# SMACR:
# SOCIAL MEDIA AGGREGATION FOR CRISIS RESPONSE*

**Tom Duffy[1], David Merrick[1] and Kristin Samulkewitsch[1]**

[1]*Center for Disaster Risk Policy (CDRP), Florida State University, Tallahassee, Florida, US*

**Abstract:**
There are currently dozens of off-the-shelf tools available for collecting, filtering, organizing and analyzing data from social media channels, each with their own bespoke functionalities. The use of such technologies in emergency response and disaster management has been well documented and is still a growing area of research. The Social Media Aggregation for Crisis Response (SMACR) system represents an effort to integrate some of these tools into a common platform with the aim that emergency managers or virtual teams will be able to manage the flow of data from social media and publish information directly into a State's Emergency Operations Center. The current focus is to utilize this data to inform ground-truth and situation awareness during the response stage of disasters. This paper describes the SMACR system design and its utilization during testing within Florida State University's Virtual Operations Support Team and integration with Florida's Emergency Operations Center.

## Introduction

Social media can generate thousands of potential disaster data points every hour. These data points originate with a wide variety of sources including citizens, responders, media outlets and official government channels. The challenge for emergency and disaster managers is to collate this data, filter it, and then manipulate it to create useful information that can be used in response and recovery.

Monitoring and processing the flow of data from social media channels during a disaster is a difficult task. Some large organizations in the United States such as the American Red Cross have established dedicated social media operations centers. These centers provide a high level of social media cognizance regarding disasters, but come with high operational costs, even when those costs are offset by donations from volunteer corporate partners † (Kash, 2012). Organizations with smaller budget capabilities may turn to commercial software packages to perform social media monitoring missions. Of the available platforms, many are web based, requiring little or no infrastructure to support them, and are free to use in a limited capacity. These tools include popular options such as HootSuite, Monitter, and Twitterfall and tend to be aimed at individual users or small teams and focus mainly on mining Twitter for data. Based on

* This paper was originally titled: "PRISM: Platform for Real-time Integration of Social Media"

† The American Red Cross partnered with Dell Corporation to provide hardware and network infrastructure for their digital operations center.

keyword and hashtag search algorithms, these small commercial platforms allow users to see individual data points posted to Twitter that relate to the event or disaster being monitored. Although these simple mechanisms create streams of data matching the key-terms or hashtags, it is less obvious how this data can be used for creating useful information.

Research in the usage of social media in disaster and crisis management has boomed in recent years. Much of the focus has been on how to tailor social media content for more effective use (Starbird & Stamberger, 2010), the verification of information providers (Starbird et al, 2012) and how the public can participate in the emerging "virtual space emergency" (Schneiderman & Preece, 2007; Palen et al, 2009). This research remains important however, the authors would suggest, there is still a lack of understanding as to how this information should be input into official channels. The Virtual Operations Support Team (VOST) concept originated in the United States in 2011 and is designed to counter many of these limitations. By employing a team of trusted digital analysts, a VOST can use a variety of tools and platforms to mine and analyze social media platforms for data related to a disaster (St. Denis, 2012). These digital analysts use the captured data to create usable information regarding survivor needs, response shortcomings, resource needs and availability. This information is then communicated to the official response and recovery organizations for action. Similarly, the VOST can assist the official organization with information amplification in social media space as well as rumor identification and control. All of these tasks are time intensive, and by allowing volunteers to perform them it reduces pressure on limited organizational resources.

The State of Florida's Division of Emergency Management (FDEM) organizes operations in the State Emergency Operations Center (SEOC) using Emergency Support Functions (ESFs)[‡]. Each ESF is headed by an Emergency Coordination Officer (ECO) from the lead state agency. In addition to this primary agency or organization, some ESFs have additional agencies providing support or capabilities. During activations, it is the responsibility of the ECO to collect, evaluate, broadcast, and use information during decision-making. No set information guidelines are required to manage information filtration. A large precedence must be placed on the relationship between the VOST and the EOC in order to ensure progressive collaboration. The avant-garde use of digital analysts in the EOC is contingent on timely and accurate communication. Usable information can only be filtered by the VOST using social media if the ECO verbalizes what information is relevant to specific ESFs.

