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The Role of Mobile and Remote Sensing Satellites in Disaster Management

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Abstract: *Disaster management aim is human casualty decreasing in natural events such as earth quack, flood, thunderstorms and …. As well as in air crashes, accidents and…. In this paper we use mobile satellite services (MSS) and remote sensing satellites to provide this purpose. Mobile satellites contains 3 type of satellites; LEO, MEO and GEO. Remote sensing satellites are two categories: optical and microwave. In first section the introduction is presented, section two and three are about mobile satellites and remote sensing satellites, section four analyzes data and finally conclusion will be presented.*

Key words: *disaster management, mobile satellite, remote sensing.*

I. Introduction

Unpredictable events are happened at anytime and anywhere. These events can be manage consciously whereas we have been the least damages and casualty. In this paper we use iDirect [1] idea to disaster management. There are 3 phases: preparedness, response, recovery and reconstruction. Preparedness phase is fast action in damaged area , response phase is search and rescue operation that takes place within several weeks, recovery phase is make temporary centers to aid victims or local people and reconstruction phase is help to develop and reconstruct the area to get normal conditions. Several problems should be considered in using satellites such as flexibility, scalability, fast deployment, portability, easy installation, mobility, industrialized equipment, bandwidth management, and security. Figure 1 shows satellites connections.

We use communication satellites for make connections among people and send different files; the main use of this is in telemedicine. Also we use remote sensing satellites to take photos from damaged area then extract data from them, finally analyze and compare data before and after event.

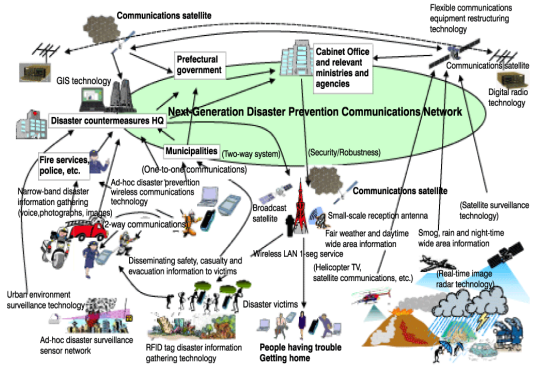


Fig.1: satellites connections [2]

Several research have been done such assatellite image analysis for disaster management [3], a satellite core network syatem for disaster recovery [4], small satellite utilization for disaster management [5], ASTER satellite for disaster management [6], rapid image product from satellite for disaster management [7] and satellite-enabled ehealth in disaster management [8].

II. Mobile satellite services

The mobile satellites have been launched since 1980. Because they have mobile ground station, they are called mobile satellites. They are used in several industries amongstdisaster management to communicate data.

2-1.whole shape

The mobile satellite network includes 3 segments: user segment, ground segment and space segment. It is illustrates in figure 2.

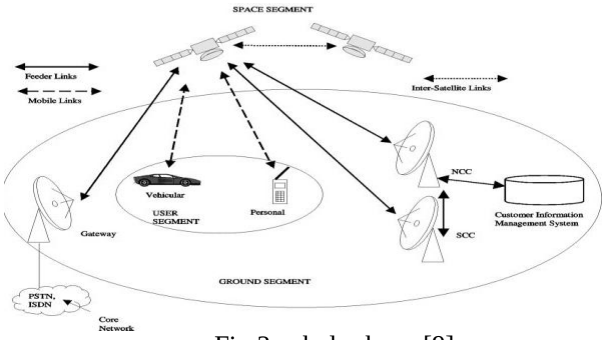
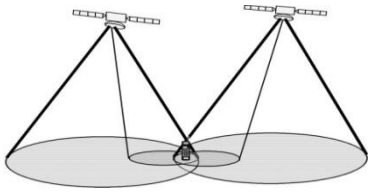


Fig.2. whole shape [9]

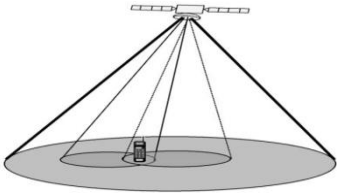
User segment is mobile node that can be a device to send telemedicine or any other data in damaged area. Ground segment contains 3 sections: gateway whichis fixednode and provides local networks, network control center which manages network and satellite control center which controls satellite performance. Space segment makes connection between users and gateways.

