

## Cross Layered Design of 3G Radio Access Network to Optimize Network Performance

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### ABSTRACT

Social media's popularity has been changed the way in which companies and individuals interact with each other and share some applications, images, videos and services. These micro blogging services have enabled customers to provide their positive, negative and/or noncommittal sentiment and opinion about any topic from entertainment to significant weather events. In this research, we build a framework that merges the twitter, natural disaster and aviation communities. We considered 4 U.S.-based severe weather events that included tornadoes, hurricane and massive snowstorm (called a nor'easter), 6 large and medium sized airlines and 3 weather stations. Through our evaluation, we showed how a suite of keywords correlated to the weather event geographically and the timeliness of the notification from the weather service and airlines. We showed how we can effectively leverage the micro blogging platform for airlines in a significant weather event situation.

**Keywords:** *Data management, experimentation, twitter, social media, smart phones, smart technology*

### 1. INTRODUCTION

In the event of a natural calamity, airlines might not stick to their original flight schedules. In that case, airlines inform air passengers of flight delays, postponements and cancellations through mobile devices (Smartphone, tablet computers) and social networking websites (twitter). Twitter has changed how individuals and companies access and disseminate information in the private and public sector with 200+ million tweets per day. The blending of hobbies, professional and personal life can be easily captured via online social networks such as the micro blogging service Twitter. Twitter use can be classified into three main categories: users who mostly tweet e.g., companies, users who tweet and follow equally e.g., active social networkers and users who mostly follow e.g., inactive social networkers. For companies, twitter provides immediate access to their customer base for new products & service promotions and releases [1, 10, 13]. The active social networker follows both companies and other people. However, the majority of the tweets are conversational messages between people. The third group, inactive social networkers, are not interested in the two-way communication aspect available on twitter, but as an information gathering resource. Regardless of which group the twitter user falls, the objective is to filter the abundance of available information into a manageable and customizable information stream. Twitter data collection has traditionally involved downloading user profiles individually and then partitioning them using community detection algorithms [4]; however, due to the time-consuming nature of this task, more real-time node-crawling and community structure building approaches have emerged [8] to effectively filter relevant tweets.

Given the twitter's popularity, airline companies have created individual profiles to reach their customer base for a variety of reasons. In many cases, airlines use twitter as another marketing and sales conduit. In providing customer service,

airlines use twitter for flight status update during a significant weather event. We study how prevalent flight-related data is available on twitter in order to determine a commercial airline's quality of service to its customers in a significant weather event. We can then assess if twitter is a valuable communication network for air passengers and their travel needs.

To accomplish this goal, we propose our Flight Data Analyzer framework, which has 4 main objectives: (1) identify flight-related categories (or clusters) being tweeted/re-tweeted, (2) gather and assess partial and exact information, (3) ascertain possible correlation of Twitter data with weather information and (4) test the effectiveness of our framework in completing the flight-related data twitter assessment. Within our framework, we focused our information gathering to selected six airlines, four significant weather events and three weather services that are all based in the United States as identified below.

- **Airlines:** American, Delta, United, Southwest, JetBlue, Spirit
- **Weather Events:** April 25-28, 2011 Tornado Outbreak, Joplin, Missouri Tornado (May 2011), Hurricane Irene (August 2011), Halloween Nor'easter (October 2011)
- **Weather Services:** The Weather Channel, Accu Weather, NOAA

In this research, we made the following contributions:

- We designed a completely java-based modular framework for gathering, storing and processing flight-related data on twitter.
- We created a semi-automated process that related each weather event to an airline called the Fetcher Module. Airline and weather services twitter accounts are leveraged to identify relevant and accessible twitter data.

- We correlated the weather conditions with the gathered tweeted content through our Post-Filter and Analyzer Modules. In particular, we sought to answer the following questions: what notifications were tweeted from the airlines and what was the timeliness of the notifications, if any? What geographical regions were affected by each significant weather event? What were the airline & flight numbers?
- We tested the performance of our Flight Data Analyzer framework through the Performance Module, which provides basic statistics about tweets, re-tweets and run time of the Analyzer Module.

Section 2 describes the prior work done on twitter and through aviation. Section 3 summarizes the targeted U.S. airlines, weather events and weather services. In Section 4, we described the components of our Flight Data Analyzer framework and the modules. This application will collect information on past natural disasters, and how they relate to the operation of the airlines in question. This application will primarily serve to analyze and draw conclusions from a small number of sample events, airlines, and weather stations. Section 5 discusses the results of our experimental evaluation. We provide each airline's quality of service assessment, including responsiveness, compensations and/or live customer service contact, during significant weather events. We conclude the research in Section 6.

## 2. RELATED WORK

Launched in 2006, twitter has altered the manner in which the business industry and individuals communicate with each other. In 2007, Java et al. [7] discussed the micro blogging phenomena and classified user activities as information seeking, information sharing or social activity. In 2008, Krishnamurthy et al. [9] characterized twitter data from January 12 to February 22 of that year with respect to the follower/following user relationships, status update influences and growth patterns. Cheong et al. [3] performed text analysis of 1500 tweets on each of the 4 selected trending topics to determine the "collective wisdom" of the twitter community. TURank [16] extended the usefulness of tweets by identifying a twitter user's authority score through a user-tweet graph analysis. However, the emerging twitter research considers cross-domain recommendations [5] that can link concepts and the building of a personalized semantic-based recommender framework.

For industry, twitter is viewed as an electronic word-of-mouth (eWOM) community [6] by examining trends and characteristics of brand micro blogging. A segment of the research is in sentiment analysis (no sentiment, wretched, bad, so-so, swell and great scale) [6], information theory [6, 11], term frequency-inverse document frequency statistics [11,15] and social network analysis [2, 4,13]. Twitter has been used during and after a significant weather event [2, 11, 15] with airlines beginning to be investigated for their usefulness in these situations [12, 14]. In Cheong and Cheong [2] extracted tweets concerning the 2010-2011, Australian floods were processed to identify crucial users for disseminating critical information about these natural disasters. Given that twitter is a real-time, highly distributed, decentralized technology, the

work discovers that local and federal agencies could leverage this resource more effectively. It can also be concluded that social network analysis approaches to find key twitter users through their user-resources network.

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