A Rapid Method for Detecting Geographically Disconnected Areas after Disasters

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Introduction

- The incidence of disasters has increased dramatically in terms of their frequency, scale, intensity, and consequent damage.

Earthquakes in 2010  
Earthquakes in 2011

*Images from Wikipedia*
Disaster Response Strategy

- An ideal solution must meet the four criteria:
  - the response must be **rapid**;  
  - it must be **methodical**;  
  - it must be **continually updated**; and  
  - it requires close **cooperation**.
Current Solutions

- Situation reports sent from the frontline to the disaster recovery center by various means, such as phone calls, faxes and emails.

- Problems: It cannot determine whether an area was safe or severely damaged if there are no situation reports for that area.

- We believe that data communication is the key to improve conventional solution and fulfilling the above criteria.
Objective

- Two reasons
  1. Network outage results in the isolation of disaster victims from the outside world
  2. It also signals the potentially destroying damage in the disconnected areas

- Our goal
  - To discover geographically disconnected areas after disasters rapidly
The Architecture of Internet Footprint Investigation (IFI)

1. Risk analysis report
   - Active Network Probing (ANP)
   - Disaster Response Authorities (DRA)

2. List of potentially disconnected areas
   - Reactive Footprint Searching (RFS)

3. List of geographic areas without Internet footprints
   - Disaster Response Authorities (DRA)
Active Network Probing

- We need a dedicated ANP pre-installed before disaster attack
- Two technical challenges

IP Geolocation Service  
Network Topology Discovery
Active Network Probing (Cont.)

- IP Geolocation Services
  - Existing solutions (e.g., IP2Location and Quova) are not feasible because
    - the accuracy is unacceptable for our purpose
    - they support one-way mapping only
    - they are expensive
  - We need to implement it by ourselves by using existing GIS resources and local knowledge.
Active Network Probing (Cont.)

- Network Topology Discovery
  - existing approaches are not feasible, because
    - they focus on the core network
    - they are ICMP-based
    - they cannot work with dynamic / distributed DNS
  - We need to select “representative” network landmarks, and find their topology.
Reactive Footprint Search

- Victims may exhaust all possible means to send out their messages.
- We can harvest their Internet footprints on LBSNs
  - e.g., Facebook Places, Foursquare, Google Latitude, Gowalla, Twitter, flickr, ...
Evaluation I : IP Geolocation Service

- We chose K-12 schools in the great Kaohsiung area as the network landmarks, and evaluated the accuracy of two off-the-shelf IP geolocation services:

  - [Quova](#)
  - [IP2Location](#)
Evaluation II: RFS Proof-of-concept

http://nrl.iis.sinica.edu.tw/RFS/
Remaining Issues

1. Which hosts are more representative?
2. Given a topology, how to find all disconnected areas in the fastest manner?
3. How to overcome the limitation of LBSN API?
4. Can we interpret the message of carried in Internet footprint?
Conclusion

- We proposed an approach called Internet Footprint Investigation for rapid discovery of geographically disconnected areas after disasters.

- The existing IP geolocation services are not accurate for disaster response purpose.

- RFS is effective to harvest Internet footprints after disasters.

- We are working on the deployment of IFI in Taiwan, and hope to have it ready before the next disaster.
Thank you

Q & A