



SUPARCO





Satellite Based Augmentation System Proposed for Pakistan

by

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OUTLINE

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A BRIEF OVERVIEW OF GNSS



GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

System	Country	Positioning Accuracy	Coverage	Operational Status
GPS	USA	10-15 m	Global	Operational
GLONASS	Russia	15 m	Global	Operational with Restrictions. CDMA in Preparation
GALILEO	European Union	10 m	Global	In Preparation
COMPASS	China	At present : 100 m 2012 : 10-15 m 2020 : 10 m	Asian Regional Asian Regional Global	In Preparation



SATELLITE BASED AUGMENTATION SYSTEM



SATELLITE BASED AUGMENTATION SYSTEM

- The augmentation of a GNSS is a method of improving the navigation system's attributes.
 - The goal is to achieve improved accuracy, reliability, availability and integrity which would normally not be possible due to errors caused by various natural elements and phenomenon.
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EXISTING AND UNDER CONSTRUCTION AUGMENTATION SYSTEMS

- **WAAS** (Wide Area Augmentation System); US
 - **LAAS** (Local Area Augmentation System); US
 - **EGNOS** (European Geostationary Navigation Overlay Service); EU
 - **MSAS** (Multifunctional transport satellite Satellite-based Augmentation System); Japan
 - **GAGAN** (GPS Aided Geo Augmented Navigation); India
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MAJOR SBAS SEGMENTS

➤ Ground Segment

Consisting of:

- **Reference stations** (located at precisely surveyed locations for ranging and integrity monitoring)
 - **Master control stations** (collects estimates and processes the data to generate wide area correction messages and integrity information to the user)
 - **Navigation land earth stations** (uplinks the messages to the geo-stationary satellites for further broadcast and communication links to transfer data collected from the reference station to the master control station)
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MAJOR SBAS SEGMENTS

Cont'd..

➤ **Space segment:**

Consisting of:

- GPS/GLONASS/Galileo/Compass satellites
- GEO satellites

➤ **User Segment:**

Consisting of:

Receiver (Capable of receiving and decoding the GPS/GLONASS /Galileo/Compass/GEO broadcast message)



