



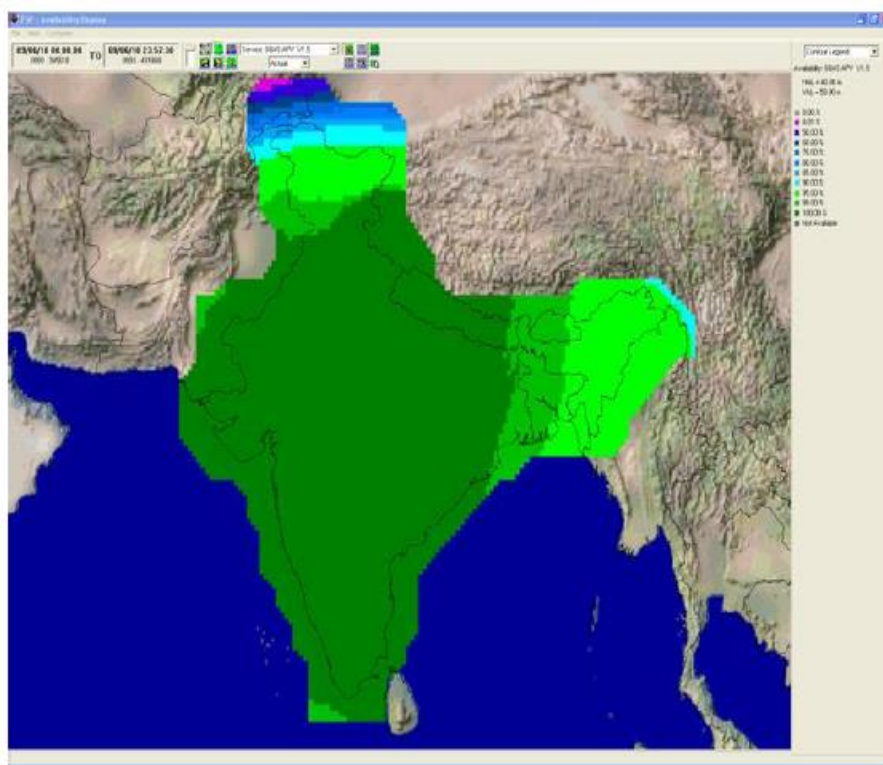
India's Perspective on GBAS/SBAS Implementation