There are four ESFs or offices in the SEOC that currently use or could benefit from an increase in social media based information. Emergency Support Function 5 (ESF-5) is responsible for Planning, which includes compiling damage assessments and reconnaissance information, publishing situation reports, and providing information for future planning. ESF-14, Public Information, supports the Public Information Officer during activations. To maintain a picture of the information currently being distributed by the public, ESF-14 monitors both traditional and social media. This activity allows for rumor control and identifies the need for public clarification on certain events. Florida places high priorities on public-private partnerships (PPP) in all areas of government. ESF-18, Business and Industry, is designed to foster these relationships in emergency management and in the SEOC. ESF-18 in Florida has adopted a 'bottom-up' model of public-private cooperation, where government provides assistance and coordination activities to the private sector, but does not dictate actions or responses to the disaster. This soft approach enables the private sector entities to focus on core strengths and capabilities without government 'interference' (Logan, 2012). Finally, the State Watch Office

[‡] The State of Florida Emergency Response Team (SERT) is comprised of eighteen mission or capability specific ESFs. The exact definition and number and focus of ESFs may vary by state or jurisdiction.

(SWO) provides inter-jurisdiction communications and coordination 24-hours a day, 7-days a week. Unlike ESFs the SWO is staffed and operational even in the absence of an active crisis or disaster. Part of the SWO mission is to monitor the state for potential threats and significant events where social media is a valuable channel for achieving that goal.

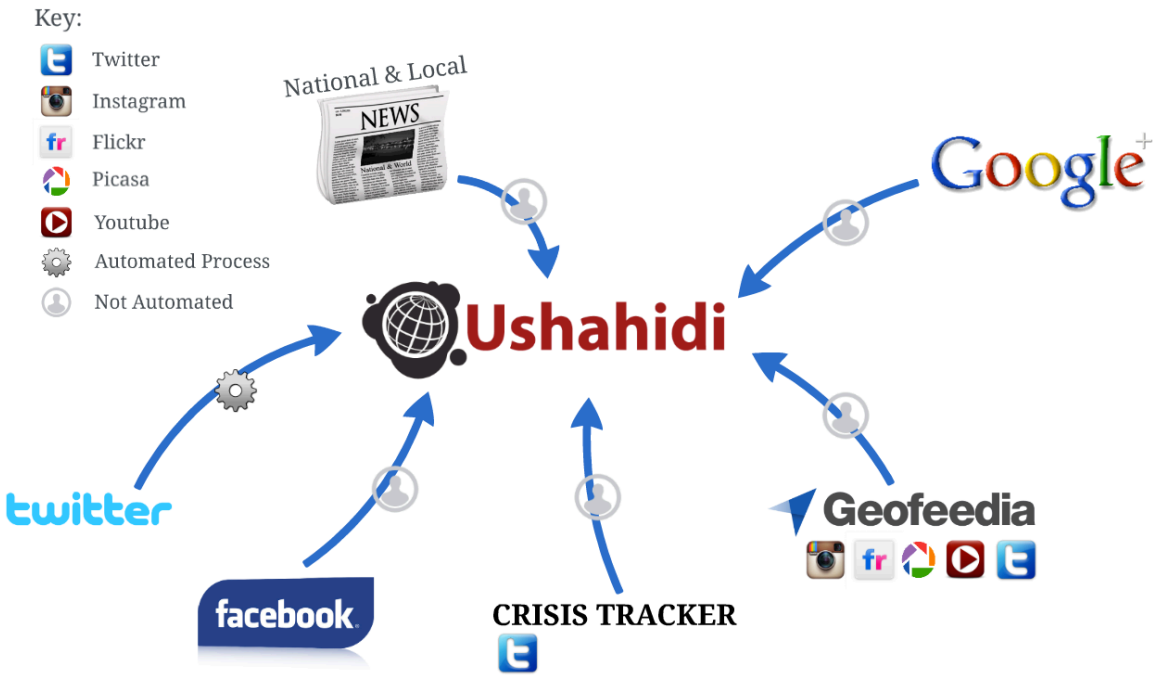
## Thesis

In this paper the aim is to present the methods and processes developed between the Florida State University Virtual Operations Support Team (FSU.VOST) and the Florida Emergency Operations Center (EOC) at Florida's Division of Emergency Management (FDEM) for providing information from social media into situation awareness reports for the EOC. This paper will present findings and discussion from two initial events; tropical storm Andrea and the public response to *Event X*[§] for which the FSU.VOST was given differing tasks.