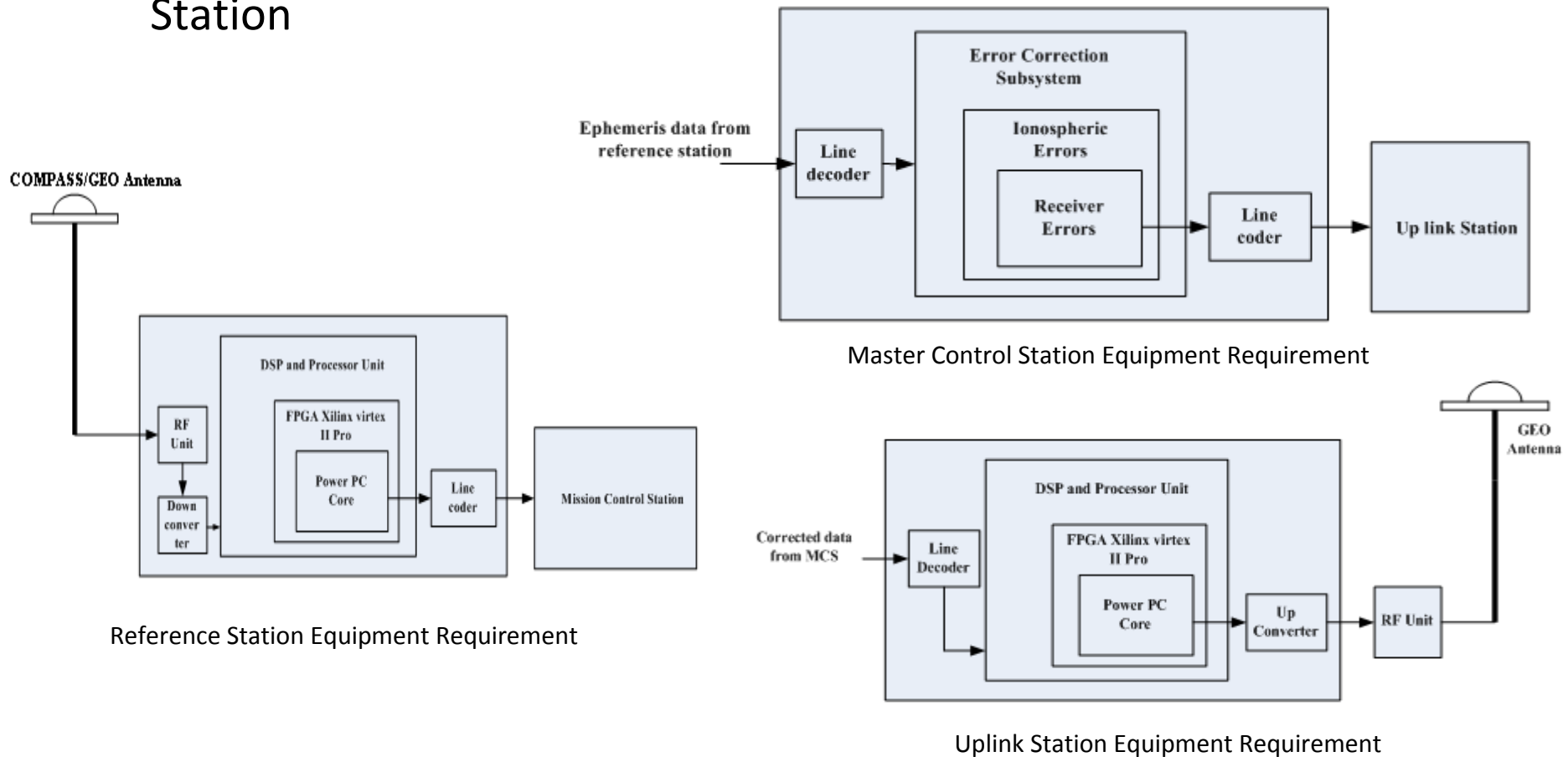
SATELLITE BASED AUGMENTATION SYSTEM PROPOSED FOR PAKISTAN



SBAS SEGMENTS PROPOSED FOR PAKISTAN

➤ Ground Segment

Should Consist of Reference stations, Master control stations and Uplink Station





SBAS SEGMENTS PROPOSED FOR PAKISTAN Cont'd..

➤ **Space segment:**

Consisting of:

- COMPASS/Galileo/GLONASS/GPS Satellite System
- Planned MM1-GEO satellite

➤ **User Segment:**

Consisting of:

- Receiver (Capable of receiving and Decoding COMPASS/Galileo/GLONASS/GPS and GEO broadcast messages).
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INFRASTRUCTURE

Country/ region	Area (sq. km)	No. of reference stations	No. of master stations	No. of satellites
USA, Mexico, Canada (WAAS)	~ 21,578,136	38	3	2
European Union (EGNOS)	4,324,782	34	4	3
Japan (MSAS)	377,930	4	2	2
India (GAGAN)	3,201,446	8 + 7	1	2