**3-5 June 2019, GBAS/SBAS
Implementation Workshop, Seoul**

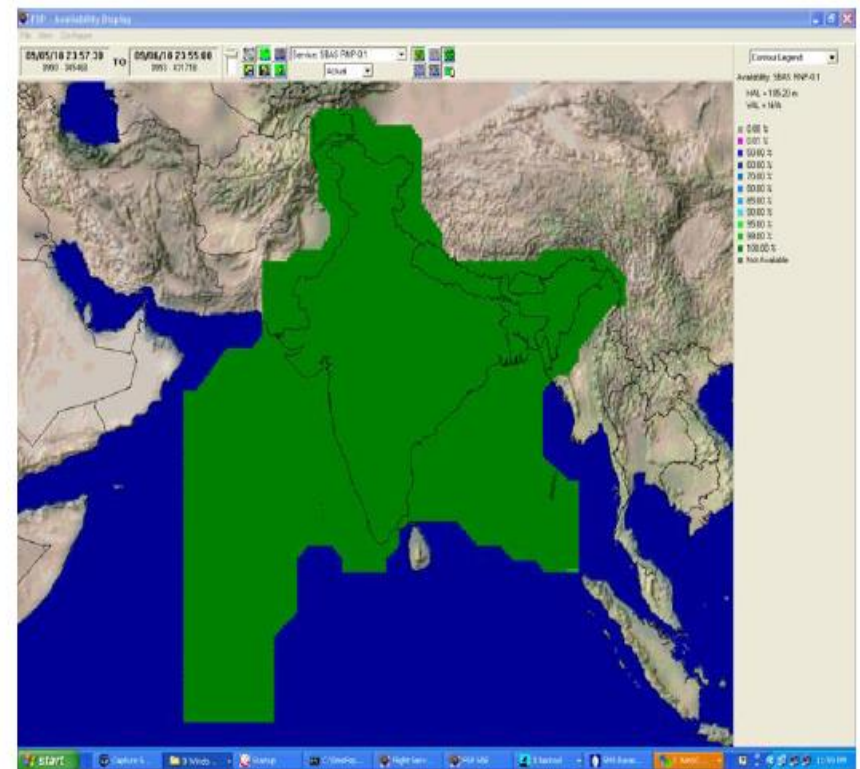
GAGAN Coverage

Typical availability of GAGAN APV 1 and RNP 0.1 service on a nominal day

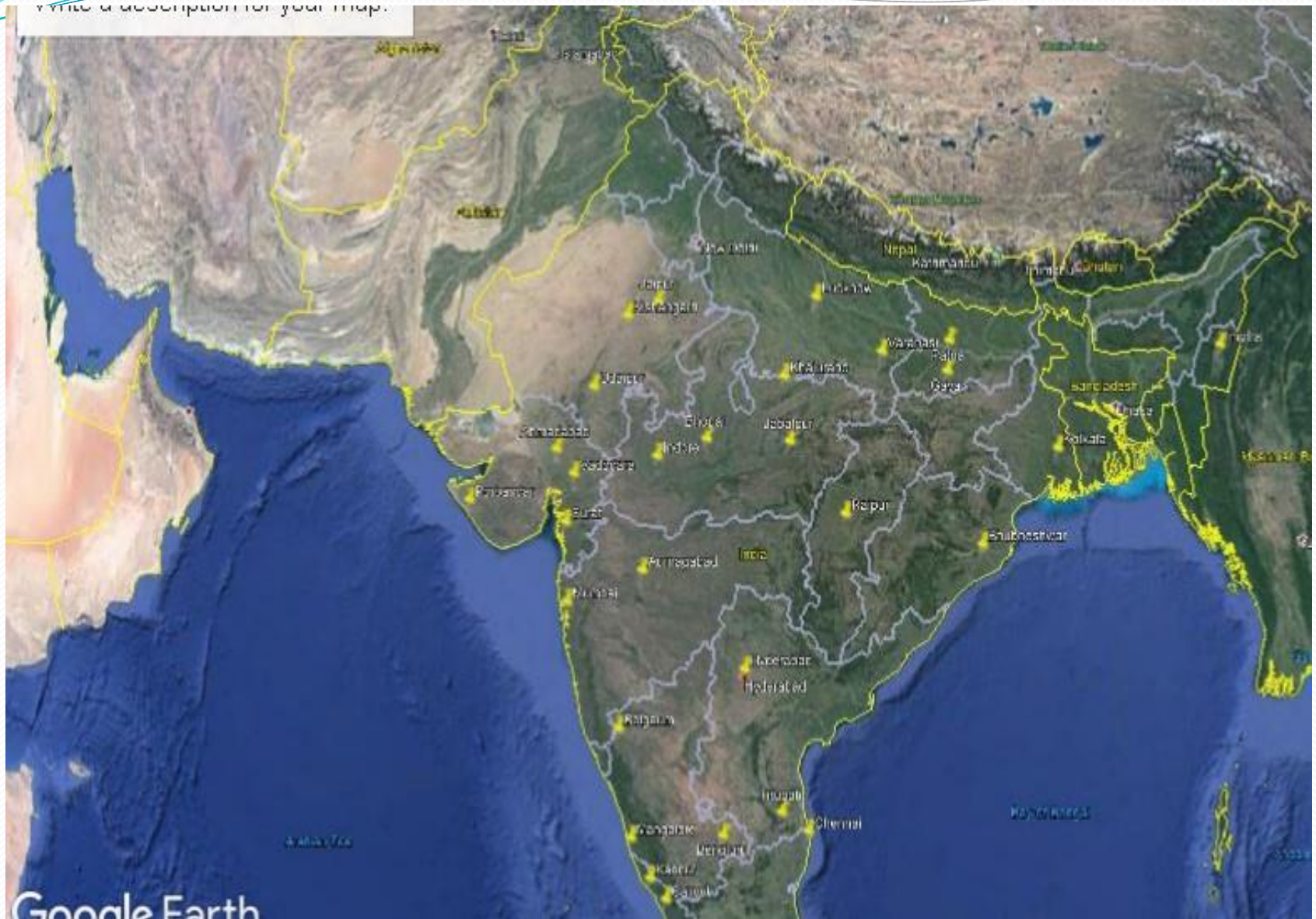
APV I



RNP 0.1



Draft LPV Procedures In India



Requirements for SBAS (LPV) Procedures

Actions for Stakeholders

- **Regulator**

- Rules for SBAS operations and airworthiness approval

- **ANSP/Airports**

- WGS 84 surveyed aeronautical & obstacles data
- Runway to be suitably certified as instrument runway
- Development & validation of IFPs-
 - Channel number for each procedures(FAA allocates as of now)
 - FAS DB through either procedure design tool or Eurocontrol FAS DB generation tool
 - Safety Assessment of SBAS system and Procedures
- Publication of IFPs
 - In AIRAC Cycle only with at least 56 days notice