### SMACR

The SMACR system is an amalgamation of off-the-shelf technologies used within the FSU.VOST for the collection and aggregation of social media. The system works by each component technology being utilized by a VOST member and feeding reports to Ushahidi which are overseen by a senior member of the team who can approve the report to be included as input into the situation report sent to the EOC.

Figure 1 - Technologies Incorporated in the SMACR system




The constituent technologies used in the system include Twitter, Facebook, Google+, national media sites, local media sites, Crisis Tracker and Geofeedia (Figure 1).

[§] We are required to mask the real name of this event to protect our partners. Event X was a prominent event in America, substantially covered by the media that highlighted a potential racial inequality in the US legal system.

***Ushahidi*:** Ushahidi is an open source tool that allows the creation of reports from various sources and a facility to display information on a map. It is utilized by the FSU.VOST as a common platform for members to input information in a common format and provides a facility for approval and verification by the VOST team leader.

***Twitter***: The Twitter (Twitter) interface offers the facility to mark tweets as 'Favorites'. The FSU.VOST was able to render these marked tweets automatically into Ushahidi through the use of RSS feeds. This was true until 1 July 2013, when Twitter retired the RSS publishing aspect of its public application programming interface (API). That third party change required all data to be added manually to the Ushahidi platform, and increased the workload of VOST members. A method for re-automating this process is being developed.

***Facebook:*** Since any Facebook users network is egocentric, there is no guarantee what kind of information any VOST member can garner from their own social ties. Facebook was mostly used to monitor pages of official agencies. More recently Facebook has deployed a hashtagging facility similar to Twitter. This enable a more objective search for key terms within the public information streams.

***News & Media***: The VOST also monitors online media channels for information. Specifically, reader submitted comments are of interest where sentiment, opinion and rumor can often be observed.

***Crisis Tracker***: Crisis Tracker is a technology for rapidly filtering and clustering tweets based on an innovative clustering algorithm (Rogstadius et al, 2013). It automatically binds tweets together to form stories based on user given filter terms and provides a front end interface for categorizing, merging or discarding stories based on the user's requirements (Crisis Tracker). The FSU.VOST is working closely with the technology's creator Jakob Rogstadius in evaluating the technology and helping develop future versions.

***Geofeedia***: Geofeedia differs from the technologies listed above in that it primarily searches social media content by location and in addition to Twitter searches Instagram, Picasa, Flickr and Youtube for geolocated content. It provides a novel interface for defining search regions and allows the user to publish publically viewable search feeds of a location. Geofeedia's weakness is that only 0.77% of public tweets are submitted with geo-location (Semiocast, 2012). At the time of writing the authors do not have figures on the number of geolocated tweets from the other platforms that Geofeedia utilizes. If we assume it is similar to Twitter's percentages then it's possible to see how Geofeedia might be of limited use. Additionally during a disaster infrastructure might be damaged to such an extent that connection to mobile services may be limited or in the event of a security threat, the mobile networks are sometimes disabled. This was observed during the 2013 bombings in Boston where the mobile network was blocked around Boston as a preventative measure in case there were additional explosives set to be detonated by mobile phone.

While exploring the SMACR system's capabilities, two core working objectives were developed for the VOST members. Firstly, they would identify data in any of the above sources that was pertinent to situational awareness and add that data point to Ushahidi via the web interface. Secondly, they were required to manage the evolution of the domain of the event by constantly updating a central list of key terms and hashtags for further filtering.