➤ Proposed for Pakistan

Pakistan (PAK-SBAS)	796,095	5	2	1
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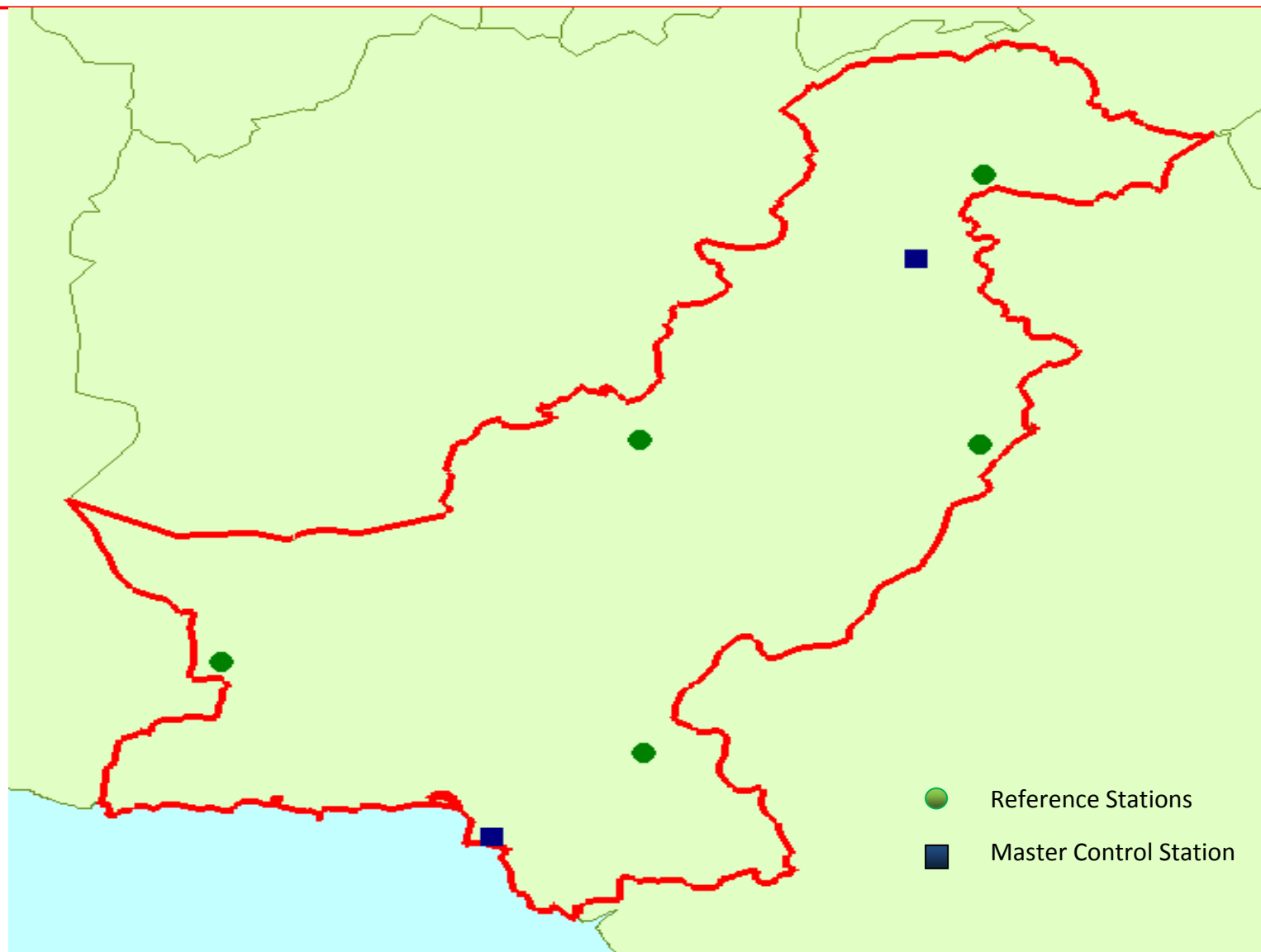
PROPOSED LOCATIONS FOR REFERENCE AND MASTER CONTROL STATIONS

Latitude	Longitude	Comments
<u>Reference Stations</u>		
27.500 N	63.200 E	In South West Baluchistan
31.010 N	69.020 E	In North East Baluchistan
34.909 N	74.166 E	In Gilgit Agency
30.845 N	73.840 E	In Punjab
26.250 N	69.090 E	In Sindh
<u>Master Control Stations</u>		
33.710 N	73.086 E	In Islamabad
24.850 N	67.030 E	In Karachi



