

# Conversion of Emergency Alerting Message Based on Common Alerting Protocol (CAP)

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**Abstract.** This paper presents conversion of an emergency alerting message based on Common Alerting Protocol (CAP) to an HTML document and an Automatic Emergency Alerting Service (AEAS) message for T-DMB. The CAP was originally created for information exchange between various disaster management organizations. Hence, it is necessary to convert a CAP document for the delivery to general public. A brief overview of the CAP and AEAS is presented. Next, the implementation detail of the conversion is described. For CAP-to-HTML conversion, XSLT technology is used. The main problem is how to select appropriate information from a CAP document. For CAP-to-AEAS conversion, XML DOM is employed. The main obstacle to the conversion is how to deal with the AEAS message constraints, such like message length, and the number of area codes. Finally, implementation examples for the two conversions are presented. The implementation can be applied to the future system design for AEAS broadcasting stations.

**Keywords:** CAP, Emergency Alerting, Public Warning, T-DMB, AEAS

## 1 Introduction

One of the important applications of the information convergence technologies is the disaster management system (DMS). Disasters are ubiquitous in all aspects of our lives. If anything, natural or artificial, goes too extreme, it can be disastrous. The DMS should prepare for the possible disasters: gathering data from sensors; storing the data; processing the data; and delivering information to the other DMSs. For effective disaster warnings, DMSs should be tightly connected together and information about the disasters should be distributed to the community of the DMSs. A common exchange protocol, which supports various types of disasters between the DMSs, will facilitate the communication.

For disaster warning to general public, broadcasting systems have been used as the main infrastructure for the delivery, because of its efficiency and reliability. Most countries developed disaster warning standard for analog TV and radio broadcasting [1]. Digital broadcasting as well as the Internet has flourished during the last decade. Also, broadcasting with various kinds of networks, such as terrestrial, cable, and satellite, is quite common these days. Especially, broadcasting for mobile reception

such as digital multimedia broadcasting (DMB) is an effective candidate system for the delivery of disaster warning message in all or specific areas. Automatic Emergency Alerting Service (AEAS) is the standard for delivering disaster warning via terrestrial DMB network [2].

The advent of the digital age and the various broadcasting networks complicate the disaster warning procedure. In order to simplify the disaster warning, disaster issuing organization should send a common message to all broadcasting stations, where each station converts the message for the one appropriate to the network [3].

Common Alerting Protocol (CAP), developed by OASIS, is an XML-based format for exchanging various disasters over all kinds of networks [4]. CAP allows a consistent warning message to be disseminated simultaneously over many different DMSs, thus increasing warning effectiveness while simplifying the warning task.

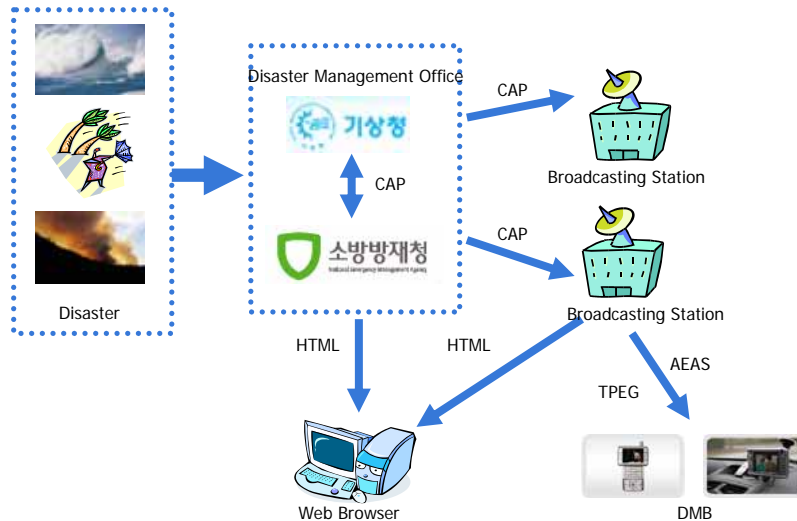
Since the CAP is XML-based, it is in machine-readable format. CAP is a standard for message exchange between DMSs rather than to general public. The final destination of the disaster warning should be of those who will be faced with the disaster and will need immediate alert. Therefore, it is necessary to convert the CAP message to the format that is readable by human or by special receivers. This paper presents conversion methods for CAP messages into HTML and AEAS messages, which is readable by Web browsers and T-DMB receivers, respectively.

We begin with an example scenario and a brief overview of the CAP and the AEAS. Next, we describe the conversion methods to the HTML and AEAS message, followed by screen shots of developed software. We conclude with the plan for further study.