Integration of SMACR Information into the EOC: Reporting Mechanism

Understanding the information requirements of each ESF is important when considering the development of a reporting mechanism for sending information gleaned from social media to the EOC. Two differing systems could be imagined. The first would involve producing separate reports at the VOST that would be directed to the relevant ESFs. The advantages of this approach might be that you can help avoid information overload within the ESFs in the EOC especially during time critical events. This approach came from the notion of Common *Relevant* Operating Pictures (CROP) (Mendonça et al, 2007) where the heterogeneous nature of multi-agency emergency service activity suggests that it might not be desirable to provide each emergency service with all the information available. McNeese et al. (2006) defined Common Operating Pictures (COP) as the representation of information in order to generate situation awareness across team members. A CROP is created by layering the COP into various subsets, which could be organized according to function, geographic location or service for example, information that is relevant to a particular emergency service, or ESF in this case, can be selected. An advantage of such an approach is that this work would be done by the VOST outside of the EOC thus freeing up in-house resources at the EOC.

While this might be an appropriate approach for the emergency services, it was decided to be unsuitable as a way for the VOST to report information to the EOC. Principally this was decided because the information requirements of the ESFs were not heterogeneous enough to warrant separate reports. For example, while the Planning section is focused on 'ground truth' regarding roads, infrastructure, and utilities, ESF-18 also needs that type of information to plan private sector response. This was experienced during hurricane Sandy where both ESF-5 and ESF-18 could have benefited from information gathered by the FSU.VOST. Restaurant business owners were volunteering their time and perishables to the community. Although a vast amount of goods were being given away, the business and planning community failed to communicate with each other, resulting in the underutilization of valuable goods and services.

The question of experience is also important. The VOST would require a member with knowledge of the inner workings of the EOC and an ability to rapidly categorize information that was relevant to specific ESFs. The FSU.VOST was fortunate to have highly experienced emergency management practitioners within its members but in developing more generic guidelines for how a VOST should operate it should not be assumed that this would be the case. However, we can usually guarantee that there will be experts within the EOC who are capable of doing this job. Also the principle of the VOST is that it is *virtual* and thus could physically exist anywhere. Meaning that its members could be distributed across large geographic areas that would require communications overheads for resolving uncategorized or questionable information. In all cases, it was clear to FDEM that there was no need for targeted reporting.

Thus a second system for reporting to the EOC was ultimately used. This involved creating a single current situation report of social media information to date and feeding it to prearranged contacts within the EOC. In developing the reporting mechanism, the FSU.VOST also needed to consider the regularity and timing of reports that would tie in with the Battle Rhythm of the EOC. Within the EOC, the Battle Rhythm is a deliberate, daily cycle of activities, which is used to synchronize current and future operations (Florida Field Operations Guide, 2012). This includes briefing schedules and shift changes at the EOC. At FDEM, the EOC is unmanned at level 3 (referred to as blue sky days), partially staffed at level 2 and fully staffed 24/7 for a level 1 activation. The reporting mechanism decided on tasked the FSU.VOST with providing reports to the EOC before every shift change at the EOC. This was decided because there is a scheduled briefing at the change of each shift in which newly arriving staffed brought up-to-date on the

current situation. At level 2 this occurs twice in a 24-hour period and at level 1 this occurs three times. In addition to the scheduled reports there was the possibility to send unscheduled flash reports to the EOC in the event that anything that was considered to be of high importance occurred.

The final consideration in reporting was the style and length of the report. The information provided to the EOC had to be reported in such a way that it did not lead the reader into a conclusion about what that information meant. The reports would contain information snippets that added to situation awareness with as much verified fact as possible and wherever possible would provide statistical information of the significance of that data in relation to its use from social media users.

## Application

Deployment: Practical Considerations

The practical activation of the VOST is a two step process. First, an initial message is sent to VOST members via email, including basic information about the event and the anticipated duration of the event. This message requests the VOST members determine their availability to work the activation, and to return that information to the VOST Team Leader. The second step involves activating all the technology tools, including keyword and hashtag lists, assigning of VOST personnel to shifts, and beginning collection of data. The command structure involves a team leader who is responsible for coordinating work assignments for VOST members, as well as communicating with FDEM personnel. During a typical work period, there will be three to four volunteers as well as the Team Leader actively monitoring and creating information for the client agency. It is important to maintain this single point of contact to ensure that all information that passes to the client is vetted and appropriate, and to ensure that the client isn't receiving incomplete or duplicated information from within the VOST's members.

