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PU	Public	✓
PP	Restricted to other program participants (including Commission Services)	
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Executive Summary

This document presents deliverable D4.2 (Mechanisms for Group-targeted Crowd Steering) of project FP7-614154 | CNPq-490084/2013-3 (RESCUER), a collaborative project supported by the European Commission and MCTI/CNPq (Brazil). Full information on this project is available online at <http://www.rescuer-project.org>.

Deliverable D2.4 provides the results of Task 2.4 (Group-targeted Crowd Steering). In this task, the use and implementation of so-called crowd steering messages within the RESCUER project is elaborated. Theoretical considerations such as special requirements with respect to the messages' recipients' cognitive load, governing law and actual use cases for crowd steering messages are presented.

Furthermore, practical details such as server side and client side implementation as well as technological implications regarding battery life and user privacy are described.

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1. Introduction

RESCUER aims to develop an interoperable solution (the RESCUER Platform) that will support emergency and crisis management in command and control centres to quickly handle emergencies based on reliable and intelligent analysis of mobile crowdsourcing information mashed up with open data. In brief, the RESCUER Platform encompasses four main components:

1. The **Mobile Crowdsourcing Solution** aims to support the communication between people at the incident place (eyewitnesses and operational forces) and people at the command and control centre.
2. The **Data Analysis Solutions** use several algorithms to filter and process data obtained from the crowd in order to extract the relevant information.
3. The **Communication Infrastructure** offers the required infrastructure (equipment and technology) in order to allow the information flowing among stakeholders.
4. The **Emergency Response Toolkit** is a set of solutions that receive crowd sourced information after the data analysis and support the command and control centres, e.g. showing the information in a clear manner using adequate visualization metaphors.

1.1. Purpose

The RESCUER project aims at developing a smart and interoperable computer-based solution for supporting emergency and crisis management, with a special focus on incidents in industrial areas and on large-scale events. The RESCUER solution will be composed of four main components, namely Mobile Crowd Sourcing Solution, Data Analysis Solutions, Emergency Response Toolkit, and Communication Infrastructure.

This deliverable presents the use of crowd steering messages – i.e. messages that are only received in certain geographic areas – within the RESCUER project. It furthermore elaborates on theoretical considerations such as the special requirements for crowd steering messages with respect to the recipients' cognitive load. Furthermore, actual use cases for crowd steering messages in the RESCUER project are presented in order to make the topic more tangible.

With respect to practical implementation details, the message format, client and server side implementation as well as the UI design employed for crowd steering messages are being presented in this deliverable. In addition to that, technical implications regarding battery life and user privacy are described.

1.2. Partners' Roles and Contributions

DFKI was coordinating for creating this deliverable. It was furthermore responsible for implementing the logic that makes sure that crowd steering messages are only received in a certain geographic area. Fraunhofer was responsible for gathering the materials regarding to message



recipients cognitive load as well as for designing the user interface. UFBA contributed to this deliverable by providing the materials for uses of crowd steering messages within the RESCUER project.

1.3. Document Overview

The remainder of this document is structured as follows:

- Chapter 2 describes theoretical background of crowd steering messages. It starts with giving a rationale for the use of location based message, defines a set of relevant messaging scenarios for RESCUER and elaborates on cognitive considerations. Finally, it presents the UI design for displaying crowd steering messages in the mobile crowd sourcing solution.
- Chapter 3 describes the actual implementation of crowd steering messages starting with a look on the server side and the employed message formats. Furthermore, the client side logic for delivering the messages only in the relevant geographic area is presented. The chapter is closed by a description of technical considerations with respect to battery consumption and user privacy.
- Chapter 4 draws a conclusion about this deliverable and Task 2.4 in general.

2. Theoretical Considerations

2.1. Use of Crowd Steering Messages within RESCUER

The main purpose of crowd steering messages within the RESCUER project is to send advice and warnings to users of the RESCUER mobile crowd sourcing solution. As advice is usually very context sensitive, those messages need to be carefully targeted at the correct group of recipients in order to not send irrelevant messages to users, which would undermine the credibility of the RESCUER concept. D1.5.2 has already elaborated on the technical capability to send messages only to a certain group of people based on their role within the RESCUER scenario (e.g., workforce, civilians, etc.).