## **2 Background**

### **2.1 An Example**

Fig. 1 shows an example of the information flow in case of a disaster, e.g. a typhoon. The National Weather Service (NWS) gathers data and provides essential information to other disaster management office. The National Emergency Management Agency (NEMA), upon receiving the information from the NWS, determines whether to alert general public in the area of concern. When NEMA decides to declare an alert, it sends appropriate information, in the form of CAP, to broadcasting stations. The broadcasting stations will convert the CAP message to the proper broadcasting formats. The CAP document can be translated into an HTML document and disseminated by the Internet or other data broadcasting such as Broadcasting Web Service (BWS) in T-DMB.



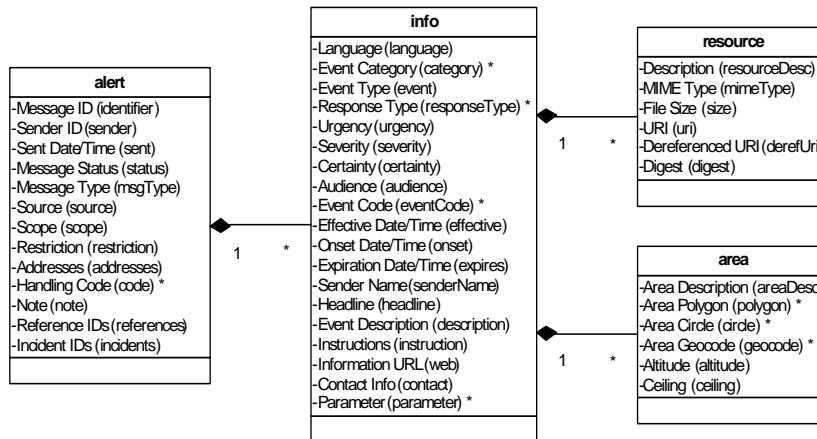
**Fig. 1 Information Flow of Emergency Alerting Message**

## 2.2 Common Alerting Protocol (CAP)

The CAP is a general format for exchanging all-hazard emergency alerts and public warnings over all kinds of networks. Fig. 2 shows the structure of the CAP message. A CAP message consists of four segments. A segment is a set of related elements. <alert> segment is for the management of the message rather than the information itself. <info> segment contains the detailed description of the event. If additional contents are available, <resource> segment carries either the contents or the links of the contents. <area> segment describes the area under consideration. It supports various spatial representations.

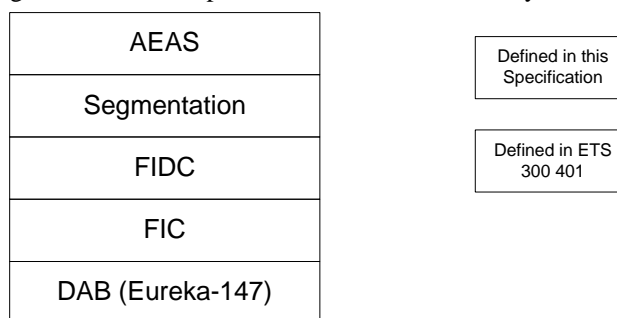
## 2.3 Automatic Emergency Alerting Service for T-DMB

The T-DMB provides mobile and personal service to the general public. Some receivers are combined with cellular phone and some are installed in an automobile usually with a navigating device. The T-DMB is believed to be ideal for the emergency alert with automatic activation. Since 2005, Korea developed a standard for the Automatic Emergency Alert Service (AEAS) to protect lives and properties of people using Terrestrial Digital Multimedia Broadcasting (T-DMB) system.



**Fig. 2 Structure of CAP Schema**

The main purpose of AEAS is to alert people in danger immediately. The AEAS message is short and contains only essential information for the alert. The standard specifies the following: definition of emergency message, i.e., AEAS message; the signalling and delivery method of the AEAS message using T-DMB; and functional requirements of T-DMB AEAS transmitting system and the AEAS receiver. The AEAS message format is designed to be short with essential information for swift delivery. In serious situation, detailed information, such as event descriptions and evacuation instructions in text or in other multimedia format, will be followed in other services. The AEAS message format provides fields for the short text message and/or the external links. The AEAS provides targeted service according to the location of the receiver. Fig. 3 illustrates the protocols stack for the delivery of AEAS.



AEAS: Automatic Emergency Alert Service  
 FIDC: Fast Information Data Channel  
 FIC: Fast Information Channel

**Fig. 3 Protocol Stack for the Automatic Emergency Alert Service**

An AEAS message contains information associated with an event, e.g. natural disasters and incidents. Table 1 illustrates the structure of the AEAS message.