2-2. Network performance

There are 2 approaches here: integration and mobility management. Integration refers to different generation of mobile telecommunication and mobility management refers to place management and handover. In place management, satellite provides a condition for users to roam within coverage areas. In hand over phase, mobile users change their communication link between two satellites or transpondersas mention in figure 3 because of received strength signal (RSS) or quality of service decreasing.



a) Between two satellites



b) Between two transponders

Fig.3: users roaming [9]

2-3.Channel characteristics

For mobile channel [9]:

Ground mobile channel: it contains 3 components such as direct wave, diffuses components and ground reflections.

Aerial mobile channel: it is more complicated and refers to aircrafts. In this case direct waves are obstructed and the body of aircraft cause to signal multipath, also the Doppler effect should be considered.

*Marin mobile channel:*in this case the reflections from sea surface should be considered.

For fixed channel [9]:

Troposphere: refers to atmosphere conditions.

Ionosphere: refers to frequencies over 10GHz.

III. Remote sensingsatellites

Using remote sensing data especially satellite photographs enable us to extract data before and after events and compare with each other, these pictures have been taken by use of different electromagnetic spectrums. Then we can manage disasters after they happen.

3-1.Optical remote sensing

Opticalremote sensing satellites work in infrared and visible wavelength. The main process to get image data is as figure 4.

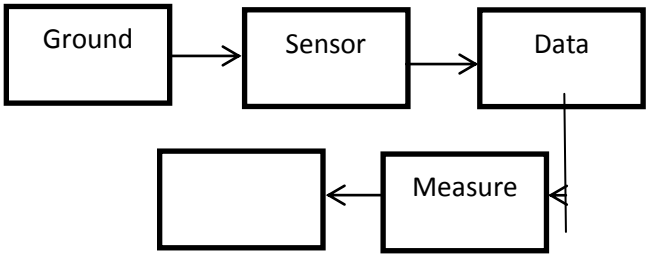


Fig.4: process to get image

Sun radiation is the main source of energy and its radiation above atmosphere is nearly equal to black body temperature (is an ideal radiator that emits all energy incident). Before sun radiation reach earth surface, it should get through atmosphere. Small part of radiation is absorbedby atmosphere windows or scatter in this area but large part of the radiation will reach earth surface.Finally there are two types of reflection from earth surface that based on shape and material of surface: diffuse and specular. The energy incident from earth surface will return to sensors of satellite to configure pictures. All process is illustrated in figure 5.

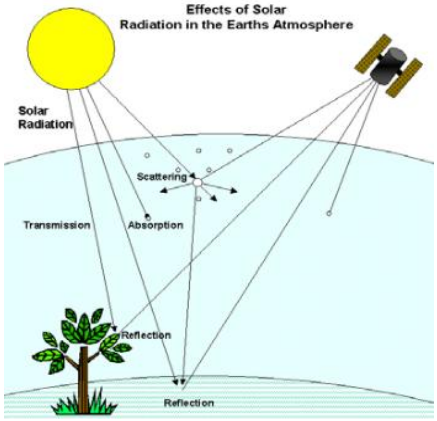


Fig.5: Sun radiation [10]

The amount of energy above Zero K measure by sensors of satellite as two ways: internal temperature and emissivity that is the radiation of an object at a given temperature relative to radiation of a blackbody at the same temperature. The radiation can be measured by Stefan-Boltzmann`s law, Wien's Radiation`s law, Rayliegh-Jean`s law and Plank`s law.

2-2. Microwave remote sensing

There are two types of microwave remote sensing: active and passive. Passive remote sensing responds to microwave energy that are reflected or emitted from surface of objects and active remote sensing suppliesits own source of illumination (radar).

As mentioned in optical remote sensing the amount of radiation emitted by an object in is determined by internal temperature and emissivity, Also this amount is applied by passive remote sensing. In passive remote sensing the emitted energy is sensed by radiometers and scanners.