The technical novelty of crowd steering messages is that they can also be sent to recipients who are located within a certain geographic area. This allows for great flexibility when it comes to sending advice to people on location. In case of a large-scale event for example, it is possible to send evacuation instructions to visitors based on their current location so that different parts of a crowd can be guided to different exits or escape routes. Implicitly, this means that the command and control centre gains the ability to “steer” the public to a certain degree – hence the name “crowd steering messages”. Another term for those messages that is going to be used loosely throughout this deliverable is “location based messages”.

The range of applications for location based messages is extremely wide, starting with simple service messages intended to better organize an event or proceedings on the premises of an industrial park and going all the way to vital evacuation instructions in case of an actual emergency. As the RESCUER project primarily focuses on dealing with incidents, this deliverable will only focus on use cases relevant for disaster mitigation and crowd control during an incident.

Crowd steering messages are exclusively sent by operators in the command and control centre using the ERTK. However, given that the RESCUER system implements a data analysis component which extracts and prioritizes relevant information from eye witness reports and also has knowledge about crowd behaviour (i.e. with respect to crowd density), a case could be made for automating the sending of crowd steering messages to a certain degree. This results in three potential methods of sending those messages:

1. Completely manual solely based on the ERTK operators’ experience.
2. Semi-automated in a fashion that would give suggestions to the ERTK operator on which instructions could be sent to which parts of a crowd based on analysis results from the RESCUER data analysis layer.
3. Fully automated sending of crowd steering messages based on analysis results from the RESCUER data analysis layer.

After careful consideration of the above alternatives, the RESCUER project decided to implement option number 1, i.e. following the completely manual approach. The reasoning for this decision is mainly based on safety concerns, as there is no guarantee that an automatic approach would be able to identify all relevant use cases for the sending of crowd steering messages. On top of that, the RESCUER system is too delicate with respect to public perception and public safety that the risk can be taken to send out messages, which may not be 100% reliable. In addition, during talks with the

end users it became apparent that they would not accept a system that would “tell them how to do their job” as first responders and command and control centre staff usually rely on decades’ worth of experience which cannot be built into a (semi-) automatic messaging system anyway within the scope of RESCUER. Last but not least, to the best of the author’s knowledge, there is no law or guideline to be found that would allow for messages of the nature of crowd steering messages (i.e. highly context and location sensitive) to be sent out automatically.

2.2. Cognitive Considerations

After having cleared the meaning and use of crowd steering messages as well as the way those messages are sent within the scope of RESCUER, it is now time to look at a set of guidelines for formulating and designing those messages.

During critical scenarios the recipients of crowd steering messages will be potentially under an enormous load of stress and therefore their cognitive capabilities may be heavily impacted. D2.1.3 deals with this general issue in detail. Based on this work, the following guidelines for crowd steering messages have been created:

G1. The message should be limited to 90 characters.

The Wireless Emergency Alerting (WEA) prescribes a maximum alert message length of 90 characters when transmitted via internet, as in the case for RESCUER. In this sense, we recommend to follow the WEA guideline.

G2. The most important information should be presented first.

First, present the most important information or instruction to the crowd, according to the message structure of CAP, particularly because of the limited space for the message and cognitive effort required to interpret the message. Detailed information can be presented later or on the website of the authority responsible for the message.

G3. The main warning text should be presented in coloured solid background with text as solid pure white.

The main message should be stressed to focus the attention of the readers. To help focus the attention, we recommend to use a coloured background with the text in white, serving as a message title. Detailed and complementary information can appear in white background with coloured text.

G4. Text fonts should be selected for high readability and be presented static.

Use fonts that ensure a high readability of the texts. *Sans serif* fonts are especially appropriate for mobile applications (e.g., Arial, Calibri, Lucida Sans). Ensure the text size is at least 17 points to also ensure readability on displays with high resolution.

G5. Use high contrast between text and background colour.

Use high contrast between text and background colour, i.e. when using light backgrounds prefer dark font colours and vice versa. The contrast level between text and background should be higher than 70%. Backgrounds with patterns or textures can significantly impair the readability of texts.

G6. Use icons to illustrate actions to be taken.

