(SMA)² - A SOCIAL MEDIA AUDIENCE SHARING MODEL FOR AUTHORITIES TO SUPPORT EFFECTIVE CRISIS COMMUNICATION

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Keywords: Crisis Communication, Information Sharing, Social Media, Emergency Management

Abstract

Effective crisis communications play a vital role in increasing the resilience of communities against natural or man-made disasters. Warning and informing affected citizens is a crucial safety-critical process with the aim to raise public awareness prior to an event, or when one is imminent. This process has traditionally been facilitated through broadcast media, such as television and radio. This paper discusses social media platforms as additional channel to public alerting systems and introduces a model of effective social media audience sharing for authorities. The paper concludes with a discussion on the challenges for effective audience targeting and on reducing conflicting information, as well as the utility of the approach to the public and authorities.

1 Introduction

The global risk landscape has changed over the past decade. Due to climatic changes, and global political/religious conflicts, the frequency of both natural disasters (Katrina 2005, UK Floods 2005, Australia 2010, Haiti 2010) and man-made disasters has increased (9/11 attacks 2001, 7/7 Bombings 2005) during this period. [4, 5, 6, 7] Emergency management focuses on the "organisation and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps". [18] "Central issues for organisations in emergencies are communication and coordination." [7] "The effective flow of information across organisational boundaries is critical for an organisation's ability to remain effective in a dynamic disaster environment." [11]

In order to improve emergency management and to make communities more resilient, it is essential to include the public in the process of planning for and responding to emergencies. Aiming to increase community resilience before, during and after crisis events, responsible authorities need to ensure that people in affected areas are informed about potential risks in order to increase their level of preparedness. Issuing timely warnings just before events, especially unpredictable contingencies such as malicious attacks or industrial accidents, is vital for the public, as the lack of information can result in a flawed perception of the risk. [12, 16]

Traditional media, such as radio and television have an important role in satisfying the increased information need of citizens during crisis situations. [15] However, recent research has shown that Internet applications, and specifically social media platforms are increasingly being used as the primary source for news. This trend towards new media is especially relevant for younger parts of the population in the UK, US, Germany and Denmark, where more than 43% consider social media to be the primary source for finding news related information. [14]

With this growing public use of social media, many public agencies are now turning to these technologies to support emergency communication. In order for responders to provide authoritative information on social media platforms it is important to do this in a timely manner while avoiding conflicting messages. [16] However, questions remain about the best ways to use these technologies; as different agencies have adopted a host of different communication strategies for crisis communication on social media. It is, therefore, important to identify ways of maximising the utility derived from scarce resources.

This paper describes a flexible and scalable approach, Social Media Audience Sharing Model for Authorities (SMA)², for increasing the effectiveness of crisis communications, by sharing social media audiences between emergency responders. The model adopts established procedures for crisis communications by identifying a lead agency whose content is automatically disseminated by other agencies in the affected areas via their own social media accounts. This offers numerous safety benefits; helping to avoid the distortion of critical information passed from one agency to another. This approach also increases the audience for critical information in the immediate aftermath of a crisis event. (SMA)² can reduce the resources required for social media communications, whilst ensuring an accelerated flow of consistent information from official channels to warn and inform the public in a timely manner. The paper analyses the potential increase in social media reach of the proposed model through a case study of crisis response in Scotland.

The current challenges, both technical and organisational, together with preliminary results of this study are discussed and several recommendations for successful social media communication during crisis events are made.

2 Emergency Planning and Response in the UK

As of 2004, the Civil Contingencies Act (CCA2004) created a framework for planning and responding to emergencies on a local and national level in the United Kingdom. Similar provisions have been made across Europe and North America. Such frameworks also support safety, because they help define the roles and responsibilities of authorities involved in responding to incidents. The CCA2004 groups authorities into Category 1 and Category 2 responders:

Category 1 responders include local authorities, e.g. city councils, as well as emergency services, including police forces, fire and rescue services, and ambulance services. They also include health related services, such as the National Health Services (NHS). Category 1 responders are subject to the full set of civil contingency duties, as defined in part 1 of the CCA2004. [5]

Category 2 responders are considered as "co-operative bodies" and include utility companies, such as operators for transport, telecommunication, electricity or water. While they "are less likely to be involved in the heart of planning work [they] will be heavily involved in incidents that affect their sector". [5] In terms of this paper, it is important to ensure that information flows between category 1 and category 2 responders. Although the focus of $(SMA)^2$ is on public communication, we will see that the same approach might also be used to increase communications between groups within category 1 and 2 responders.

