nationwide broadband network to support first responders in an emergency. For an excellent overview of emergency interoperability initiatives and guidance, as well as the continuing challenges, see the NIST paper, Voss, B., Anderson E., “Interoperability of real-time public safety data: Challenges and possible future states” (2018).

# Tasks, Schedule & Cost

The EMF initiative needs to be collaborative, open, and focused. A three-year effort is envisioned with three phases: Year 1: Establish the cloud-based open-source EMF and Mobile App, Evolve the DE, Design Target Scenarios; Year 2: Extend the EMF, EDXL Family of Standards and Formats to Address the Scenarios; Test the EMF Against the Target Scenarios; Year 3: Extend the EMF with Industry Partners; Encourage Adoption

***Open-source EMF and Mobile App (Year 1: FY20)***

First steps are the establishment of the EMF open-source initiative with initial community open-source contributions. OASIS looks forward to supporting the establishment and plans to contribute software, scenarios, requirements, architecture concepts, and standards recommendations. An initial EMF planning session will be scheduled for mid-FY19. An initial version of an EMF web service and mobile app would be one of the prime deliverables of this effort. The app would address the initial key tasks for individuals to describe individual needs, capabilities, routing rules, and information packages.

1. Key components of the EMF architecture should include:
2. \* A Web-based Graphical Interface to Create, Retrieve, Update, and Delete Emergency Information
3. \* A Persistence Solution Bridging SQL, NoSQL, and Semantic Technologies
4. \* Support for Agile Development, Big Data, Machine Learning, and AI
5. \* A Scalable and Rapid Information Pipeline for Distributing & Sharing Emergency Info
6. \* A Smart Software Router Tailored and Designed to Leverage the DE

***Extend the EMF, EDXL Family of Standards and Formats to Address the Scenarios and Test (Year 2: FY21)***

Second steps are the extension and tailoring of the EMF and the EDXL standards, in particular the Distribution Element (DE), to ensure the packaging and addressing of emergency information for routing is aligned with the EMF reference implementation demonstrating how an infrastructure can support the smart routing use cases. Testing of the EMF capability, i.e. the app, the software, the standards, the use cases, will also be a focus for this effort.

***Extend the EMF with Industry Partners; Encourage Adoption (Year 3: FY22)***

Third steps are to extend the EMF capability with Industry Partners who would develop commercial capability to interface with the EMF data and services. Adoption of the EMF will be encouraged and supported through developers’ workshops and user engagements.

Estimated cost of the EMF open-source initiative is $3M per year or roughly 12 Full-Time Equivalents (FTE). The cost is 90% software labor which can be provided in kind, e.g. as companies recognize the value of leading and leveraging and extending their technologies, concepts and expertise in this domain and how this assists their business models; however, the key stakeholders will also prepare proposals and perform reachout to funding organizations to seek investment in this critical area.

# Conclusion

Individuals need to and actually do organize themselves and share needed information in an emergency to help save and protect themselves, their loved ones, their friends, neighbors and often complete strangers. The safety and protection extends to homes, animals and property. Individuals offer assistance and aid. Individuals have special needs, allergies, disabilities, dependents. The emergencies don’t respect traditional work, organizational or governmental boundaries, so the organizing efforts must be quick, flexible, and cross-organization and cross-government. Individuals and their local friends, neighbors, colleagues, leaders must have the tools they need to get emergency information to those who need it.

This paper recommends an open-source Emergency Management Framework (EMF) initiative, combining a common emergency language with smart technologies, to enable faster, more reliable, more standardized and more effective organizing and sharing of emergency information. The EMF should be enabled following a set of principles that emphasize respect and empowerment of individuals and their rights for access and control of their data. The EMF will recognize the community aspect of emergency management to build the mutual trust needed for cross-individual, cross-organization, and cross-government information sharing for comprehensive, unified emergency management across all phases of an emergency, e.g. preparation, action, assessment and response.

The EMF will make emergency organizing and information sharing easier, more standardized, more automated, and more useful to save and protect human lives, animals, homes and property.

You and your organization are vital to the success of this initiative. Please indicate your interest, support and feedback by contacting the OASIS Emergency Management Technical Committee Chair, Elysa Jones (elysajones@yahoo.com ).

# References

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# APPENDIX A: FAQ

1. What is an Emergency Management Framework (EMF)?

The EMF is envisioned software to enable individuals (and organizations) to organize themselves and share information needed to prepare for, act, assess, or recover from an emergency, i.e. an important threatening event.

1. Why do we need an EMF?

The EMF is needed because individuals from different communities, neighborhoods, organizations, and governmental entities need to work together in an emergency and current information repositories and information sharing solutions are limited, proprietary, commercial, centralized, insecure, with little individual control, and no common emergency language.

1. Who will use an EMF?

The EMF will be used by everyone everyday, because emergencies can be big or small and everyone deals everyday with small emergencies, is threatened by medium emergencies, and worries about large emergencies. The EMF is designed to support individuals for all types of emergencies, across all phases of emergencies, including preparation, action, assessment and recovery.

1. How much will the EMF cost?

The EMF will be free to download and use. The EMF will cost approximately $3M / year for three years to develop. The EMF will cost approximately $1M / year to maintain.

 … to be continued …