Use icons to illustrate and stress the actions that are to be taken during the emergency. The *UN Office for the Coordination of Humanitarian Affairs* has composed a library of 500 symbols for humanitarian response. The Government of Canada and the U.S. Homeland Security also developed symbols that can be applied in order to illustrate the emergency messages to make them more understandable to the users at first glance.

G7. Use the logo of the authority responsible for the message.

To increase the communication of reliability and authoritativeness of the content to members of the crowd, the logo of the authority responsible for the message should be included. It is very important that people involved in an emergency know that there is an official organisation undertaking the rescue efforts.

G8. Enable navigation to the official website of the authority responsible for the message.

The messages sent to the crowd should allow the navigation to the official website of the authority responsible for the message. This website should in turn provide detailed information about the emergency directly to the visitor. This way, people have an additional possibility to confirm the authenticity of the message and obtain further information.

G9. The presentation of crowd steering messages should be accompanied by a distinctive tone.

Especially in case protective actions must be taken, it is very important to direct the attention of the crowd to the message. We recommend using a distinctive tone that informs people of receiving a crowd steering message on their device. Such tones should not be used for any kind of notification sent from the Mobile Crowdsourcing Solution, but solely be restricted to the crowd steering messages.

G10. Crowd steering messages should be accessible to persons with disabilities.

People with disabilities have to be able to receive and read the crowd steering messages. For this reason, symbols and pictograms used to illustrate the messages have to be tagged with a clear descriptive, so that visual impaired people can understand the message and do not miss important information. Crowd steering messages should additionally follow general accessibility guidelines for mobile devices.

G11. The design of the messages should be consistent for the entire duration of an emergency.

Crowd steering messages have to present the same graphical representation and semantic throughout the emergency to ensure that the crowd can understand the message more quickly, and recognize it as being part of the same event. Modifications to the structure or design of the messages may be made only when no emergency is ongoing.

The above set of guidelines has been taken into consideration for creating the UI design for the presentation of crowd steering messages. Please see Section 2.4 for details.

2.3. Definition of Messages

Amongst other things, D1.1.3 performed a stakeholder analysis based on workshop with RESCUER's end users. Within this work, it was analysed which pieces of information would be relevant to each stakeholder during which phase of an incident. Table 1 and Table 2 summarize those findings and give an overview about potential use cases for sending crowd steering messages.

With respect to the naming of incident phases within the tables, the following scheme was used:

- A: incident detected
- B: incident under combat
- C: incident under control
- D: incident finished

Table 1: Crowd Steering Use Cases for Industrial Park Scenarios

GROUP-TARGET	INFORMATION	Emergency phases							
		Industrial Parks (Brazil)				Industrial Parks (Europe)			
		A	B	C	D	A	B	C	D
Employee - affected unit	Keep calm, don't run, walk / Keep calm		X				X		
	Follow the emergency coordinator orientations / Follow the brigade's orientation		X				X		
	The incident is under control, remain calm and stay where you are.			X				X	
	The incident is finished, wait for further orientation.				X				X
	Return to your unit / Return to your place				X				X
	Unit in emergency		X				X		
	In case of breathing discomfort, use the scape mask.		X				X		
	Wait for further instructions at the safe meeting point		X				X		
Employee - non affected unit	Keep calm, don't run, walk / Keep calm		X				X		
	Company "X" in emergency		X				X	X	X
	The incident is under control, remain calm and stay where you are.			X				X	
	The incident is over, wait for further orientation.				X				X
	Return to your unit				X				X
	Total evacuation		X			X	X		
	Follow the instructions of the evacuation coordinator of your company		X			X	X	X	X

