

# PROPOSAL

## IMPLEMENT AN AIR-BASED MOBILE BASE STATION TO CRISIS AND EMERGENCY MANAGEMENT

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# PROBLEM STATEMENT

## Statement

This project aims at providing an efficient rescue plan on crisis and emergency management for official organization and authority only. Any illegal commercial application shall be sanctioned by law.

## Approach

This project takes effect by existing GSM technology (Global System for Mobile Communications) and SMS (Short Messaging Service), with initiative mobile BS (base station) conception.

When confront large-scale natural or man-made disaster, traditional base stations often fail to diffuse and collect vital signals, because of shocks, outage or man-made detriment. According to reports about communication passage in the Wenchuan great earthquake, Sichuan, China, 2008, telecommunication of civilian use did not recover until 25 hours later<sup>1</sup>. Even though the center government deployed 2 sets of satellite car, 1 power truck, 6 satellites phones (330 mobile telecommunication equipment in total) to cope with the damage of mobile communication invalidation at first time, unfortunately, mostly installments are blocked on the way to distress area.

Therefore, this project desires to provide a new method to accelerate rescue process by a pseudo service zone. All entities in need are Helicopters (more than three), mobile base station and an information processing backstage, and the latter can be settled outside of disaster area.

# SUPPORT ANALYSIS

## Mobile phones application (TE+MS)

According to a report from International Telecommunication Union 2010, 57% of residents in developing or less-developed countries sign up own mobile phones<sup>2</sup>. The current state is even more hopeful, because many people do use unregistered mobile phones.

## Helicopter

- Carrying capacity: more than 20 T<sup>3</sup>;
- Max flying duration: more than 24 hours, 10 hours average;
- Max hang stops time span: more than 40min<sup>4</sup>

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<sup>1</sup> <http://www.cnetnews.com.cn/2008/0514/859588.shtml>, accessible on November 11, 2010

<sup>2</sup> <http://news.bbc.co.uk/2/hi/8560310.stm>, accessible on November 11, 2010

<sup>3</sup> <http://2jji.com/?p=917>, [http://www.deagel.com/Tactical-Support-Helicopters/Mi-26\\_a000359001.aspx](http://www.deagel.com/Tactical-Support-Helicopters/Mi-26_a000359001.aspx)  
accessible on November 11, 2010

## Base Station

- GSM has covered the entire world. Data shows every  $\frac{1}{4}$  mobile phone users is a consumer of GSM network.<sup>5</sup>
- Fixed base stations or even outside distributed mobile base stations are not stable for



Figure 2 Base station's malfunction in storms, Guangxi, China 2008-02-02 16:26:29



Figure 1 icing cable in storms, Guangxi, China 2008-02-02 16:26:29

serious natural or man-made conditions.

This is a conception, which helps to understand of the mobile base stations' relative position, comparing with each other from a view of the God. We suppose one of the ground base stations is totally destroyed by the disaster. The helicopter will hang above the disaster area and offer continuing signal transmission to the lost cell phone stay in standby status.

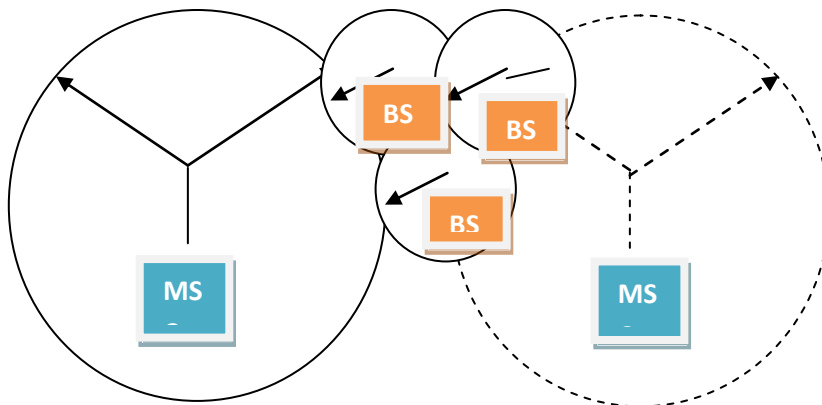


Figure 3 minimization feature and construction of base stations deployment.

