Using Ontological Information to Ensure Responder Availability in Emergency Response

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Agenda

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Problem Statement

• In any emergencies, urgent task-related communication must reach key officials in a timely manner.
• Contacting the person in charge of a specific task can be difficult.
• No automated method existed today of call redirection.
• If the key person is not available, the communication breaks down.
• OASIS developed standards for interagency exchange of emergency management data and messaging: CAP & EDXL.
Related Works

- Li et al. [1] proposes an ontology for crisis management, which defines a common set of vocabularies to facilitate an effective communication.
- Yu et al. [2] illustrates a good use of Activity-First Method (AFM) to construct an emergency ontology for creating a decision support system from existing emergency documents and use cases.
- Malizia et al. [3] constructs an emergency ontology for event notification and system accessibility.
- Maio [4] proposes an open ontology to provide a great flexibility to extend into a mission-oriented ontology.
Universal Lexical Exchange (ULEX) defines the top sharable objects that can be formed into a coherent message. Although ULEX defines the sharable contact information, its objective is to provide the contact information for deployable systems and services.

Universal Core (UCore) is another Federal information sharing initiative that supports the national information sharing strategy among all federal departments and agencies.

Government Emergency Telecommunications Service (GETS) and Wireless Priority Service (WPS)

Common Alert Protocol (CAP) and Emergency Data Exchange Language (EDXL)
Enhancing EDXL for Responder Availability

Important considerations:

- CAP & EDXL were designed for multiple purposes.
- Tasks & Roles for Human Responders.
- The objective is to reach the human responders in most suitable capabilities.

Realistic Consideration:

- What if the responder is unreachable.
- Propose a lexicon/ontology that has a list of alternative roles
- Complain role to address the failure of these alternatives.
## Enhancing PBX Redirect Algorithm

### Roles and Tasks

<table>
<thead>
<tr>
<th>Role: Emergency Gas technician</th>
<th>Other Contacts</th>
<th>Contact Phones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks: (1) Licensed to shut down main valves, (2) (dis)connect household lines, (3) Repair valves</td>
<td>Email: <a href="mailto:emergency@gasexpert.com">emergency@gasexpert.com</a></td>
<td>Phone: 7031111111</td>
</tr>
<tr>
<td>zip codes 22222, 22221, 22223</td>
<td>SMS: 7031111111</td>
<td>Alternatives:</td>
</tr>
<tr>
<td></td>
<td>Response Window: 24 hours/day</td>
<td>7032222222</td>
</tr>
<tr>
<td></td>
<td>Estimated Response Delay: 20 seconds</td>
<td>7033333333</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7034444444</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7035555555</td>
</tr>
<tr>
<td></td>
<td>Email: <a href="mailto:emergency@gassol.com">emergency@gassol.com</a></td>
<td>Compliant: 7039999999</td>
</tr>
<tr>
<td></td>
<td>SMS: 7031110001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Response Window: 7AM to 10PM EDT, weekdays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9AM – 6PM EDT, weekends</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Estimated response Delay: 15 minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phone: 7031110001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternatives:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7031110002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7031110003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7031110004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliant: 7031110005</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Email: <a href="mailto:emergency@gaspro.com">emergency@gaspro.com</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMS: 7032220001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Response window: 6AM – 11PM EDT, weekdays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8AM – 10PM EDT, weekends</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Estimated Response Delay: 10 minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phone: 7032220001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alternatives:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7032220002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7032220003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7032220004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliant: 7032220009</td>
<td></td>
</tr>
</tbody>
</table>

### Other Contacts

- Email: emergency@gasexpert.com
- SMS: 7031111111
- Response Window: 24 hours/day
- Estimated Response Delay: 20 seconds
- Phone: 7031111111
- Alternatives: 7032222222, 7033333333, 7034444444, 7035555555
- Complaint: 7039999999

### Phone: 7031111111

#### Alternatives:
- 7032222222
- 7033333333
- 7034444444
- 7035555555

### Complaint: 7039999999

#### Email: emergency@gassol.com

- SMS: 7031110001
- Response Window: 7AM to 10PM EDT, weekdays
- 9AM – 6PM EDT, weekends
- Estimated response Delay: 15 minutes
- Phone: 7031110001
- Alternatives: 7031110002, 7031110003, 7031110004
- Compliant: 7031110005

### Phone: 7031110001

#### Alternatives: 7031110002, 7031110003, 7031110004

### Complaint: 7031110005

#### Email: emergency@gaspro.com

- SMS: 7032220001
- Response window: 6AM – 11PM EDT, weekdays
- 8AM – 10PM EDT, weekends
- Estimated Response Delay: 10 minutes
- Phone: 7032220001
- Alternatives: 7032220002, 7032220003, 7032220004
- Compliant: 7032220009

### Phone: 7032220001

#### Alternatives: 7032220002, 7032220003, 7032220004

### Complaint: 7032220009

#### Figure 2: Local PBX Redirection Algorithm

```java
public int makeEmergencyCall (Node role)
begin
    table = getTableFromRoleAttrs(role, getTasks())
    role = sort(table, getCurrentTime(), role)
    defaultContact = getDefaultContact (role)
    returnType = dial(defaultContact)
    if (returnType == Disconnect)
        begin
            listAlts = getNextAlt(listAlts)
            returnType = dial(listAlt)
            if (returnType == OK)
                break
        end
    if (returnType == Disconnect)
        begin
            compContact = getComplaintContact (role)
            returnType = dial(compContact)
        end
end
```
Ontological Enhancement

Figure 3: EDXL enhancement

```xml
<recipientRole>
  <valueListUrn>valueListUrn</valueListUrn>
  <value>value</value>
</recipientRole>
```
Example Application
Gas Leak

• A construction worker drilled an 8-inch hole into the gas line.
• Construction workers in the area immediately smelled a gas odor and called 911.
• The operator then notified the gas company, the county police and the fire department.
• Within a few minutes, the police and fire trucks came and blocked all roads in and out of the neighborhood.
• They informed the entire neighborhood to evacuate immediately.
• In response to this gas leak, the gas company had to consult gas experts in the area and finally after about 15 minutes, the gas company was able to talk to an expert on the phone and he decided to shut down the main gas pipe, which left 50 houses in the entire neighborhood without gas.
Example Application

![Diagram showing a sequence of actions for an emergency scenario]

Figure 4: Calls generated by example emergency scenario
Approach:
• Examine the current CAP message structure.
• Our additional tags to achieve the highest availability of the callee.
• Enhance the GETS/WPS
• Enhance the 911 System
Conclusion

• We have examined a collection of standards for emergency management messages and identified a short fall with respect to ensure the availability of the responders.
• We addressed this short fall by providing an enhancement in extending the EDXL language.
• We also suggested the applicability of this enhancement for GETS/WPS and local PBX.
• For the future work, translation of the pseudo names to addresses...
Reference


http://opensource.mit.edu/papers/TOWARDS_AN_OPEN_ONTOLOGY_FOR_ER.pdf