- **Airspace Users**

- Avionics available & certified
- Flight Crew training and approval



GOVERNMENT OF INDIA
OFFICE OF DIRECTOR GENERAL OF CIVIL AVIATION
OPP. SAFDARJUNG AIRPORT, NEW DELHI-110003

F. No. AV.27031/06/2015- ANS

GUIDELINES ON THE
DESIGN, VALIDATION, APPROVAL AND
PROMULGATION OF INSTRUMENT FLIGHT
PROCEDURES (IFP)

8.5.3 Flight validation (Simulator Evaluation)

- 8.5.3.1 To provide an initial evaluation of database coding, flyability and feedback to the procedure designers, a Simulator Evaluation might be necessary based on the recommendation of Ground validation.
- 8.5.3.2 Simulator Evaluation must be accomplished by a qualified and experienced Flight Validation Pilot (FVP).
- 8.5.3.3 Simulator evaluation must not be used for obstacle assessment. Preparation for the simulator evaluation should include a comprehensive plan with description of the conditions to be evaluated, profiles to be flown and objectives to be achieved. Flight simulator evaluation will be accomplished by completing the Simulator evaluation form (**Appendix 4/Form IFPV-02**).
- 8.5.3.4 IFPs with complex turning missed approach procedure, RNP-APCH (LNAV, LNAV/VNAV) IFP and Required Navigation Performance Authorization Required (RNP AR) IFP should undergo simulator evaluation.

Note: For RNP-APCH (LPV Minima) refer para 8.5.4.2 below.

8.5.4.2 Flight evaluation should be performed in the following cases:

- i. New IFP is being implemented for the first time for a runway where no other procedure exist. In such cases, three evaluations with atleast one flight evaluation shall be conducted.
- ii. If the flyability of a proposed IFP cannot be determined by other means.
- iii. If the proposed IFP contains deviations from PANS-OPS (ICAO Doc 8168-Vol II) criteria
- iv. If the accuracy and/or integrity of obstacle and terrain data cannot be determined by other means
- v. If modified/amended IFP differ significantly from existing IFP
- vi. For Helicopter Pins IFP

- vii. RNP APCH (LPV minima) (GAGAN procedures) provided that Flight simulator evaluation of the procedure for same runway with LNAV and LNAV/VNAV minima has been conducted **satisfactorily**.

NOTE: Flight validation of LPV procedures may be conducted by flight inspection aircraft of AAI, provided it is equipped with requisite GAGAN/SBAS sensors, FMS, flight profile and GNSS performance recording equipment and with necessary arrangements in place with data coder to provide test Nav Data Base (NDB) for such procedures. **However, AAI must obtain the operational approval from DGCA for conducting the flight trial for this purpose.**

- viii **RNP APCH (LNAV & LNAV/VNAV minima) procedures for the runways where the simulator data is not available.**

8.5.4.3 Flight evaluation may not be required in the following cases:

- i. In the case of modification/amendment to non-precision approach (NPA) IFP:
 - a) final approach track (FAT) does not differ from the existing FAT by more than 5^0 ; and
 - b) there is no change in the OCA/H; and
 - c) other segments of the IFP remain unchanged. However, in case of change in initial/intermediate/missed approach segment but the final approach segment remains unchanged and flyability of the IFP can be ensured either by ground validation or flight simulator validation.
- ii. In the case of precision approach, initial/intermediate/missed approach segment is/are amended but the final approach

segment and the OCA/H remain unchanged and the flyability of the IFP can be ensured either by ground validation or flight simulator validation.