The Civil Contingency Act additionally defines the role of Category 1 responders to be around the planning for emergencies, including, risk assessment for events likely to occur in a given area; and putting in place emergency plans and business continuity arrangements.

Further, they need to arrange the information provision to warn, inform and advise the public in a timely manner, especially in regards to civil contingency matters or in the event of an emergency. This is to ensure that the public has access to a sufficient level of information about the emergency, e.g. in order to take appropriate and required actions, as this might help to save lives and protect property and thus reduce the overall severity of the event.

While all Category 1 responder have the duty to maintain plans to warn, inform and advise the public, particular organisations – depending on the nature of the incident – might be appointed to lead multi-agency incidents. During such an event the agencies must co-operate with each other on various levels, including communication with the public, e.g. to prevent the dissemination of unnecessary messages duplications and conflicting information from different responders. [5]

Previous research discussed the importance of these issues, as the violation of these principles can lead to non-compliance of message recipients and thus to a reduced effect of the messages disseminated. [16]

3 Existing PAS Capabilities and Social Media

Current emergency management frameworks in the UK and the US are based on an all hazard approach, thus incorporating natural as well as man-made disasters. Despite having standardised approaches to manage hazards of various kinds, the employed public alerting systems (PAS) can vary widely. Current channels of PAS to warn and inform the public before, during and after an incident include [13, 14, 15]:

- acoustic alarms, such as sirens,
- radio or television broadcasts,
- newspaper articles,
- fixed telephone line warnings,
- mobile phone warnings, e.g. via cell broad-casting,
- person-to-person alarms, such as door knocking.

Each of these channels can contribute to the overall performance of a PAS to a different degree. Hence, warning and informing strategies should employ a combination of channels to ensure a timely and reliable delivery of the messages, considering the nature of the incident. [17]

Assessment Criteria for Public Alerting Systems

Previous research identified a number of requirements for public alerting systems. These requirements primarily concern demographics, support of different modes of operation, performance, reach and system security. [3, 6] Each of these characteristics has an impact on public safety during contingency events.

Public alerting systems need to be able to deliver information to as many people as possible (reach). Simultaneously, the percentage of people reached in affected areas in relation to the overall audience should be as high as possible (targeting). The system should operate in a timely manner, as a quick dissemination of warnings provides more response time to affected citizens (speed). Effective systems should also allow for the simultaneous delivery of messages (multiplicity). The system should further allow for different modes of operation, e.g. automated, semi-automated or manual, to allow for a higher degree of flexibility for the system operators (operation modes). Furthermore, it should be considered what media formats are supported for the message delivery, e.g. visual, audio, or textual (media support). Similarly, the system should support multiple languages in order for the messages to be understood by all groups of people in affected areas (language support). It is also noted that effective public alerting systems should not only work on an opt-in basis, so that messages can be delivered to people without their prior

consent where necessary. The public alerting system should further offer a high level of accessibility, enabling recipients to access the messages from various devices/platforms (accessibility). [6]

Functionality that should be provided by the system in order to assess performance and optimise operations are: message acknowledgment/confirmation, ability to detect non-reception, replaying messages on demand and sharing/forwarding messages. [3]

Additional assessment criteria may focus on other systems engineering characteristics, such as required training, reliability, performance, costs of ownership, security and auditing. Therefore we acknowledge that the above stated list is non-exhaustive. However, the above stated criteria had been selected, as each of them are crucial influencing factors in regards to the overall channel performance and hence the impact on public safety during civil contingencies.

Assessing the Capabilities of Social Media for PAS

As the proposed model is exploiting social media functionality for effective and efficient warning message distribution, the capabilities of social media as a channel need to be assessed against the criteria listed above. In regards to the proposed model, social media is defined to be an Internet-based application that allows users to connect to each other and share and comment on multi-media content. [2] While, this is a very broad definition of platforms, the model considers social networks or micro-blogging platforms, such as Facebook, Twitter, or Google+, to be preferential. Table 1 illustrates this analysis.

Evaluation Criteria	*Discussion of Performance against Evaluation Criteria*
Reach & Targeting	Social media is actively used by more than 1.3 billion people globally, but messages on these existing platforms could theoretically be accessed by all Internet users. Targeting is challenging on social media platforms, due to their often global nature. Successful strategies for targeting require detailed, prior knowledge of social media audience demographics.
Speed & Multiplicity	The speed of message dissemination is almost instantaneous and broadcasting to multiple people at the same time is a fundamental capability of social media platforms.
Modes of Operation	All modes of operations are supported. While manual would be the default, automated modes can be achieved through accessing individual platform APIs.
Media & Language Support	The majority of existing social media platforms supports multiple languages and diverse media, from text, over audio, to visual content.
Accessibility	Social media platforms are mostly accessed using desktop computers or notebooks. However, recent statistics show that the use via mobile devices is increasing rapidly, hence are the most popular platforms optimised for a vast range of devices.
Reliability	Most social media channels platforms were never designed to operate in safety-critical environments. Nevertheless, reliability of major platforms has proven to be stable, offering daily services access to millions of users simultaneously. However, certain types of external disruption to power or telecommunication networks could make content disseminated over these channels inaccessible.