**Table 1.** AEAS Message Format

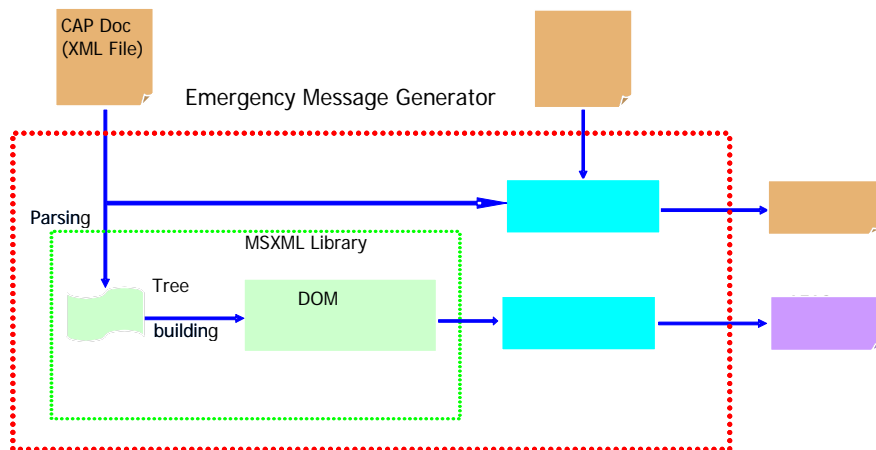
EventCode	Priority	d&t	tGeocode	nGeocode	rfu	Geocodes	Desc&Link
3bytes	2bits	28bits	3bits	4bits	3bits	variable	variable

### 3. Conversion

Two factors should be considered for the conversion of CAP message. One is how to select appropriate information from the CAP message for the conversion. The other is to choose the proper conversion technologies. Each field in a AEAS message is created as defined in the standard. That is, the target format is well-defined. However, when converting to an HTML, there are no specific guidelines how to select information. The selection may depend upon the stage of disaster management, e.g. disaster warning/mitigation/relief.

There exist many technologies to transform an XML document into another format. XSLT is a language to translate an XML document to another XML document or an HTML document [5]. XML DOM is a set of APIs to access elements of an XML document [6]. Since AEAS messages are in a binary format, it is necessary to use the XML DOM technology in order to convert a CAP message in an AEAS message.

Fig. 4 illustrates the structure of the converter developed in this study. We designed XSLT Style sheets for CAP-to-HTML conversion. For CAP-to-AEAS conversion, the CAP document is first parsed into a DOM tree, using MSXML library [7], then the AEAS message generator create an AEAS message.



**Fig. 4** Structure of CAP Converter

HTML documents are the most useful format for the Internet dissemination. They can also be delivered using Broadcasting Web Service (BWS) in T-DMB. As such, HTML documents are for the “user-pull” delivery, i.e. the information is initially requested by people. Hence, they are not suited for “user-push,” e.g. disaster warning or alerting. However, once people are alerted to the disaster situation, they will be interested in gathering more information. The HTML documents will be useful for gather additional information after the acknowledgement of the disaster alert.

We have created CAP messages from the disaster warning message posted on the NWS Web site. Fig. 5 illustrates the original CAP message and the resulting Web page showing the converted HTML document with the XSLT style sheet.