- iii. RNP APCH Procedures: Whenever RNP APCH procedures are designed for the runways where procedures based on conventional nav aids (precision/non-precision) have been published and the procedures share the following in common:
 - a) MSA
 - b) Minimum altitude at IF and FAF
 - c) Final approach track of non-precision approach (VOR) is not offset by more than 5 degree, from extended runway C/L provided that,
 - Simulator evaluation of the procedure is SATISFACTORY for flyability and navigation data and,
 - Periodicity of Survey data is maintained as per para 1.6 (Table I-1-2) of Aerodrome Survey Manual of AAI on the date when procedure designing is initiated by AAI.



GOVERNMENT OF INDIA
CIVIL AVIATION DEPARTMENT

DIRECTOR GENERAL OF CIVIL AVIATION

OC NO 3 OF 2016
Date: 11th March 2016

OPERATIONS CIRCULAR

File No AV 22024/21/2015-FSD

**Subject: Aircraft and Operators Approval for RNP-APCH Operations
Down to LP and LPV Minima Using GNSS Augmented by
SBAS**

LPV Equipage status of Indian Fleet

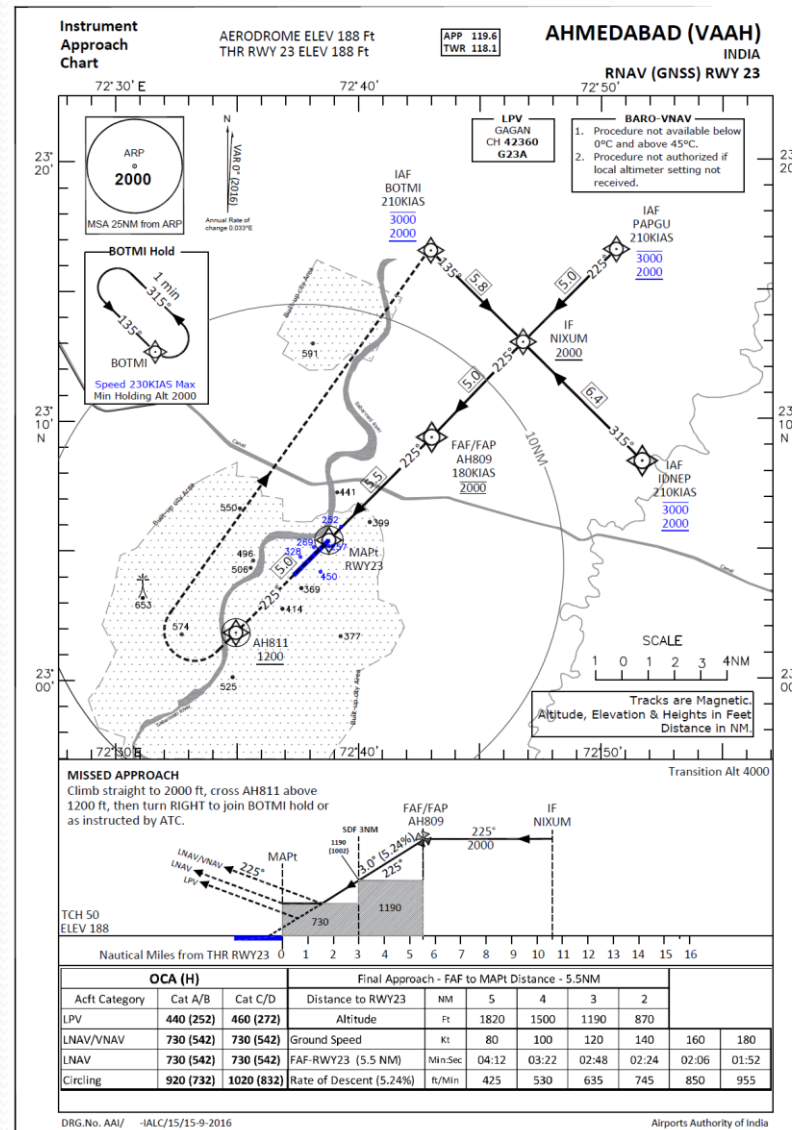
Avionics (SBAS Receivers) availability & certification

- Commercial Airlines aircraft are not equipped except Q400 aircraft of Spicejet.
- Few GAs are equipped but not yet certified by DGCA
- National Civil Aviation Policy of India prescribes *“All aircraft being registered in India from 1st January-2019 will mandatorily have to be GAGAN enabled”*. This date has been postponed to 30th June 2020.
- *Accordingly, all the aircraft being imported for registration on or after 30.06.2020 shall be required to be suitably equipped with GAGAN equipment.*