PROPOSED LOCATIONS FOR REFERENCE AND MASTER CONTROL STATIONS

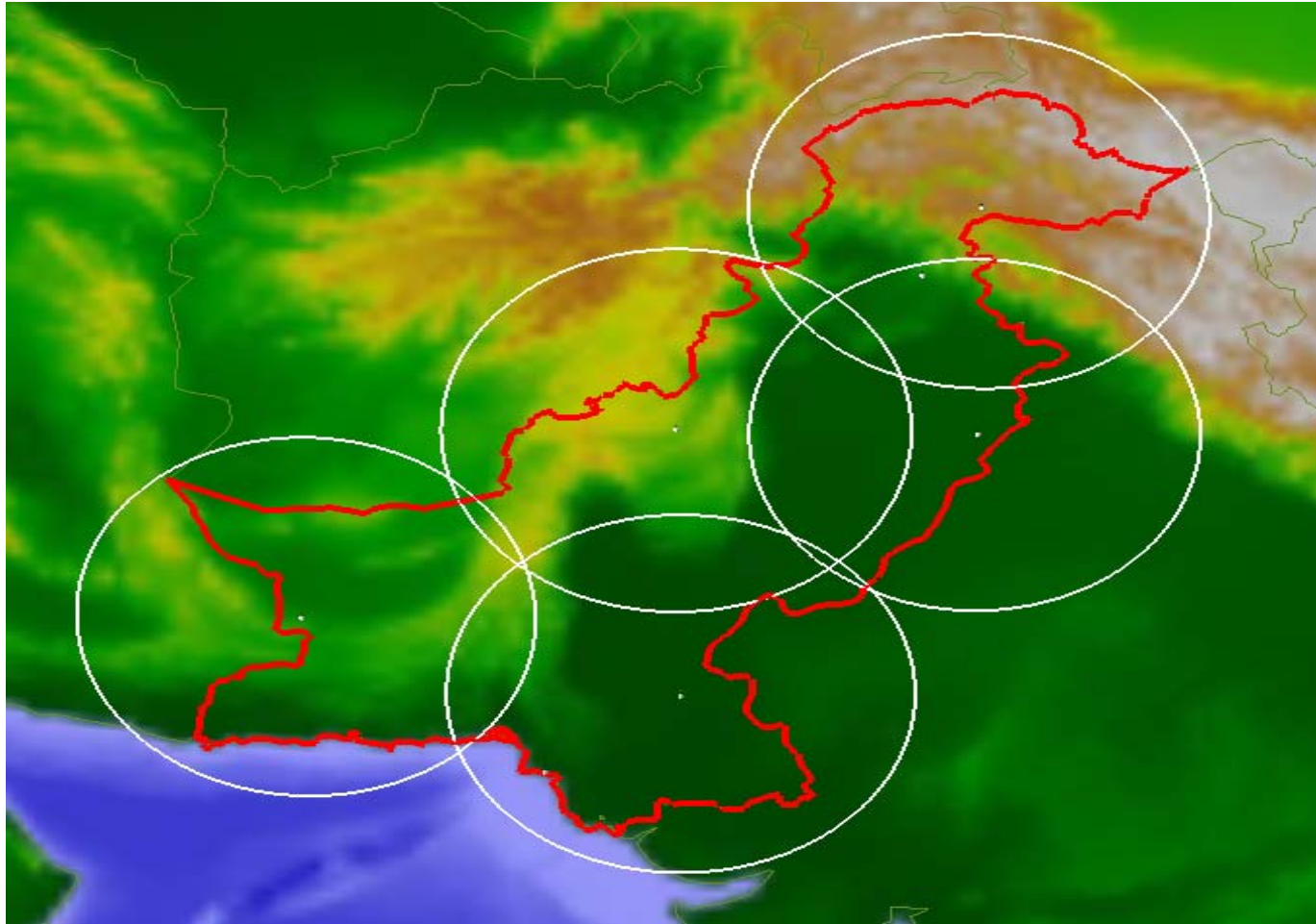