Visitor (inside the plant)	Follow the instructions of the evacuation coordinator		X			X	X		
	Keep calm, don't run, walk		X			X	X		
	Company "X" in emergency		X			X			
	The incident is under control.			X				X	
	The incident is finished.				X				X
	Return to your unit				X				X
	If necessary, use the scape mask		X			X			
	If you are driving, stop the car		X			X			
	Go to the meeting point		X			X			
Visitor (outside the plant)	Follow the instructions of the evacuation coordinator or patrimonial security		X			X	X	X	
	Company "X" in emergency		X			X			
	The incident is under control.			X				X	
	The incident is over.				X				X
	Return to your unit				X			X	X
	If you are driving, park the car in the roadside		X			X	X		
	Go to the safe meeting point		X			X	X		
	Follow the others		X			X			
	Wait for guidance at the safe meeting point until the emergency is over.		X	X		X	X		
	Keep calm don't run, walk.		X			X	X		
	The roads are unblocked				X				X
Neighbour Community	Emergency level 4 in the Industrial Parks		X				X		
	Follow the Civil Defence instructions		X				X		
	Keep calm		X			X	X		
	If you are at home, turn off electronic equipment and the stove, and go walking to the safe meeting point "X"		X				X		
	Close the doors and windows and leave the house		X				X		
	If you are driving, stop the car and go walking to the safe meeting point "X"		X				X		
	If you are unable to move, inform the Civil Defence and ask for guidance		X				X		
	If you are walking down the street, go to the safe meeting point "X"		X				X		
	The situation is under control			X				X	
	The emergency is over				X				X
Return to your home and/or normal activities				X				X	

Table 2: Crowd Steering Use Cases for Large-Scale Event Scenarios

GROUP-TARGET	INFORMATION	Emergency phases							
		Large-scale events (Brazil)				Large-scale events (Europe)			
		A	B	C	D	A	B	C	D
Civilians	Please, go to the gate "X"	X	X			X	X		
	Keep calm	X	X			X	X		
	In case you have limited mobility, follow the brigade's orientation	X	X			X	X		
	Do not use the elevator, instead use the stairs	X	X			X	X		
	Follow the brigade's orientation	X	X			X	X		
	The incident is under control, remain calm and stay where you are.			X				X	
	The incident is finished, wait for further orientation.				X				X
	Return to your place				X				X
Employee	Please, go to the gate "X"	X	X			X	X	X	
	Keep calm, don't run, walk / Keep calm	X	X			X	X	X	
	In case you have limited mobility, follow the brigade's orientation	X	X			X	X		
	Do not use the elevator, instead use the stairs	X	X			X	X		
	Follow the emergency coordinator orientations / Follow the brigade's orientation	X	X			X	X		
	The incident is under control, remain calm and stay where you are.			X				X	
	The incident is finished, wait for further orientation.				X				X
	Return to your unit / Return to your place				X				X
	Turn off the equipment and get out.	X	X			X	X		

2.4. UI Design

The design of the user interface for presenting crowd steering messages was heavily influenced by the work outlined in Section 2.2 of this deliverable and by D2.1.3. Taking the resulting guidelines and the overall design of the RESCUER mobile crowdsourcing solution into account, the following wireframe model for crowd steering messages was created:

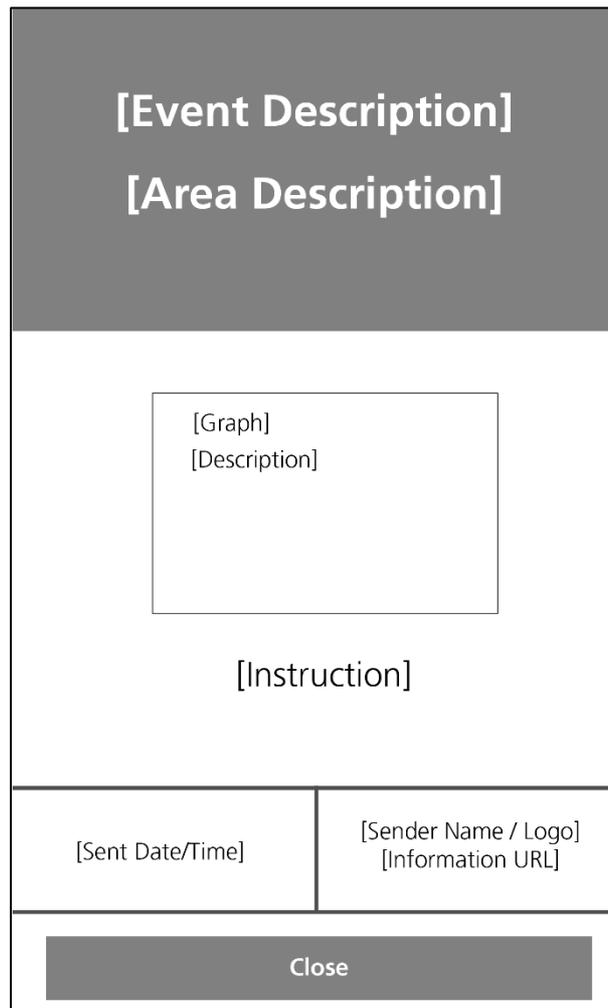


Figure 1: UI wireframe for presenting crowd steering messages

Please note that while the above wireframe contains a placeholder for the description of an area, this value is not mandatory. The reason for this is that in some use cases it does not make sense to name the location of an incident. Take for example a large open festival area with a crowd steering message that's intended for those visitors that are located in a sub-section of the south-west corner of the area. Naming that area "Lower part of the south-west corner of the festival area" is both confusing for the recipient and time consuming to type for the ERTK operator. On top of that, crowd steering messages are only received by people who are in the target area of the message and given that those people usually know where they currently are, the added value of naming a location is not always present.

Figure 2 shows two concrete examples for crowd steering messages. Note how both types of message use distinctive colours so that it becomes immediately apparent that they are of different type. The message's recipient can also get a quick grasp of the instructions by simply looking at the icon above the text. In order to stress the reliability of the message, the logo of the sender's organization is shown in the bottom right of the message.



Figure 2: Examples for crowd steering messages

Of course, users of the RESCUER mobile crowdsourcing solution are also notified about the presence of a new crowd steering message when the app is not actively running in the foreground. This happens via the smartphone operating system's standard notification mechanism. Figure 3 shows an example of such a notification.

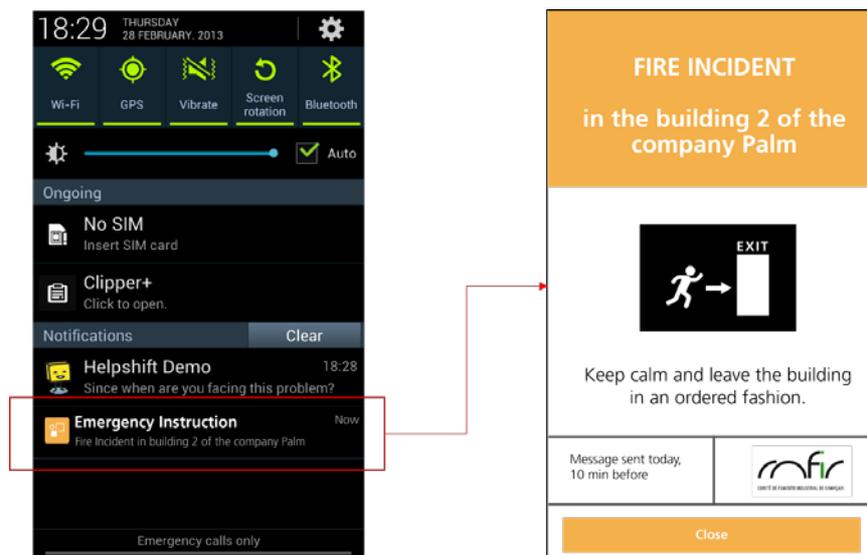


Figure 3: Illustration of how a message is accessed from an operating system notification

3. Practical Implementation

3.1. Server Side Implementation

The server side implementation of crowd steering messages is very straightforward. In principle, the process is the same as it is in case of sending a follow up report. Also, as it is the case with most communication duties within the RESCUER project, crowd steering messages are sent via a RabbitMQ topic (see D1.5.2 for details about the general approach).

3.1.1. RabbitMQ Topic

Crowd steering messages are sent via a dedicated RabbitMQ topic, which is built according to the following scheme (which is similar to the one for ERTK group follow up messages defined in D1.5.2):

```
crowdsteering.<workforces>.<supporting>.<civilians>
```

Table 3: Definition of crowd steering message topic

Parameter	Description	Value
crowdsteering	Name of the topic	crowdsteering
workforce	Indicates if the message is received by workforces.	[true, false]
supporting	Indicates if the message is received by support staff.	[true, false]
civilian	Indicates if the message is received by civilians.	[true, false]

Taking the information from Table 3 as a basis, a sample topic for messages that are received only by civilians would be *crowdsteering.false.false.true*.