Table 1: Evaluation of social media for message dissemination during crisis management

There are some limitations. Social media platforms currently lack the ability to detect non-reception of messages. However, with features such as sharing, commenting or rating content, a message confirmation process could be implemented that employs the natural functionality of most social media platforms. The requirement to share information or replay messages on demand is similarly satisfied by standard functionality.

4 Social Media Audience Sharing Model (SMA)^2

Broadcast communication channels traditionally employed for warning and informing purposes, like radio and television, have audience sets that are dependent on the radio or television station, the programme, and the time of the day. This means that audience size and demographic will be the same, independent of the authority issuing the warning messages. This is different on social media platforms, such as Twitter or Facebook, as every organisation builds up a unique audience set that can be completely different to that of other responders involved in the incident response.

(SMA)^2 aims to increase the reach for messages disseminated via a given social media platform in the context of an emergency. This would decrease the dependence between the channel reach and the issuing authority. The model adopts existing communication processes, especially in regards to information sharing, and places them in the context of social media. As a core principle, (SMA)^2 relies on the nomination of a media lead agency, whose messages are additionally disseminated to the unique audience sets of other emergency responders. Best practices advocate the appointment of a lead agency for risks involving multi-agency operations during the planning phase and thus prior to the actual incident. [13]

While public communication is important during all phases of an emergency, e.g. to raise public awareness prior to and event, or to inform, and advise as part of post-event communications, the proposed model should only been employed for public warning purposes either at time of the event or when one is imminent. [17] Events that are considered to require an increased audience reach are those expected to have a severe impact on the population or environment. Examples are attacks on crowded places, major industrial accidents, wide-spread public disorder, major flooding or any other risks similar to those described in the national risk register for civil emergencies. [4]

Figure 1 shows a generic example of three agencies engaging in (SMA)². It illustrates the different components of the model with the audience F_l of the lead agency ***l*** on the left, with two audiences F_1 and F_2 of the selected agencies ***1*** and ***2*** intersecting with the existing audience F_l of the lead agency. The benefit ***b***, additional channel reach, is illustrated as area enclosed by the red border.

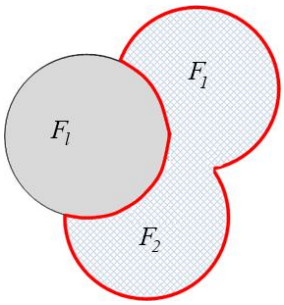

Figure 1: (SMA)² Audience gain explained as Venn-Diagram

In order to calculate the advantage of employing (SMA)² on a given social media platform, the following formula can be applied. During a multi-agency event, let there be $1 \leq i \leq n$ agencies, and one lead agency denoted ***l***. Then the set of followers, or audience, of an agency is denoted as F_i and the set of followers of the lead agency F_l. The benefit ***b***, additional channel reach, of applying (SMA)² is as follows:

$$b = |(\bigcup_{i=1}^{n} F_i)/F_l| \qquad (1)$$

This means that the benefit of applying the social media audience sharing model can be described in terms of set theory, where the additional reach (***b***) on a platform is defined as the union of all audience sets without the audience of the lead agency. While this model is channel-specific to social media, the process of automatic message sharing is platform-independent, enabling the use of (SMA)² on or possibly across various social media platforms. This increases the applicability of the model as social media continues to evolve over time – with novel platforms being introduced time and again.

(SMA)² can be scaled to incorporate ***n*** agencies disseminating messages of the lead agency. Depending on the degree of system automation, e.g. through a rule-based system, the workload on initial resources of agencies other than the lead agency can be reduced. Additionally, as only one agency has an active role in formulating and distributing messages, the risk of conflicting messages could be substantially reduced. However, it can be argued that a higher number of participating authorities results in a higher number of message duplications and therefore potentially lead to an information overload for some message recipients. Hence, it is generally debatable if an increase in social media platform reach automatically translates into a more effective public alerting system.