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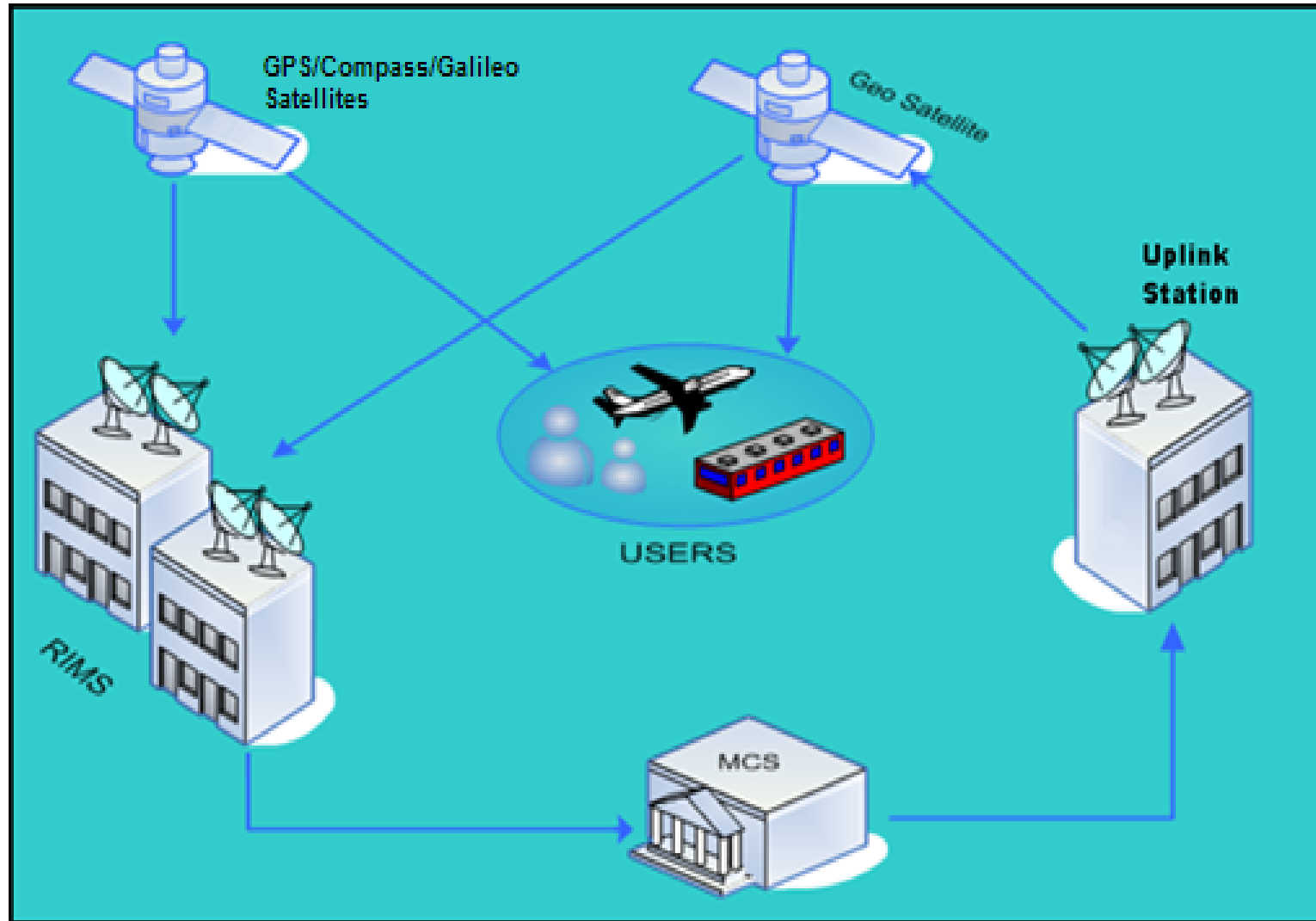
COVERAGE OF REFERENCE STATIONS

