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GAGAN provides a civil aeronautical navigation signal consistent with International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) as established by the Global Navigation Satellite System (GNSS) Panel. GAGAN system provides NPA (Non-Precision Approach) services of RNP-0.1 over Indian FIR and PA (Precision Approach) services of APV-1.0 (Approach with Vertical guidance) over Indian landmass with effect from December 30, 2013 and May 19, 2015 respectively.

Although primarily meant for Civil Aviation, the GAGAN signal can be used by a vast majority of non-aviation users, such as intelligent transportation, maritime, highways, railways, surveying, geodesy, precision agriculture, security agencies, telecom industry, personal users of position location services etc in the Indian sub continent. The applications of GAGAN to various users are enabled through dissemination of GAGAN messages through the GEO satellites GSAT-8, GSAT-10 and GSAT-15.

GAGAN is utilized for sending short service messages with suitable changes in the message structure. The availability of free bandwidth in the GAGAN system makes it possible to broadcast additional text messages that could be Early Warning/ Alert messages on the occurrence of natural disasters, calamities, dangers for the safety of life within GAGAN coverage area

### **Why through GAGAN**

The Asia-Pacific region has had to cope with an unprecedented number of disasters. People of the Asia-Pacific region are four times more likely to be affected by natural disasters than those living in Africa, and 25 times more likely than those living in Europe or North America – and while the region generated only one quarter of the world's GDP, it accounted for a staggering 85 per cent of deaths and 38 per cent of global economic losses during 1980-2009. In addition to the growing exposure to disasters, the increasing socio-economic losses due to disasters should also be recognized.

*The Asia-Pacific region is very prone to disasters caused by natural hazards. These include droughts, floods, storms, extreme temperatures and wildfires, as well as mass movements such as landslides, volcanoes, earthquakes, avalanches and tsunamis.* According to the International Disaster Database, between 1980-1989 and 1999-2009, the number of disaster events reported globally increased from 1,690 to 3,886 and the trend seems to continue. Over the whole period of 1980-2009, 45 per cent of these were in Asia and the Pacific. India ranks second in the number of disasters and number of people affected in the Asia-Pacific regions.

Timely provision of effective information allows people exposed to hazard to take appropriate action to avoid or reduce the risk and prepare better for effective response. The current early warning systems use communication methods to broadcast the messages which have the limitations like the Warning and location information are not available with the same system; No guarantee for timely service; Limited coverage area and inability to ensure the timely information to the users.

Satellite systems present a distinctive and efficient solution to the delivery of one-to-many messages. In order to reach the maximum number of people in the target area with a reliable information service, a specific technical solution has to be adapted. GAGAN will provide an excellent opportunity to send alert messages and early warning messages through its GEO broadcast reaching out to wider area within shortest possible time.

- The GMS (GAGAN Message Service) concept is concerned with the provision of early warning/Alert messages to citizens or governmental/local authorities in case of a major event or disaster.
- The GMS will open up new means to inform people at risk, for instance, through natural events such as earthquakes, landslides, avalanche's, tsunamis, hurricanes, storm surges, extreme precipitation and flooding, so that specific actions can be taken to mitigate the impact of the disaster and ultimately, to save lives
- The GMS will also support rescue and aid operations in the aftermath of disasters thus reducing the total loss of human lives

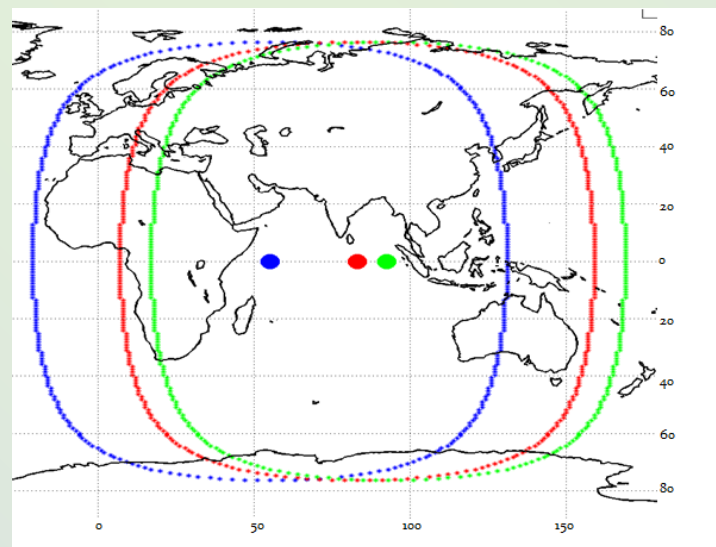
As GAGAN foot-print covers a vast area from South Africa to Australia it can be utilized very effectively in the Asia Pacific region to broadcast short service messages.

Knowing the area/location of the possible disaster or event, which is possibly available with agencies like the NDMA (National Disaster Management Authority), Meteorology Department, INCOIS or SASE, the people living in the affected areas could be warned through GAGAN message broadcast.

The data related to nature of disaster, longevity of catastrophe, expected area of disturbance etc., can be fetched from responsible agency and broadcast through GAGAN GEO satellite to reach out all over Indian region. The satellite based system offers a number of advantages for real-time disaster alerts over current approaches to sending warnings via personal devices.

**Special Features:**

- 1) GAGAN with location information can be used during an emergency. This provides the ability to indicate high priority messages for specific areas and groups.
- 2) The service can cover wider area simultaneously – e.g. the whole of GAGAN foot-print area (from Africa to Australia) – because of its wide area broadcast foot print, and global reception of the signal, there is no limit to the number of people who can be warned simultaneously.
- 3) The messages can still be received even when terrestrial communications infrastructure is damaged or not available. This allows for redundancy.
- 4) As the system is independent of mobile phone coverage it would reach people wherever they are, regardless of the existence of mobile phone coverage.



## FEASIBILITY OF GAGAN MESSAGE SERVICE

It is known that any SBAS transmits correction and integrity parameters in scheduled manner to provide intended service over the coverage area. RTCA DO229C MOPS standard defines the minimum update rate that needs to be respected by SBAS to comply with the safety of life requirements. Even after fulfilling this requirement,

- About 35% of bandwidth is still available free

Also, the message statistics of the GAGAN broadcast shows that about 13000 null messages (Message Type 63) are being sent every day and they are ignored by aviation users. These null message slots can be effectively utilized to carry short text message information for providing emergency services alerts throughout the GEO footprint. Through MT63 – appr. 250 characters /min can be transmitted and this data would be ignored by aviation sensors but usable throughout India and the neighboring countries by mobile phone users and anyone else with an SBAS enabled receivers which are configured to read MT-63.

## User Segment:

The user segment consists of common public residing in affected areas, fisher man, travelers, hikers, etc., The user equipment available today discards the Null message and do not examine its contents. The GAGAN enabled receiver which is configured to read the Null message will receive the L1 signal from GEO satellites, process it, extracts the ALERT/EARLY WARNING TEXT Messages and display the same. Also, the receiver gives the current location of the user from which he can identify whether he is currently in the affected area or not. Separate Apps can be developed to extract these Alert/Early warning messages from GAGAN signal through mobile phones. It may be noted that the aviation receivers will not utilize this capability as MT63 is ignored by them.