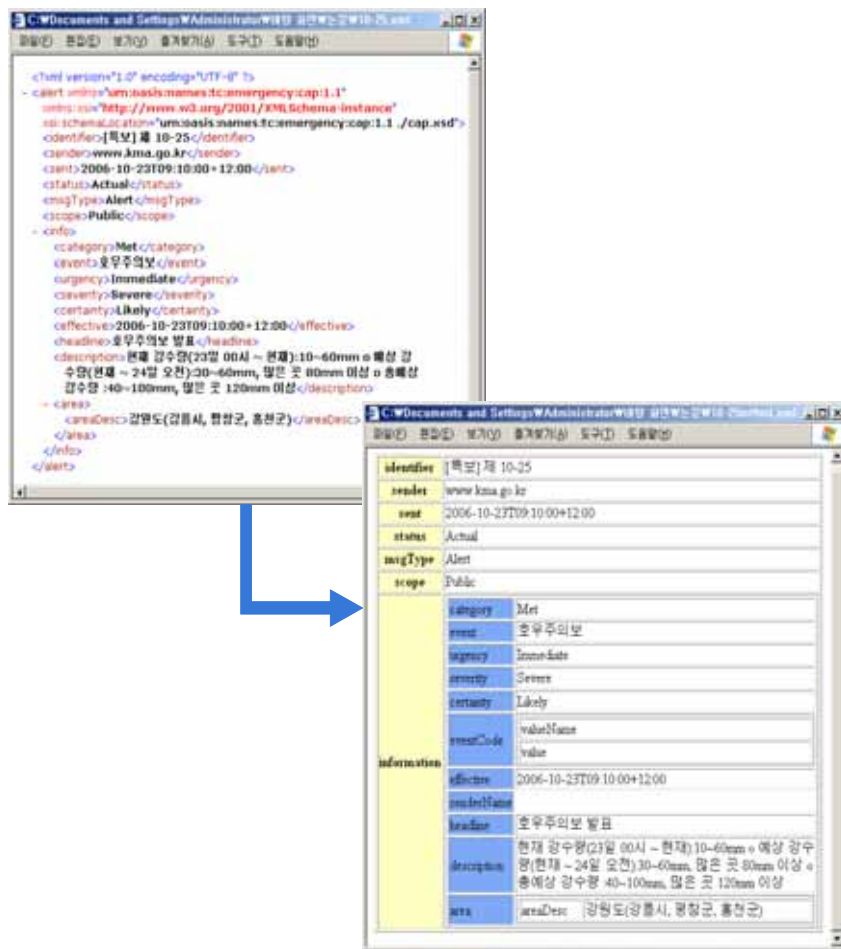


Fig. 5 Conversion to HTML Message

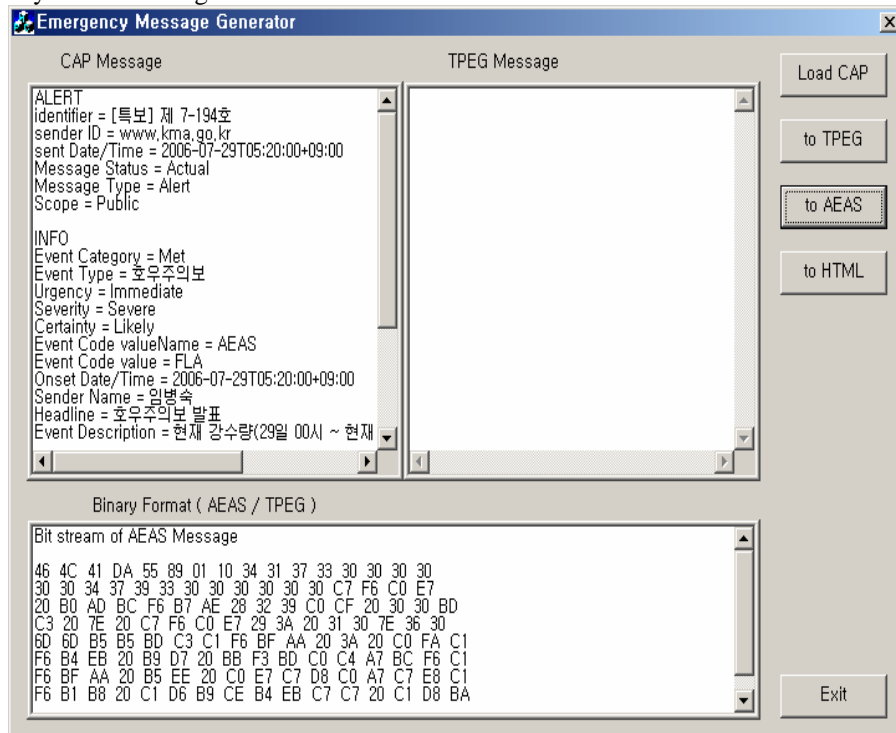
The AEAS standard defines the semantics and the syntax of each message field. In order to convert to an AEAS message, a CAP document should include the following additional constraints:

1. The event code should be expressed as defined in the AEAS standard.
2. The area code should be expressed in terms of ten-byte national region code.
3. The maximum number of area code is sixteen.
4. The maximum size of an AEAS message is 416 bytes.

The first three constraints can be expressed in terms of an XML Schema. For example, <event> element should include three byte event code defined in the AEAS standard. However, the last cannot be expressed with an XML Schema.

The priority field in the AEAS does not have a corresponding element in the CAP Schema. Instead, the CAP has three elements, <urgency>, <severity>, and <certainty>, that distinguish less emphatic from more emphatic messages. There can be many approaches how to map these three elements into the priority. We devise a method to calculate the priority. Each of the three elements has five levels. We assign zero to the less emphatic level and 4 to the most emphatic level. Then, we find the average of the three elements. The average is used as the priority in AEAS.

Fig. 6 shows an example that converts a CAP message to a binary AEAS message. Top-left frame shows the contents of the CAP message; the bottom frame shows the binary AEAS message.



**Fig. 6 Conversion to AEAS Message**

## 4. Conclusion

This paper presents conversion method of XML-based CAP messages to HTML messages and AEAS messages. The CAP message is for message exchange between disaster management systems rather than to the general public. Hence, it is necessary to convert CAP message for the general public. For CAP-to-HTML conversion, we employ XSLT technology. The selection of CAP elements for the conversion should be carefully implemented according to the disaster situations. To implement CAP-to-AEAS conversion, additional constraints imposed by AEAS are analyzed first. We employ XML DOM technology for the conversion.

The results of the study will be used for the UCT project for data exchange and for public warnings. Especially, AEAS conversion method developed in this paper will be essential for T-DMB broadcasting stations.

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