The coverage area of each reference station is assumed at 360 km radius.





SBAS ARCHITECTURE PROPOSED FOR PAKISTAN





CONCEPT OF OPERATION

- The PAK-SBAS reference stations should be deployed at the regions where the navigations services are expected most. The function of reference station will be to measure pseudo-ranges and carrier phases on L1 frequencies from all visible satellites.
 - The reference stations send these measurements to SBAS master station, which calculate clock and ephemeris corrections for each COMPASS/Galileo/GPS satellite monitored, ephemeris information for GEO, and ionospheric delays.
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CONCEPT OF OPERATION

Cont'd..

- The master station sends these corrections and error bounds to the users through GEO communication satellite. User apply these corrections to their pseudo ranges obtained from COMPASS/Galileo/GPS measurements in order to improve the accuracy of their position estimates.
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PHASES OF DEVELOPMENT

PAK-SBAS may be implemented in three phases:

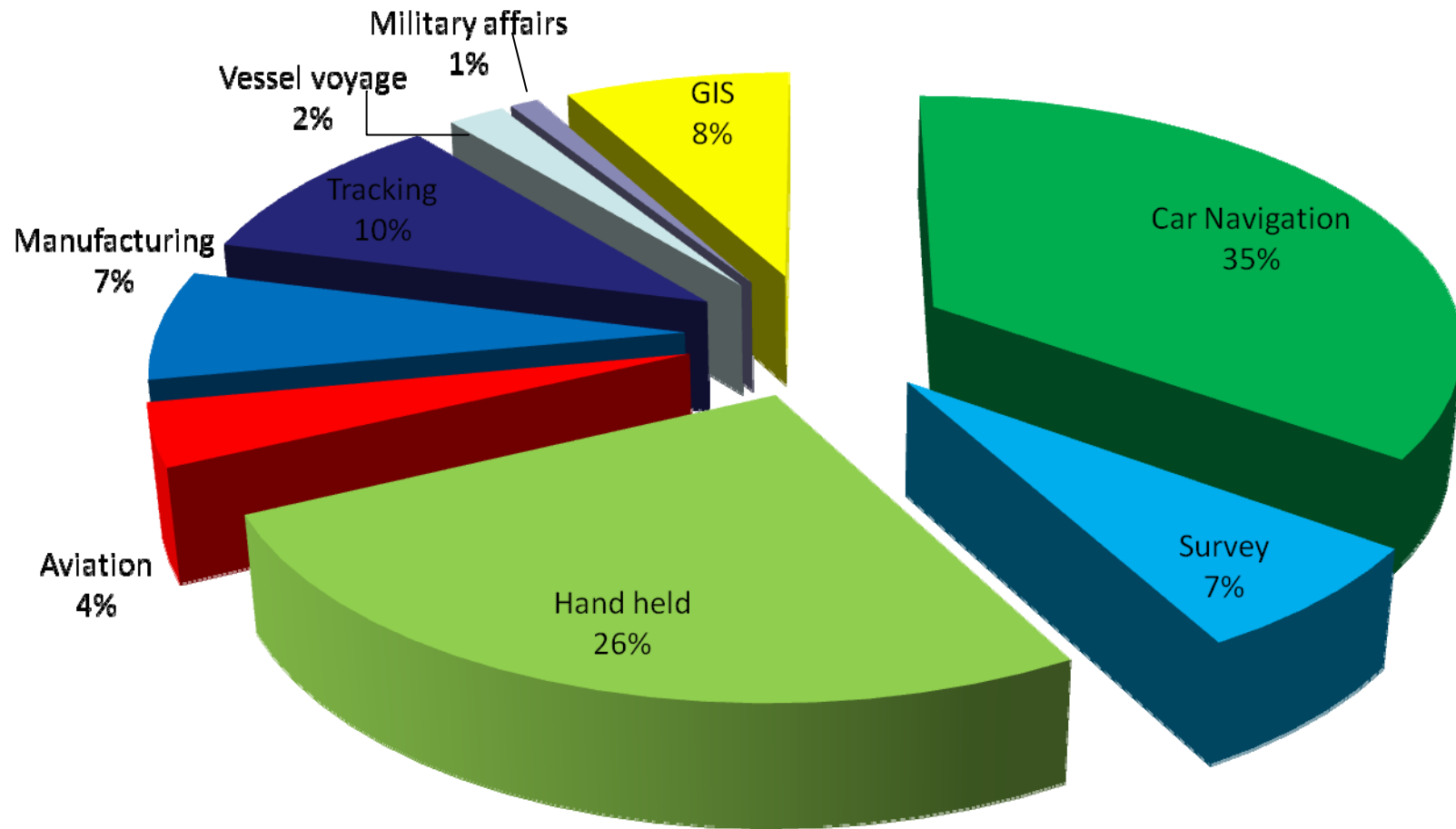
- Demonstration Phase (DP)
 - Experimental Phase (EP)
 - Operational phase (OP)
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GNSS USERS IN PAKISTAN