Deployment: TS Andrea & Event X

For tropical storm Andrea, FSU.VOST was tasked by the FDEM EOC to monitor social media to report what people were doing in preparation for the storm and report on the extent of any damage caused. The official dates of the event were 5th-8th July. Crisis Tracker processed 3853 tweets over a 54-hour period, 4.57 % of which were geolocated, with a smaller unspecified amount being collected manually. The VOST collected data on small amounts of damage mostly caused by tornados spinning off from the storm. Six scheduled reports were submitted to the SEOC.

For *Event X*, FSU.VOST was tasked with assessing public sentiment in relation to the event, incitements of violence and identifying potential places where violent acts might take place. Crisis Tracker processed 2,410,486 tweets over a 62-hour period. FSU.VOST provided eight scheduled situation reports and five flash reports for this event.

## Findings and Discussion

The SMACR system represents an ongoing project on how to actually utilize and integrate the many off-the-shelf products that can be utilized by a VOST for monitoring social media and reporting this information to working emergency operations center. The benefits of working with Florida's SEOC is that it is regarded as one of the busiest and most

experienced EOCs in the United States. Based in the midst of the Atlantic basin encountering on average eleven named weather systems per year, around six of which are hurricane strength where two are likely to be category 3 hurricanes (wind speeds greater than 111mph) (National Hurricane Center, 2013). As such the FSU.VOST is in a privileged position of being able to develop and evaluate the processes by which a VOST can integrate social media into the situation awareness of the EOC.

Unfortunately the two events for which the FSU.VOST was activated, the SEOC never reached above level 2 activation. In real terms this means that tropical Storm Andrea and Event X were non-events from the view of the SEOC whose primary objects are to firstly prevent loss of life and secondly, to prevent damage or destruction of property. As such the reports submitted by the FSU.VOST did not feature a great amount of new information that would directly prompt the SEOC in to action in relation to its primary objectives. However, this can be viewed positively since it provided a chance to test the processes involved within the VOST and the reporting mechanism with the SEOC under less stressful conditions than a level 1 activation might provide.

The missions given to the FSU.VOST by the SEOC were significantly different for the two events. During tropical storm Andrea the task was to collect information from social media reporting damage and hazards. Such information is usually quantitative and possible to verify, especially if images are collected. For Event X, the task was to collect data on sentiment with a view to assessing the likelihood of unrest or acts of violence breaking out. This is a harder task since it is to do with qualitative information. In this scenario the human element in the SMACR system was appreciated since there is a certain amount of interpretation required and meaning attributed which a simple computer program might struggle with.

The feedback from the SEOC was positive in relation to the reports that were submitted and the working process between the two organizations was deemed suitable. In addition to the developed working process, a continuous feedback stream emerged from the SEOC to the FSU.VOST with new sub-events or terms that it requested additional information on and which were subsequently added to the domain of the event. This represents a continuous collaborative process of refining the domain of the event so that the correct filters are being applied during searching and suggests that the VOST should also discard redundant filters as the event evolves.

Comparatively, tropical storm Andrea had significantly less data points (tweets, flikrs, instagrams etc.) than *Event X*. A learning point for the SEOC was that a lack of reaction on social media correlated with non-severe meteorological reports could verify that the storm was not going to significantly impact on the regions it hit. Alternatively, a lack of social media traffic correlated with severe meteorological reports could signify that serious infrastructure damage had occurred in those areas.

Following these two initial activations of the SMACR system, the FSU.VOST is now looking to further integrate the composite technologies so that that the creation of reports into Ushahidi is more automated and thus quicker for the VOST member. This will allow more efficient gathering of information, which it is foreseen, will become more important during a level 1 activation.

The FSU.VOST are also working with the FDEM to develop a standardized tweeting system for reporting incidents through social media that they will promote to the public. The hope is that if the public understands the ways in which they can be more useful in their social media contributions then there will be a higher degree of immediately ready information available for social media streams.

## References


Crisis Tracker, Online: http://ufn.virtues.fi/~jakob/twitter/explorestories.php

Florida Field Operations Guide, Chapter Six (Oct 2012). http://floridadisaster.org/FOG/chapter06.pdf

Geofeedia, Online: https://geofeedia.com

Kash, W.: Red Cross Launches Social Media Ops Center For Humanitarian Relief. http://gov.aol.com/2012/03/07/red-cross-launches-social-media-ops-center-for-humanitarian-reli/ (2012)

Logan, K., Ramsay, J. (2012) Introduction to Homeland Security. Westview Press.