Active remote sensing is divided to two parts: imaging (radar) and non-imaging (altimeters and scatter meters). For imaging remote sensing the most important parameters for both satellite and target are wavelength or frequency, polarization, look angle, look direction, resolution, surface roughness, complex dielectric, slop angle and orientation as well as it is divided to two type: real aperture radar and synthetic aperture radar, the difference between them is their beam width. Figure 6 shows performance of imaging remote sensing.Azimuth is thedirection on the ground parallel to the motion of sensor and range is the directionin which the signal is transmitted.

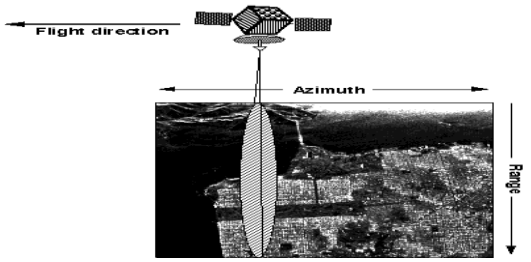


Fig.6: Imaging remote sensing [11]

IV. Data analysis

After explanation of mobile satellite and remote sensing satellite in previous sections, in this section the given data by this satellites and their application will be discussed. Figure 7 illustrate an area in Indonesia before and after earth quake. These received data from optical remote sensing satellite enable local officials to better identify the area then evaluate the finance and human casualty as well as all damages. Eventually, try to reconstructthe area as soon as possible.


a) Before earth quake


b) After earth quake

Fig.7: Earth quake in Indonesia [12]

In figure 8, the data received by optical remote sensing satellite illustrate a serious damage in farm lands of Manitoba, the farm damage is obvious by the white sign.These data that help farmers and related specialist to better evaluate the area and make consequent decisions in future.


Fig.8: Tornado in ManitobaFigure 9illustrates a photo before and after hurricane like flood in Haiti. This photo has been taken by imaging (Radar) remote sensing satellite. The data from this photo can help local officials to better manage crisisand locate damaged areas that has been specified by cream color after disaster.

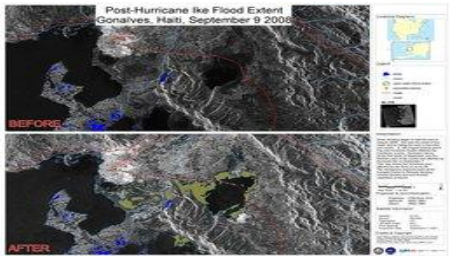


Fig.9: Before and after hurricane in Haiti [13]

Figures10 to 12 show interpret the disaster, send telemedicine data and communicate with each other in disaster time.Mobile satellites can provide these communications at this time and help related officials to better manage disaster and other people to inform that.


Fig.10: Emergency management [12]


Fig.11: Mobile communication [12]

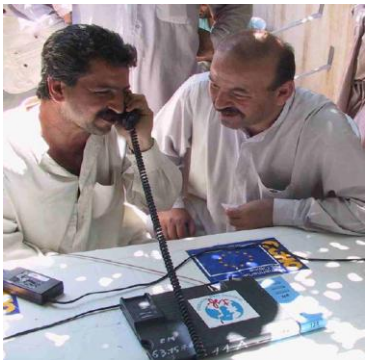


Fig.12: Communication within disaster hours [12]

V. Conclusion

As weviewed in this paper, the phases of disaster management based on iDirect method [1] was discussed and we summarize it in a figure 13by using the method which has been stated in esoa [12] then the performance of mobile and remote sensing satellites were explained.

We should consider to relation between performance of satellites and access data. As mentioned before mobile satellites provide communication and send data at and after disaster time but remote sensing satellite provide an images to compare before and after disaster. We should use the procedures, types, designs, information and … about satellites and combine them to extract data from images.

This field of study has great extent as well as is expandable and can be related with other fields to interpret results from images.

Because of unpredictable nature of disasters, we should more focus on this field to prevent human and environments damagesand finally provide a secure world.

Fig.12: Disaster management phases [12]

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