<sup>4</sup> <http://en.wikipedia.org/wiki/Helicopter> , [http://en.wikipedia.org/wiki/Boeing\\_A160\\_Hummingbird](http://en.wikipedia.org/wiki/Boeing_A160_Hummingbird). Accessible on November 11, 2010

<sup>5</sup> <http://www.cnetnews.com.cn/2010/1104/1930268.shtml>. Accessible on November 11, 2010

### Ring-Shaped Cell Clustering simplifies the framing system

Traditional arrangement of cells in a hexagonal pattern covering the plane is a natural consequence of the way wireless coverage is provided in terrestrial systems. However, when coverage is established from an antenna mounted on a circling plane, or on an airship rotating around its central axis due to stratospheric winds, the “natural” cell shape is a geometric pattern invariant to such platform movements. Such coverage, made up of a set of concentric rings, is shown in Fig. 4. The arrangement is possible since cell shapes and their relative positions are of no consequence to the operation of a cellular system and, in fact,

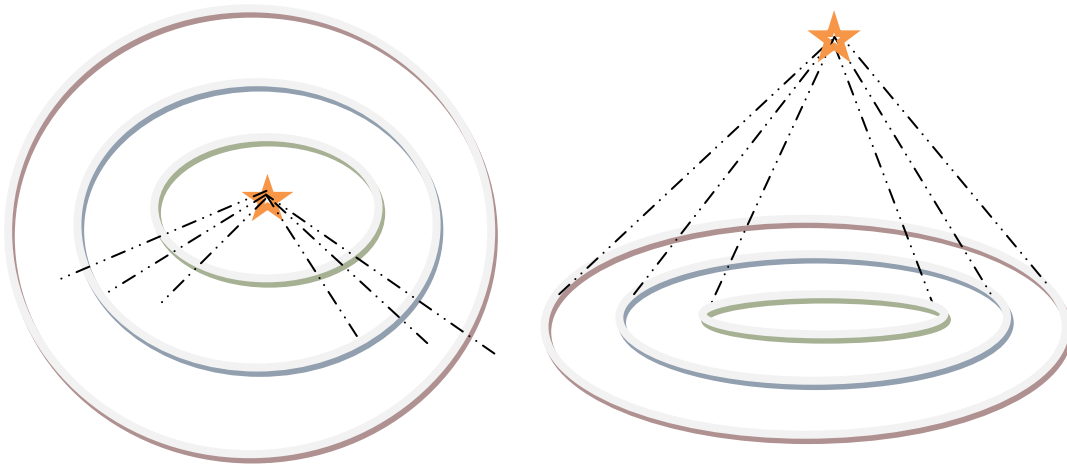


Figure 4 plain view and plan view of the mobile base station

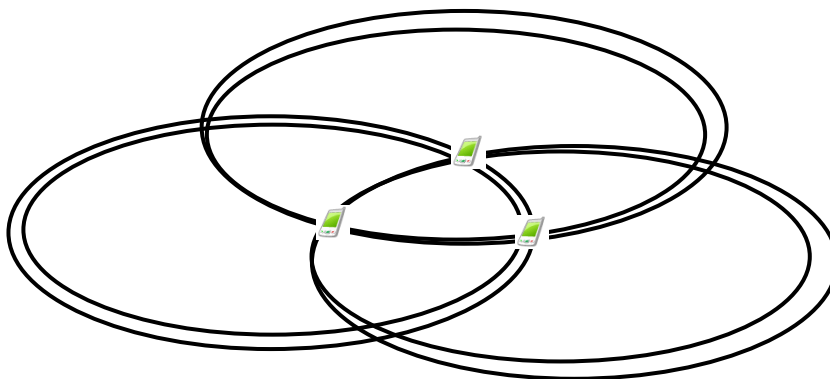
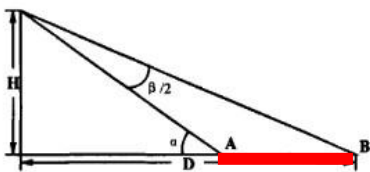
Even have certain advantages over the traditional pattern<sup>1</sup>.

To be specific, the included angle of the various signals sent to the ground will calculate the cell phone's possible position in a concentric circle. When the two concentric circles infinitely close, then they coincide and limit the signal on one circle line.

As common sense, two intersected circle will have two crossing points, which cannot identify one exact coordinate. Then if the intersection locates in another circle which the third mobile base station's covering, it is easy to know about the accurate location of this signal.

After this processing process, the information center will calculate the framing signal of all the standby status cell phones.

Figure 5 Angle change method



Cooperation Involved

- Local Government
- International NGOs
- Technology Group and Information Processing Group
- Rescue Teams

## **IMPLEMENT PROCEDURE**

The core processing procedures conclude:

- A. To calculate and program an emergency information processing center with basis of MSC (mobile switching center) for collecting and dismiss messages.
- B. To install and implement mobile base stations on helicopters, which hang in the air with a honeycomb structure.
- C. To set up a pseudo service area and induce a spontaneous signal with IMSI (International Mobile Subscriber Identity) sent from victims' active mobile phone. With all collected IMSI data, center will know how much mobile phone keep standby mode.
- D. To push in one self-rescued instruction message (SMS) to standby users' mobile phones
- E. To collect a "read report" data from active user, calculate all/active users' framing signal by an Antenna Decline Technology. Meanwhile, a time angle of arrival (AOA) data fusion location algorithm is proposed to draft two pictures: one is all the standby mobile phone's distribution graph, the latter shows active users' frame of references on the former.
- F. To process collected and summarize short messages from victims.
- G. To appoint a pointed rescue team to the most-help-in- need district.