LPV Procedure status & Implementation challenges in India

- 65 - LPV IFPs designed and submitted to DGCA as per Govt. of India mandate. Along with LPV, LNAV, LNAV-VNAV procedures are also being designed. Simulator/Flight Trial awaited.
- In India procedures are to be validated in aircraft simulator. None of the aircraft simulator is LPV enabled.
- Airlines aircraft are not LPV equipped except Q400 type of aircraft operated by Spice Jet.
- In dialogue with Spice Jet to use Q400 for flight validation of LPV procedures.
- AAI aircraft B350 meant for flight calibration of nav-aid has been equipped with LPV receivers.
- Efforts are underway to get DGCA approval for AAI aircraft to validate the LPV procedures through flight trials.
- AAI has floated an Expression of Interest for design and validation of LPV procedures at 10 Airports.
- Discussion with DGCA to review the current IFP approval process.

LPV Procedure Design status for Indian Airports



LPV Procedure Design status for Indian Airports

FAS Data Block Information	VAAH RWY23
Field	Value
Operation Type	0
Service Provider Identifier	3
Airport Identifier	VAAH
Runway	23
Approach Performance Designator	0
Route Indicator	
Reference Path Data Selector (RPDS)	
Reference Path Identifier (Approach ID)	G23A
LTP/FTP Latitude	230518.4665N
LTP/FTP Longitude	0723847.2300E
LTP/FTP Ellipsoidal Height	+00020
FPAP Latitude	230356.5550N
FPAP Longitude	0723719.7105E
Threshold Crossing Height (TCH)	50
TCH Unit	F
Glide Path Angle (GPA)	03.00
Course Width at Threshold	105.00
Length Offset	0040
Horizontal Alert Limit (HAL)	40.0
Vertical Alert Limit (VAL)	50.0
CRC	
ICAO Code	VA
LTP/FTP Orthometric Height	+00573
FPAP Orthometric Height	+00546
Channel ID	42360

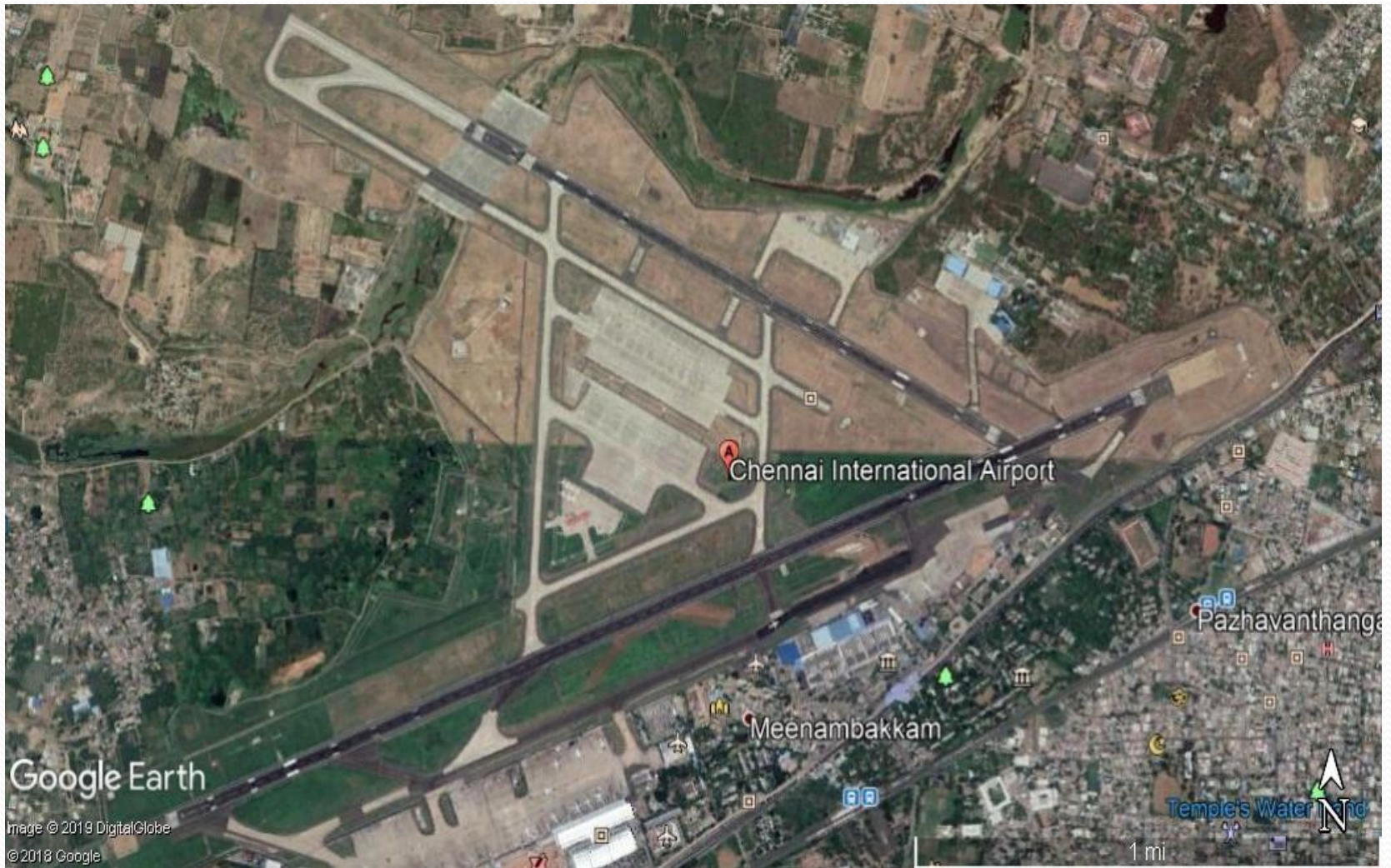
LPV IAP implementation requirements & strategy