3.1.2. Crowd Steering Messages Container Format

Now that we have defined the topic to be used for sending out crowd steering messages, we must define the container format used to encapsulate the actual message. This container is necessary in order to be able to implement the fact that crowd steering messages should only be received in certain locations.

As container format we're using a JSON (Java Script Object Notation) object with the following structure:

```
{
  "id": 61,
  "payload": {
    "message": "<Escaped XML String>"
  },
}
```

```
"geozone": [  
  {  
    "latitude": 49.4314146,  
    "longitude": 7.7472806  
  },  
  {  
    "latitude": 49.4324472,  
    "longitude": 7.7586532  
  },  
  {  
    "latitude": 49.4250785,  
    "longitude": 7.7571941  
  },  
  {  
    "latitude": 49.4273674,  
    "longitude": 7.7428604  
  }  
],  
"exclusion_zones": [  
  [  
    {  
      "latitude": 49.4301237,  
      "longitude": 7.7515078  
    },  
    {  
      "latitude": 49.4305703,  
      "longitude": 7.7519048  
    },  
    {  
      "latitude": 49.4302632,  
      "longitude": 7.7536214  
    },  
    {  
      "latitude": 49.4296422,  
      "longitude": 7.7531279  
    }  
  ]  
]  
}
```

Table 4: Definition of crowd steering message container format

Attribute	Description	Value
id	The crowd steering message container's ID. This value needs to be unique.	Integer
payload	A JSON dictionary containing the container's payload. In case of our crowd steering messages, it consists of only the "message" key whose value is the escaped message XML document (see Subsection 3.1.3 for details about its structure).	JSON Dictionary
geozone	The outline of the geographical area where the crowd steering message should be received. This is implemented as a JSON array containing a JSON dictionary for each node of the polygon describing the area's outline. The node JSON dictionaries contain keys for the nodes latitude and longitude values.	JSON Array
exclusion_zones	An arbitrary number of "holes" that can be cut into the message's geographical area (e.g. allowing for ring shaped message zones). This is implemented as a JSON array which itself carries potentially several arrays, each describing the outline of one "hole" in the message's geographical area. The format of each of those arrays is identical to the one used for the "geozone" attribute.	JSON Array

On the client side, the above container is received and passed on to the location based message engine which is responsible for delivering the crowd steering message transported within the container to the mobile crowdsourcing solution if the user has reached the message's geographic area. Details about this process can be found in Section 3.2.

3.1.3. Crowd Steering Message Format

In order to be consistent both with common standards and with the message format used for other RESCUER messages, it was decided to use a subset of the CAP (Common Alerting Protocol) XML format as a basis for the actual crowd steering messages.

Table 5: Definition of the crowd steering message format based on the CAP standard

Element Name	Definition	Notes and values recommended by CAP	Notes and values for RESCUER – Crowd Steering Messages
System related objects			
Message ID (identifier)	The identifier of the alert message	(1) A number or string uniquely identifying this message, assigned by the sender. (2) MUST NOT include spaces, commas or restricted characters (< and &).	For RESCUER, an integer number is chosen as message ID
Sent Date/Time (sent)	The time and date of the origination of the alert message	(1) The date and time SHALL be represented in the DateTime Data Type format (e.g., "2002-05-24T16:49:00-07:00" for 24 May 2002 at 16:49 PDT). (2) Alphabetic time zone designators such as "Z" MUST NOT be used. The time zone for UTC MUST be represented as "-00:00".	
Event Type (event)	The text denoting the type of the subject event of the alert message		Current incident types for RESCUER are: <ul style="list-style-type: none"> • Fire • Explosion • Gas Leakage • Environmental • Vandalism • Crush • Mass collapse • Stampede • Shooting
User Interface related objects			
Sender Name (senderName)	The text naming the originator of the alert message	The human-readable name of the agency or authority issuing this alert.	Organizations that can send crowd-steering messages to the crowd: <ul style="list-style-type: none"> • Police Command and Control Centre • Firefighters Command and Control Centre • Rescue Service Command and Control Centre • Company • Industrial Park • Event Organizer
Sender Logo (senderLogo)	A web URL to the sender's logo		

