Secure Information Sharing and Analysis for Effective Emergency Management

Nabil R. Adam
Rutgers University
CIMIC and MS/IS
Newark, NJ 07102
adam@adam.rutgers.edu

Vijay Atluri
Rutgers University
CIMIC and MS/IS
Newark, NJ 07102
atluri@cimic.rutgers.edu

Soon Ae Chun
City University of New York
College of Staten Island
Staten Island, NY 10314
chun@mail.csi.cuny.edu

John Ellenberger
SAP Research
Eastern Region of North America
john.ellenberger@sap.com

Basit Shafiq
Rutgers University
CIMIC and MS/IS
Newark, NJ 07102
1-973-353-1642
basit@cimic.rutgers.edu

Jaideep Vaidya & Hui Xiong
Rutgers University
CIMIC and MS/IS
Newark, NJ 07102
1-973-353-1642
{jsvaidya,hui}@cimic.rutgers.edu

ABSTRACT
Effective incident management and response requires timely and coordinated decision making. 9/11, Katrina and other emergent events demonstrate the need for effective information sharing and decision support at the operational as well as at the strategic levels. There has been significant work on emergency response at the first-responder level. This paper addresses the challenge of integrating, aggregating and securely sharing information to support situation awareness and response at the strategic level. Drawing on data from various autonomous systems, the system uses context-sensitive parameters to filter, integrate, and effectively visualize information necessary to get a common operational picture. One of the challenges is to facilitate information sharing in a secure manner. Information sharing remains a major barrier due to the privacy and ownership concerns on the data, and due to a wide variety of security policies adopted within different government agencies.

Categories and Subject Descriptors
H5.3 [Group and Organization Interfaces] Computer-supported cooperative work; J7 [Computers in Other Systems] Command and Control

General Terms
Secure information sharing, Policy, Situation Awareness, Emergency management, strategic decision support

Keywords
Context-based content filtering, data analysis and fusing, policy-based sharing and dissemination, Web services, Emergency management ontology, semantics

1. INTRODUCTION
Effective incident management and response require timely and coordinated decision making. 9/11, Katrina and other emergent events demonstrate the need for effective information sharing and decision support at the operational as well as at the strategic levels. The Regional Information Joint Awareness Network (RIJAN) was established in 2003 as a framework to provide information sharing, collaboration and communications capability that enables local, state and federal government entities to share information and coordinate incident management response during an emergency. The operational prototype for RIJAN has been under development to provide secure communication networks, information visualization and collaboration tools for situational awareness and to enable senior leaders to make informed decisions.

The high-level goal of the RIJAN system is to provide the following: a) Multi-agency collaboration that allows commanders from multiple agencies to work together to resolve an emergency situation; b) A flexible data architecture that allows a wide range of public and private sources to be integrated together to provide a comprehensive situational awareness; c) A robust security model that allows emergency response agencies access to their own information as well as the ability to selectively share information with other participating agencies.

This demonstration presents RIJAN project’s overall goal, requirements, research activities, prototype system architecture and capabilities of intra and inter-agency secure information sharing that improves emergency management and collaboration, with meaningful and intelligent information analyzed, filtered and meshed with diverse relevant data sources.

We present the capabilities of information sharing based on agency-specific policies, location and temporal context, events, semantics and preferences. The incident reports from the agencies and public can be disseminated and shared according to the roles, incident types, locations and preferences. The policy management tool, map-based visualization tool, and resource annotation and management tool will also be demonstrated.

2. ISSA: RIJAN PROTOTYPE SYSTEM
RIJAN’s prototype system, Intelligent Shared Situation Awareness (iSSA) system, is an SOA infrastructure solution that is capable of information extraction and knowledge discovery and integration, that helps decision makers and responders to be aware of the emergency and crisis situation for making right and timely decisions to manage crisis situations. The system uses a hurricane scenario to illustrate the research approaches and development feasibilities, but the basic functionalities and
approaches should be duplicable in other types of incidents. The major functionalities is achieved by several components shown in the system architecture Figure 1.

![i-SSA Prototype Architecture](image)

**Figure 1 RIJAN Prototype System Architecture**

### 2.1 Functionalities

**Context-based Content Extraction, Filtering and Fusion:** The content extraction and filtering component monitors the data sources on the Web and sensor networks, and extract the relevant data items. Specific functionalities include weather parameter extraction from Weather RSS feeds, news data extraction from major news agency RSS feeds that describes the potential and current incidents; Also included are functionalities such as traffic condition data extraction from road and traffic conditions news; traffic choke point identification, bus tracking and vehicle classification, traffic statistics from traffic video and image sensor data.

The information is fused based on the location and presented with geospatial map. We filter and extract using the map-related web services such as Geocode services, to identify co-location events from different sources. (See an example in Figure 2.). In addition to this dynamic live data from the Web sources, we also extract information from documents to construct the static knowledge and rule base. This includes extraction of zone and evacuation rules from evacuation plan documents of different agencies; The rules may contain zone information and hurricane category information as condition of the rules and shelter information, evacuation routes and transportation media as part of rules body. The extraction of general hurricane-related information is also part of this component. This component also includes the extraction and filtering of the manual data feeds such as situation reports, sensor alarms, and email alerts.

**Secure Resource Sharing and Collaboration:** This component provides functionality for collaboration and sharing information among agencies. Agency-specific information sharing policies are important factors, thus providing secure sharing and interoperation. The agency specific policies dictate the resource sharing [1].

**Event-based Information Dissemination:** The system is capable of recognizing an event from either human interaction or an automatic data source monitoring. An event triggers actions that are pertinent to the relevant policies and roles to notify. It disseminate the alerts and information via personalized manner, such as diverse devices and modes [2].

**Ranking and Prioritization:** The iSSA system provides functionality of extracting meaningful events from unstructured data. Examples of these include text data such as News feeds, transcripts of eye witness accounts, and situation reports, as well as graph data such as linked web logs. We use an event taxonomy which includes conceptual level information of different event types. Prioritization and rankings are also personalized based on the event severity, semantics as well as agency roles.

**Semantic and Contextual Annotation Tools:** Often the focus area of the events may require attention from all participating decision makers. The map annotation tools allows one user draw on an area (e.g. circle), and the resources and needed information in that location will be shared with other participants.

**Video and Sensor Data Stream Analysis for Situation Awareness and Predictions:** Video and camera surveillance devices on critical infrastructure feeds data in rapid manner. Automatic detection of significant events and patterns are required.

**Risk Assessment and Trend Analyses:** iSSA system will provide risk and damage assessment tools for estimating the magnitude of incident effects. These tools will facilitate strategic-level decision making for proper allocation of resources before, during and after incidents. The existing simulation models available as Web Services is utilized. We also develop algorithms and methodologies to detect the risk areas and objects using remotely sensed data and other GIS data.

![Location-based Data Fusion](image)

**Figure 2 Location-based Data Fusion**

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### 4. References
