Emergency Messages in CMAS

Paul Ngo
PhD Candidate
George Mason University
Agenda

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• CMAS Limitations
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• Architecture Enhancement
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Brief Introduction to CMAS

• September 11 unfolded the reality that emergency workers in Federal, State, and Local governments were not able to communicate in orchestrating relief efforts and rescue operations due the extreme overload in telecommunication infrastructures.
• In 2006, the Federal Government established a Worker Adjustment and Retraining Notification (WARN) Act that supported the research and development of Common Mobile Alert System (CMAS).
• Utilize existing commercial telecommunication infrastructures to broadcast emergency alerts.
• Three types of emergency alerts being supported: Presidential, Imminent Threat, and AMBER alerts.
• Use emergency communication standard protocol: Common Alerting Protocol (CAP v2) standard.
CMAS Limitations

1. CMAS alert messages can not be broadcast to an area smaller than a cell site.
2. CMAS disseminate only three type of alerts: Presidential, Imminent Threat, and AMBER alerts. Local emergencies are NOT being addressed.
3. CAP 1.2 was designed for emergency communication between different levels of government. Most of information in the CAP 1.2 message structure was irrelevant for emergency mobile broadcast.
4. CMAS broadcast message size limits to only 90 characters of clear text. Plus, CAP 1.2 is used as the communication protocol. CAP is in XML format and verbose. Therefore, this limitation restricts emergency responders to disseminate necessary information of impending emergencies.
Considerations for Enhancements

- Standards & Technical Specifications in Telecommunications
  1. In 2003, OASIS sponsored the Common Alerting Protocol (CAP) initiative with the objective of providing fundamental messaging protocols to facilitate inter-agency emergency communications.
     - In March, 2004, CAP 1.0 was released.
     - In October, 2005, CAP 1.1 was released with some corrections.
     - In July, 2010, CAP 1.2 was released after three major provisions.
  2. CAP message structure was built on XML, which was quite verbose.
  3. According to the Technical Specifications of GSM, UMTS, LTE Cell Broadcast Service (CBS), there are no features or options that could be configured to support the broadcast of alert messages for a smaller area than a cell site.

- Emerging Technologies
  1. Improving bandwidth in Access networks, 2G, 3G, now 4G.
  2. Improving handheld devices in terms of processor speed, battery power, screen resolutions, internet enabled.
  3. Smart phones and IPhones are capable of running services and applications.
Architecture Enhancement
Just-In-Time Encoding

In order to encode this CMAS alert message, we need a mapping (codepage) of all the tag names, attribute names, and their static values.

In order to decode, we need a codepage and an entity that has the knowledge about this mapping and the ability to decode this message.

```xml
<?xml version = "1.0" encoding = "UTF-8"?>
>alert xmlns = "urn:oasis:names:tc:emergency:cap-cmas">
  <identifier>CMAS-01</identifier>
  <status>Actual</status>
  <info>
    <category>Met</category>
    <urgency>Expected</urgency>
    <severity>Severe</severity>
    <certainty>Observed</certainty>
    <expires>2010-10-02T17:00:00-0500</expires>
    <description>Multiple tornados are expected around 2PM in the Washington, DC area.</description>
    <affectedarea>1000</affectedarea>
    <spreadable>No</spreadable>
    <event>Tornado</event>
    <location>
      <lat>38.882334</lat>
      <lon>-77.171091</lon>
    </location>
  </info>
</alert>
```

Figure 2: CMAS Mobile Alert Message – Tornado Example
Just-In-Time Encoding (cont.)

**Advantage:** Great flexibility

**Disadvantage:** Still a little verbose due to tag and attribute name encodings.
Predefined Encoding

Requirements:
1. A mapping (codepage)
2. CMAS Alert message format

```xml
<?xml version = "1.0" encoding = "UTF-8"?>
<cmas-format>
  <alert order="1" tagbits="1" tagtype="static">
    <identifier order="2" tagbits="2" tagtype="text"/>
    <status order="3" tagbits="2" tagtype="static" valuebits="3"/>
    <info order="4" tagbits="2" tagtype="static">
      <category order="5" tagbits="4" tagtype="static" valuebits="4"/>
      <urgency order="6" tagbits="4" tagtype="static" valuebits="3"/>
      <severity order="7" tagbits="4" tagtype="static" valuebits="3"/>
      <certainty order="8" tagbits="4" tagtype="static" valuebits="3"/>
      <event order="10" tagbits="4" tagtype="static" valuebits="5"/>
      <spreadable order="11" tagbits="4" tagtype="static" valuebits="1"/>
      <expires order="12" tagbits="4" tagtype="static" valuebits="32"/>
      <description order="13" tagbits="4" tagtype="text"/>
      <affectedarea order="14" tagbits="4" tagtype="int" valuebits="32"/>
      <location order="15" tagbits="4" tagtype="parent">
        <lat order="16" tagbits="1" tagtype="float" valuebits="32"/>
        <lon order="17" tagbits="1" tagtype="float" valuebits="32"/>
      </location>
    </info>
  </alert>
</cmas-format>
```

**Advantage:** Eliminate 100% verbosity = more information.

**Disadvantage:** Not very flexible. Always rely on the CMAS alert message format, which must be communicated to both encoding and decoding entities ahead. Potential problem at real time.
## Experimental Evaluation

<table>
<thead>
<tr>
<th>Encoding Algorithm</th>
<th>Tornado Alert</th>
<th>Encoding Length</th>
<th>Base64 Encoding Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBXML</td>
<td>179ms</td>
<td>267 bytes</td>
<td>356 bytes</td>
</tr>
<tr>
<td>Prime Power</td>
<td>Infeasible</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MXML - Predefined</td>
<td>160ms</td>
<td>98 bytes</td>
<td>132 bytes</td>
</tr>
<tr>
<td>MXML</td>
<td>158ms</td>
<td>118 bytes</td>
<td>160 bytes</td>
</tr>
</tbody>
</table>

Table 1: Performance Evaluation Summary
Related Works

1. Emergency Notification at the organization level
   • Reply on the telecommunication infrastructures to deliver alerts to their subscribers.
   • Put a massive burden on the bandwidth when large scale emergency strikes. Potentially cause a grid lock on mobile services.
Conclusion
Conclusion

Figure 9: Off the Emergency Affected Area

Figure 10: Inside the Emergency Affected Area