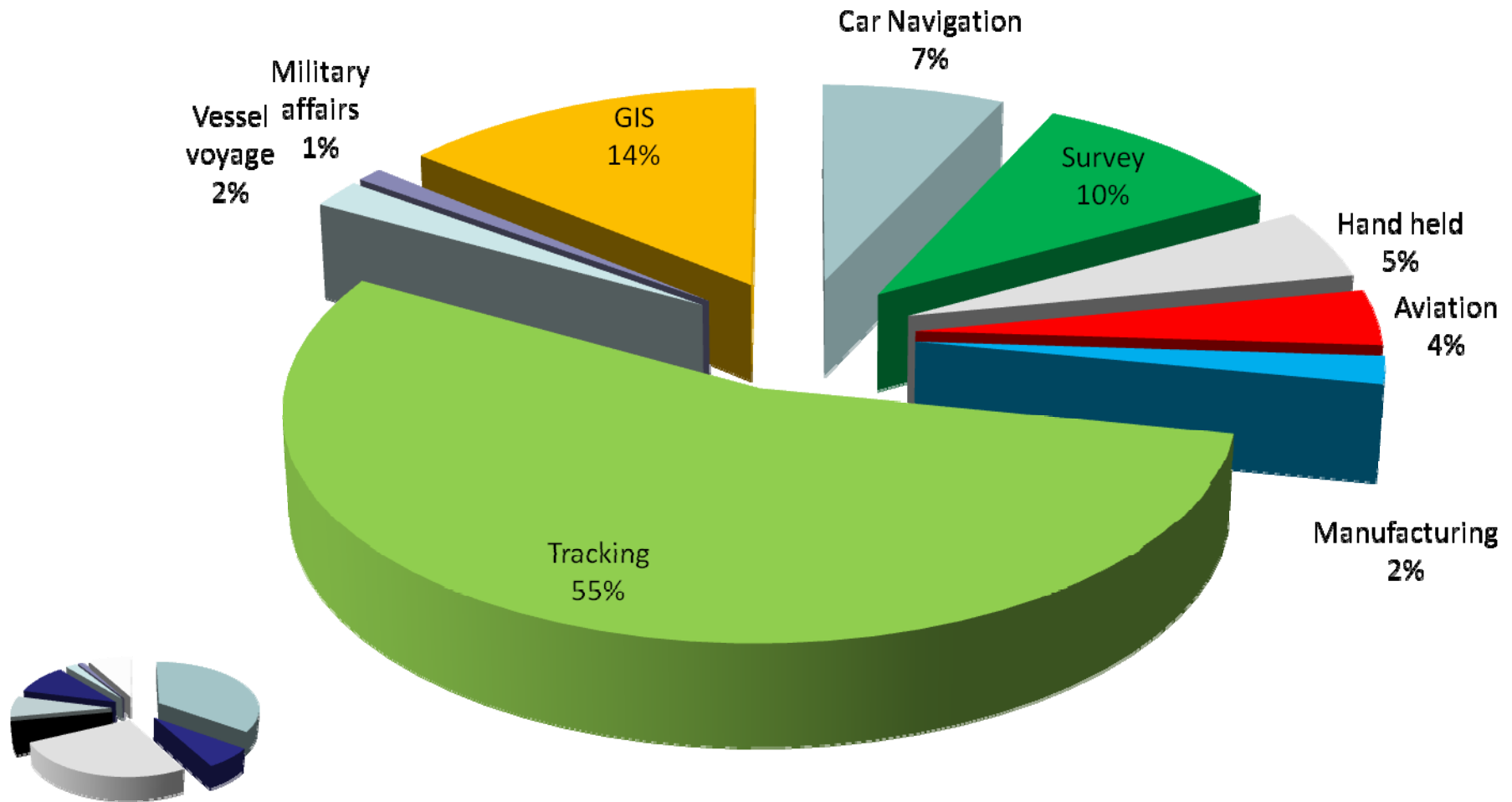


GLOBAL GNSS USERS





GNSS USERS IN PAKISTAN





STAKEHOLDERS

A brief list of stakeholders:

- Civil Aviation Authority (CAA)
 - Survey of Pakistan
 - Pakistan Railways
 - Police
 - Mobile phones service provider agencies
 - Forest department
 - Agriculture department
 - Town planners
 - Pakistan costal guards
 - Pakistan Telecommunication Authority (PTA)
 - Environment monitoring agencies
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Thanks...