Event Description (description)	The text describing the subject event of the alert message	An extended human readable description of the hazard or event that occasioned this message.	Current incident types for RESCUER are: <ul style="list-style-type: none"> • Fire • Explosion • Gas Leakage • Environmental • Vandalism • Crush • Mass collapse • Stampede • Shooting
Instruction (instruction)	The text describing the recommended action to be taken by recipients of the alert message	An extended human readable instruction to targeted recipients. If different instructions are intended for different recipients, they should be represented by use of multiple <info> blocks.	A set of standard instructions will be available in RESCUER
Information URL (web)	The identifier of the hyperlink associating additional information with the alert message	A full, absolute URI for an HTML page or other text resource with additional or reference information regarding this alert.	Include the web-link of the current organization for the specific countries and regions, where RESCUER is used:
Area Description (AreaDesc)	The text describing the affected area of the alert message	A text description of the affected area.	

During workshops performed with RESCUER’s end users, it became apparent that it makes sense to have a set of standard instructions available to the ERTK operators to cover the most common messaging use cases. This set of standard instructions has been defined as follows:

- “Keep calm and leave the building in an ordered fashion”
- “The incident is under control. Remain calm and stay where you are.”
- “It is now safe to return to your unit.”
- “Your unit is not affected, so stay calm and watch out for further instructions.”
- “Please stay calm and pay attention to the instructions of the security staff.”
- “There has been an incident at the industrial park. If you are at home, turn off all electronic equipment and the stove, and walk to the meeting point X.”
- “Please go to gate X in an orderly fashion”
- “You are approaching an area that is currently involved in an incident. We advise you to turn towards location X instead.”
- “The incident has been resolved. Please remain where you are and await further instructions.”
- “There has been an incident. Please follow the emergency coordinator’s instructions.”
- “Keep calm and leave the building in an ordered fashion. Do not use the elevators.”

Of course, the “instruction” attribute of a message can be set to any string value that suits the ERTK operator’s needs. The set of standard instructions is merely available for the operator’s convenience. Appendix A contains an example of an actual XML document describing a crowd steering message.

3.2. Client Side Implementation

From the RESCUER mobile crowdsourcing solution’s (MCS) point of view, crowd steering messages are being delivered by the DFKI sensing library in exactly the same fashion as all other messages. In order for the app to receive crowd steering messages, it needs to build a RabbitMQ topic according to the scheme described in Subsection 3.1.1 and register this topic together with its callback method with the sensing library. Whenever a crowd steering message becomes relevant for the user, it will be delivered to the callback method, which can then handle displaying the message contents.

Figure 4 illustrates how crowd steering messages are received and processed by the sensing library. The container messages carrying the actual crowd steering message together with the metadata describing its geographic area are received via the RabbitMQ topic specified by the mobile crowdsourcing solution. They are then stored in an evaluation buffer. With each incoming location fix, the geographic area of each message is evaluated to see if the user’s current location is within a message’s area. If that is the case, the actual crowd steering message is unpacked from the container and delivered to the mobile crowdsourcing solution’s callback method that was specified during the initial registration phase as described above. The crowd steering message can now be displayed to the user.

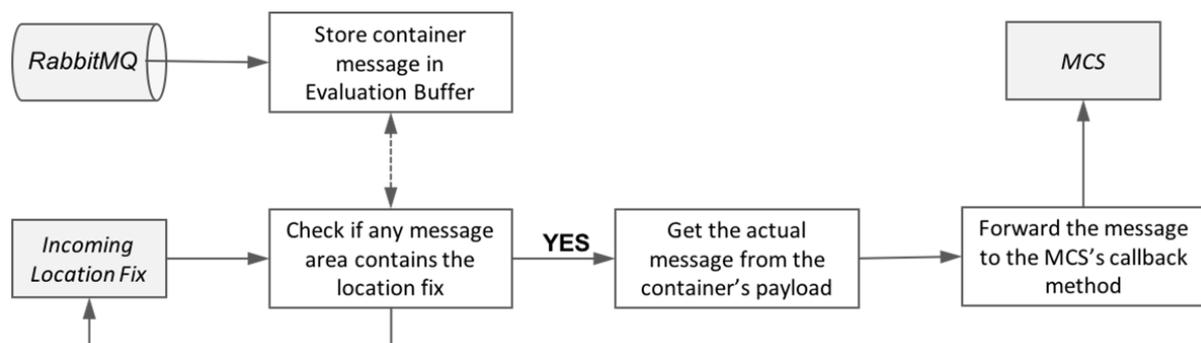


Figure 4: Illustration of crowd steering message handling

3.3. Technical Considerations

3.3.1. Battery Drain

Given the fact that it is necessary to constantly check the user’s location in order for crowd steering messages to be delivered reliably, concerns about the technology’s battery drain are likely.