- Suitably qualified runway – 130 Runway ends
- WGS 84 surveyed aeronautical & obstacles data - Available
- Qualified procedure designers and appropriate procedure design tool - Available
- Availability of flight simulator with LPV capability for conducting Simulator trials of the LPV IFPs –
 - EOI for design & validation of LPV procedures for 10 Airports.
 - Discussion with DGCA to review IFP approval process.
- Suitably equipped, certified, approved aircraft and flight crew for conducting LPV flight trials -
 - AAI plans to conduct flight validation with its own B350 aircraft equipped with SBAS receiver(GPS4000S).
 - Q400 aircraft of Spice Jet under consideration for flight validation.

GBAS Implementation at Chennai

- Chennai was chosen for GBAS as it is close to Equator and has two intersecting runways and 4th busiest Airport in India.
- Experience during GAGAN indicated that there could be impact of Ionospheric scintillation at lower latitudes.
- If GBAS could be successful in Chennai, then it will be easier to implement at other airports at higher latitudes.
- GBAS equipment was ready in 2015, when a severe flood washed it away.
- A new equipment has now been installed and is ready.
- After Safety Analysis, GLS operation at Chennai has been restricted from dawn to dusk in first phase in view of anticipated ionospheric scintillation.
- GLS procedure design is under development.
- As this will be a first GLS procedure to be designed, procedure designers are to be imparted training to meet regulatory requirements.

Chennai Airport(VOMM)



GLS Antenna at Chennai



Safety Critical Data for GBAS

- Determination of WGS84 coordinates for
 - Runway coordinates (threshold – LTP/FTP, FPAP)
 - GNSS reference antenna phase centre coordinates
- Procedure design
 - Typically uses threshold coordinates of the runway as input
 - Outputs FAS data block file – Cyclic Redundancy Check (CRC) wrapped- in binary format for each precision approach
 - Procedure publication (AIP)
- Transfer and Load into the GBAS Ground Station
- GBAS Ground & Flight Testing (ICAO Doc.8071)
 - Use VDB or GBAS receiver to check the data content and CRC
 - Fly all procedures
- VDB transmission of data to the aircraft
 - Ground station monitors data content and CRC internally
 - Airborne receiver checks FAS data file and CRC

Activities prior to procedure publication

- Ground Validation – AAI & DGCA has qualified procedure designers.
 - Obstacle Clearance
 - Charting
 - Coding
 - Flyability
- Flight Inspection – AAI aircraft is equipped.
 - Infrastructure
- Flight Validation - AAI aircraft & other Indian fleet is equipped.
 - Obstacle Verification (optional)
 - Flyability (workload, charting, manoeuvring)

Safety Assessment & Regulatory approval of IFPs

AAI has Corporate Safety Management System Manual(CSMS) for all safety assessments



Thank You