Here is the flow chart for automatically completed process:

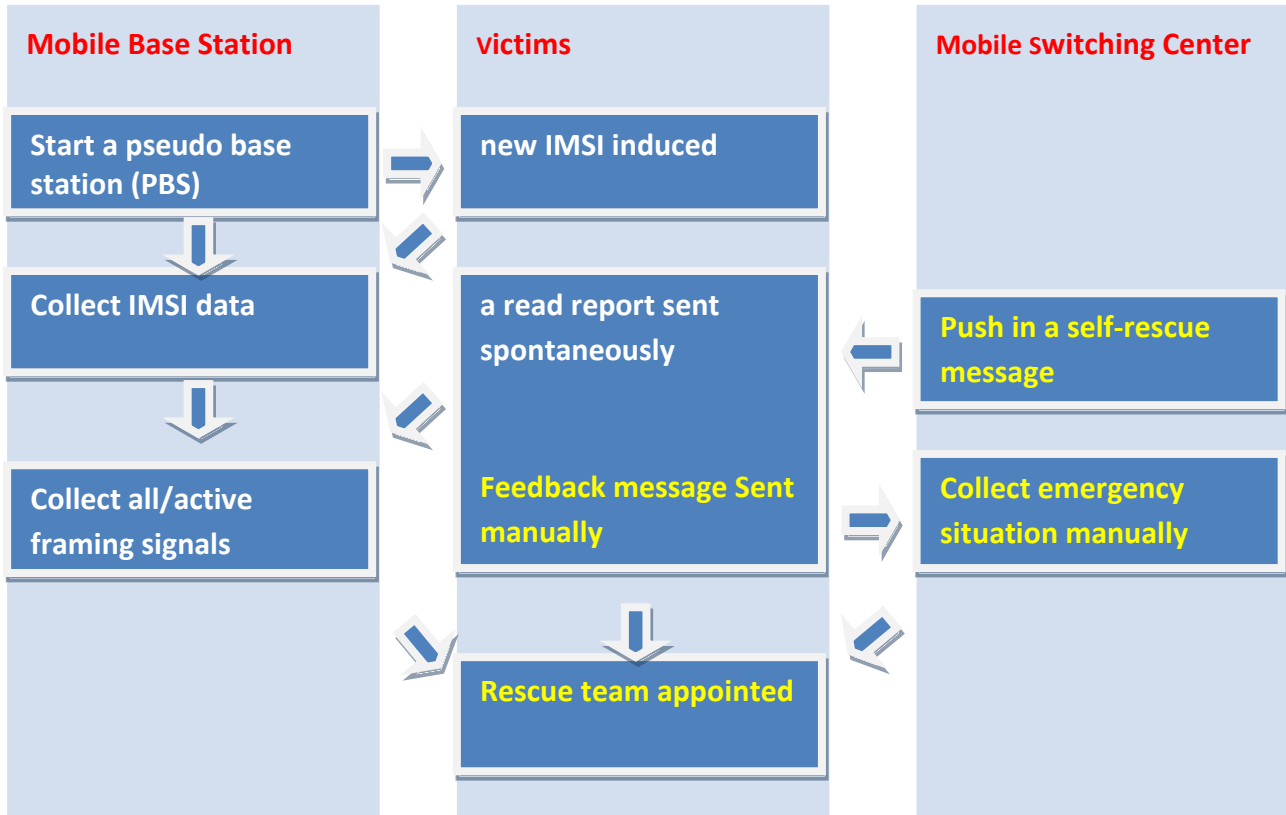


Figure 4 Notice: all procedure in white is implemented inartificially; others in yellow are led by artificial intelligence.

This project involves a great number of budget analysis and negotiation process. Therefore, the timeline of whole project is depends on the speed of response of technology group people and permission given by relevant government.

Hopefully, when three parts involved in the emergency management get ready. Helicopters will arrive fast, and all the signal distribution and gathering process will be finished in 0.3-140s.

## DISCUSSION

This project has an innovation implemented into a high-level information processing platform of SMS application and mobile base station development. It has practical and theoretical guiding value, especially for today's world wide crisis and emergency studies.

Analysis the complementation of all above, advantages of this project is:

- Considering the limitation of 3G coverage in less-developed countries;
- Considering the practical application cost and feasibility of helicopters;
- Considering the existing weakness of mobile base station shipped by automobile on ground;
- Considering the distinction between mobile phones in standby mode and active mode;

- Considering the multi-dimensions of information's collection and summary.

## **EXPECTED OUTCOMES**

- Start a crisis and emergency management in 30 min.
- Pseudo Base Station network takes effect.
- Communication with SMS and relevant channel won't stop for more than 1 hour.
- Victims distribution graph will help to allocate aid requires with scale error in 5-50m.
- This project saves 30% more victims in first 3 years.



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