On top of that, RESCUER aims for the highest possible accuracy when it comes to localizing the user so that messages are delivered immediately upon entering a zone. This results in the need for employing the smartphone's GPS sensor for acquiring the location fixes – the most energy consuming localization method. On the other hand, the users of the RESCUER mobile crowdsourcing solution expect their phones to behave normally without having to recharge their battery after half a day's use.

In order to not put too much strain on the phone's battery, it was decided that the check for new crowd steering messages is being performed according to the user's context, i.e. if there's an incident taking place or not. This knowledge can be easily obtained by checking if crowd sensing is currently enabled. During times without incidents or without challenging crowd conditions, crowd sensing is usually not enabled (also in order to minimize the impact of the mobile crowdsourcing solution on battery life).

During "normal" times without crowd sensing being enabled somewhere in RESCUER's activity zone, the sensing library only checks if crowd steering messages need to be delivered to the user while the mobile crowd sourcing solution is running in the foreground. When it's in the background, the GPS sensor is disabled in order to maintain a low impact on the battery.

However, if crowd sensing is activated *anywhere* in RESCUER's activity zone (regardless of whether the user is inside a crowd sensing zone), the sensing library enables the GPS sensor also when it's running in the background. This way, it is ensured that crowd steering messages are received immediately when a user enters the relevant area.

In summary, we believe that this is an acceptable compromise between the users' wish to conserve their phones' batteries and the necessity to be able to receive potentially critical crowd steering messages if the situation calls for it.

3.3.2. User Privacy

In principle, any technology involving the processing of user location data is potentially in danger of being under scrutiny by privacy advocates. Being aware of that fact, the mechanism for delivering crowd steering messages has been designed in a way making sure that no location data needs to be transmitted from the users' phones to a central server.

Instead, the delivery mechanism is designed in a way that crowd steering messages are delivered to all devices simultaneously. Once they are received by the sensing library, they are being kept in a local cache. With each incoming new location fix a program routine checks if any of the buffered crowd steering messages is valid for the current location (see Subsection 3.2 for details). If that is the case, the message is forwarded to the mobile crowdsourcing solution and thereby presented to the user.

From a privacy point of view this means that the user's location data never has to leave the phone in order to decide when a crowd steering messages needs to be displayed. Therefore, the user's privacy is safeguarded.

4. Conclusion

This deliverable presented the outcome of Task 2.4 (Group-Targeted Crowd Steering). It presented the use of crowd steering messages (also known as location based messages) within the scope of the RESCUER project. The cognitive considerations building the basis for the visualisation of the crowd steering messages were elaborated before the actual design of the UI was shown. Furthermore, a host of use cases for location based messages was shown.

With respect to the practical implementation it was shown how crowd steering messages are constructed and how they are received on the client side. Also, it was shown how technical concerns like battery drain and user privacy are being handled by RESCUER's implementation of crowd steering messages.

Appendix A: Example of an XML crowd steering message

```
<?xml version="1.0" encoding="UTF-8"?>
<alert xmlns="urn:oasis:names:tc:emergency:cap:1.2">
  <identifier>43080</identifier>
  <sent>2016-04-03T15:22:14+02:00</sent>
  <event>Fire</event>
  <info>
    <senderName>Cofic</senderName>
    <senderLogo>http://www.abc.xy/logo.png</senderLogo>
    <description>Fire at chemical plant</description>
    <instruction>Lorem Ipsum dolor sit amet ...</instruction>
    <web>http://www.coficpolo.com.br</web>
    <area>
      <areaDesc>Chemical plant XYZ</areaDesc>
    </area>
  </info>
</alert>
```