Mendonça, D., Jefferson, T. and Harrald, J. (2007) Collaborative adhocracies and mix-and-match technologies in emergency management. *Communications of the ACM*, March 2007, Vol.50, No. 3 pp. 45-49.

National Hurricane Center (2013) Toprical Cyclone Climatology, National Weather Service, last updated 31-may-2013, Online: http://www.nhc.noaa.gov/climo/ Last Accessed: 10/7/2013

Palen, P., Vieweg, S., Liu, S.B. & Hughes, A.L., (2009) Crisis in a Networked World. Features of Computer-Mediated Communication in the April 16, 2007 Virginia Tech Event, Social Science Computer Review OnlineFirst, April 8, 2009, Sage Publications
Schneiderman, B. & Preece, J., (2007), 911.gov, Science, Vol 315, pg 994, AAAS

Rogstadius, J., Vukovic, M., Teixeira, C., Kostakos, V., Karapanos, E., & Laredo, J. Crisis Tracker: Crowdsourced Socal Media Curation for Disaster Awareness. *Pre-print manuscript accepted for publication in September 2013 in the IBM Journal of Research and Development.*

Starbird, K., Palen, L. & Muzny, G. (2012) Learning from the Crowd: Collaborative Filtering Techniques for Identifying On-the-Ground Twitterers during Mass Disruptions, Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada April 2012, L.Rothkrantz, J. Ristvej and Z. Franco, eds.

Starbird, K. & Stamberger, J. (2010) Tweak the Tweet: Leveraging Microblogging Proliferation with a Prescriptive Syntax to Support Citizen Reporting, Proceedings of the 7th International ISCRAM Conference-Seattle, USA, May 2010

St. Denis, L., Hughes, A., Palen, L. (2012). Trial by Fire: The Deployment of Trusted Digital Volunteers in the 2011 Shadow Lake Fire, Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada April 2012, L.Rothkrantz, J. Ristvej and Z. Franco, eds

Semiocast (july 2012) Twitter reaches half a billion accounts – More than 140 million in the U.S, Online:
http://semiocast.com/en/publications/2012_07_30_Twitter_reaches_half_a_billion_accounts_140m_in_the_US, Last Accessed 10/7/2013

Twitter, Online: http://twitter.com

## Acknowledgements

The authors would like to thank Brad Skillman from the Emergency Management and Homeland Security Programme at Florida State University for his contribution to this paper.

## Author Biography

Tom Duffy

Originally from North Yorkshire in England, Tom currently works as a research scholar at Florida State University for the Center for Disaster Risk Policy and the Emergency Management and Homeland Security program. Tom has a MEng in Computer Systems Engineering from University of Birmingham UK and a MA in the History and Culture of Paris from The University of London Institution in Paris. Tom is currently in his writing up stage for a PhD entitled 'Collaborative Sensemaking', with University of Birmingham. His research is currently focused on establishing ground truth in disasters and collaboration in emergency response and recovery.

David Merrick

David F. Merrick (MA) is the Director of the Center for Disaster Risk Policy and Deputy Director of the Emergency Management and Homeland Security Program at Florida State University. He teaches "Disaster Systems", "Emergency Management Planning and Policy", and "Foundations of Emergency Management" and regularly guest lectures in other EM program courses. His research interests include the use of information systems in disaster management, post-disaster logistics, and homeland security policy. He supervises applied and academic research regarding disaster management and is a reservist for the State of Florida's State Emergency Response Team and a current member of the International Association of Emergency Managers.

Kristin Samulkewitsch

Kristin Samulkewitsch is a student researcher for the Center for Disaster Risk Policy at Florida State University. As a Student Researcher, Kristin assists with classes in the Emergency Management and Homeland Security program, supports and staffs the Disaster Incident Research Team and the Virtual Operations Support Team, and concentrates in plans and conducting exercises. Ms. Samulkewitsch graduated from Florida State University in 2011 with a Bachelor's degree in Economics and is currently pursuing her Masters in International Affairs, concentrating in Emergency Management.