An additional factor establishing the overall utility of (SMA)² is how often a message has been received by a given individual. Previous research suggests that a message needs to be received from multiple sources and multiple times in order to increase the response rate. [12] Also, the more credible the sources issuing the message, the higher the likelihood of recipients taking immediate action. [13] These factors are addressed by (SMA)² with multiple agencies disseminating messages as credible sources. In order to address the challenge of targeting and to ensure that messages are send out to an individual at least *n*-times, a near-optimal union of audience subsets, given prior knowledge about each item's demographics such as age, gender or geo-location, could be calculated.

Generally, it should be acknowledged that the utility of this approach is strongly dependent on the context or nature of the incident, and will vary for each of the participating actors of that system, including both responder agencies and message recipients. Contributing factors that need to be incorporated in formulating a context- and agency-specific utility function are:

- overall audience size in combined audience sets
- number of unique people in combined audience sets (reach)
- percentage of unique users in combined audience sets that are affected by the incident (targeting)
- percentage of unique users in combined audience sets that are accessing the information from mobile devices (targeting/accessibility)

These last factors aim to assess the utility also in regards to ETSI's five different contexts that should be considered for public alerting systems ranging from: citizens in their dwelling, workplace, in public places, travelling on foot or using other means of transportation. [6] As (SMA)² is based on social media platforms, with a genuinely high level of accessibility for multiple devices, it is able to provide messages to citizens in all five contexts.

5 Case Study: Social Media Warning and Informing in Scotland (UK)

Applying the Social Media Audience Sharing Model to the context of Scotland, this section describes a scenario illustrating the potential gains for a selection of category 1 responders – fire services, police forces and councils. The social media platform of choice in this case-study is Twitter, a micro-blogging service with more than 300 million global users.

Scotland's government structure was changed in 1996 with the Local Government (Scotland) Act 1994. It put into place 32 designated council areas covering Scotland. The previous local government region of Strathclyde contains twelve councils.Despite the introduction of dedicated council authorities, the region is still used as a police force area and fire service area designation, covered by Strathclyde Police (SP) and Strathclyde Fire and Rescue Services (SFRS). The overall size of Strathclyde is around 13,625 km² with an estimated population of around 2.3 million – 41% of Scotland's overall population. Figure 2 describes the non-

unique audience on Twitter of SP, and SFRS, as well as for the twelve councils in Strathclyde.

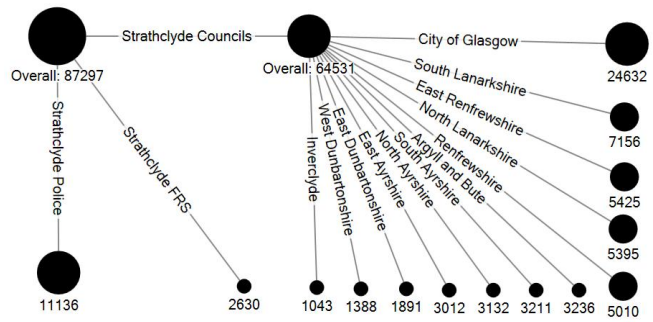

Figure 2: Non-unique Twitter audiences in Strathclyde

The scenario used to describe the application of social media audience sharing is as follows: For a detailed calculation of the gain in social media reach, we consider Glasgow City as the affected council area. The selected emergency scenario is a bomb threat to the immediate city centre area, requiring the timely warning of people in or travelling through the affected areas. This scenario is based on a real incident when a man was suspected to have carried a bomb into Glasgow City Centre, causing an eight hour operation to secure the area. People in all five of ETSI's contexts are required to receive the messages. The responders most likely to be involved are Strathclyde Police (A_2), and Strathclyde Fire and Rescue Services (A_3), as well as Glasgow City Council (A_1). Additional category 1 responders, such as ambulance services, or category 2 responders, such as transport operators, would most likely be involved in such a scenario as well. But, in order to keep the complexity of this example to an acceptable level, the case-study will only consider the three category 1 responders mentioned above. The emerging audience subsets of all three authorities are illustrated in Figure 3.

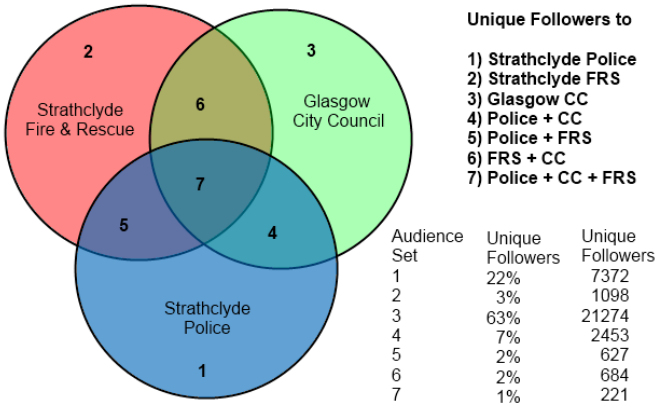

Figure 3: Unique follower subsets for three authorities

A lead agency must be appointed for this multi-agency scenario to facilitate public communications through various media channels, including social media. Considering the scenario of an immediate bomb threat in Glasgow City Centre, the lead agency most likely to be appointed will be Strathclyde Police. The anticipated audience gain through the application of (SMA)² for the lead-agency ***l*** Strathclyde Police (A_2) can be calculated as follows:

$$b_l = b_{A2} = |(\bigcup F_{A1}F_{A3})/F_{A2}| \qquad (2)$$

Table 2 illustrates the audience gain through applying (SMA)². Independent from the choice of the lead agency there is always an audience gain, thus allowing the timely dissemination messages to bigger audience sets. It also highlights that currently 29,744 followers (88.2%) have subscribed to only one of the authorities, whereas a number of 3,985 followers (11.8%) have already subscribed to two or more authorities. The audience gain over all three scenarios ranges between 37% for Glasgow City Council up to 1,182% for Strathclyde Fire and Rescue. Thus, by applying (SMA)² during the scenario Strathclyde Police would have been able to increase its social media reach by 22,372 (203%).

Authority	Glasgow City Council (A_1)	Strathclyde Police (A_2)	Strathclyde FRS (A_3)
Audience (abs)	24632	11136	2630
Unique Audience (abs)	21274	7372	1098
Unique Audience (%)	86%	66%	42%
Potential Audience Gain	37%	203%	1182%

Table 2: Audience gain by applying (SMA)² in Glasgow

6 Conclusion and Recommendations

Effective communication with the public remains a vital role in public safety through crisis preparation and response. This paper discussed social media as an additional channel to public alerting systems. It further introduced the Social Media Audience Sharing Model for Authorities (SMA)², which employs the concept of lead agencies during multi-agency incidents as defined in Civil Contingency Act 2004. Messages are created by the lead agency and shared amongst audience sets of all supporting authorities. This approach can result in a substantial increase of the overall social media reach on a selected platform. The paper discussed challenges of information overload as a result of excessive message sharing and highlighted potential benefits, especially in regards to message consistency. A scenario considering a bomb threat to the densely populated city centre area of Glasgow, Scotland, was analysed to demonstrate the additional audience gain through applying (SMA)². The result in regards to additional audience was between 37% and 1,182% depending on the agreed lead agency. The following technological and organisational recommendations were also formulated:

- While social media platforms can increase interoperability features for inter-agency message exchange, recent developments, especially in regards to the common alerting protocol (CAP), should be considered for future use.

- Access to required social media accounts needs to be ensured prior to the incident to allow timely response and collaboration.
- Clear arrangements in regards to system activation and duration of system operation need to be defined during the emergency preparedness phase.
- Social media analytics, especially in regards to audience demographics, allow for improved targeting during an incident.
- Messages from trusted sources result in a higher compliance level of message recipients. It is therefore essential to build up positive relationships with social media audiences during non-crisis times.
- Official agency accounts should be verified by social media platform operators to increase the credibility of the messages delivered.
- Strategic partners for message dissemination should be identified during the emergency preparedness phase. Organisations, such as universities, theatres or football clubs, can improve social media reach to event- or location-specific audience groups.
- In case of warning messages containing links to content hosted on in-house IT infrastructure, it needs to be assured that the system is able to cope with the increased demand from the social media channels, e.g. as low response times may result in a delay of accessing knowledge and thus taking action.
- An increasing number of social media users access services via mobile devices, thus it needs to be assured that warning messages and linked external content is optimised/supports mobile devices.

Social media platforms are a vital part of communications in modern life. Assessed against established public alerting system criteria, such as reach, speed and multiplicity, language and media support, or accessibility, it can be concluded that social media platforms can be an important additional channel for existing public alerting systems.

However, the stated criteria only refer to broadcasting capabilities of a given channel. Thus, one of the potential major benefits of social media platforms, the two-way communication capabilities, was not addressed. Especially given the growing capabilities of mobile devices and the almost ubiquitous access to the Internet, the application of social media platforms will not only benefit affected citizens, but also allow for emergency responders to receive multi-media content from the ground – prior to arrival – and thus to increase their situational awareness more efficiently.

Acknowledgements

This research is funded by the Scottish Government, Strathclyde Police and the University of Glasgow as part of an EPSRC CASE studentship to explore the impact of social media platforms on future emergency management. We would like to thank all our project partners for their feedback and support throughout this research.

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