NavIC (IRNSS)

STANDARD POSITIONING SERVICE

PERFORMANCE REPORT

JANUARY-MARCH 2020

SATELLITE NAVIGATION PROGRAM

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INDIAN SPACE RESEARCH ORGANIZATION
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<th>Description</th>
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<td>SPS</td>
<td>Standard Positioning Service</td>
</tr>
<tr>
<td>HPE</td>
<td>Horizontal Position Error</td>
</tr>
<tr>
<td>PE</td>
<td>Position Error</td>
</tr>
<tr>
<td>CEP</td>
<td>Circular Error Probability</td>
</tr>
<tr>
<td>drms</td>
<td>Distance root mean square</td>
</tr>
<tr>
<td>SV</td>
<td>Space Vehicle</td>
</tr>
<tr>
<td>NSAT</td>
<td>Number of Satellites</td>
</tr>
<tr>
<td>DOP</td>
<td>Dilution Of Precision</td>
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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The performance of the Signals in Space, broadcasted by NavIC (IRNSS) system, is continuously being evaluated for both single and dual frequency users across various locations within the service area. The NavIC (IRNSS) SPS service performance in dual frequency mode for the months of January, February and March 2020 has been provided in this document.

1.2 PERFORMANCE INDICATORS

Table 1 describes the various parameters considered as the indicators of performance.

<table>
<thead>
<tr>
<th>Position Accuracy</th>
<th>Horizontal Position Error (HPE)</th>
<th>3-D Position Error</th>
<th>Circular Error Probability (CEP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HPE is two dimensional and can be quantified in terms of error in latitude and longitude. It is calculated as twice the distance-root-mean-square (2drms) with the probability of 95% in this report. 3-D Position Error describes the overall accuracy by combining the effects of horizontal as well as vertical accuracy. The values taken are 2-sigma with 95% probability. CEP is the radius of a circular region, defined in such a way that, the probability of computed estimates falling inside this region is 50%. CEP can be computed from the scatter plot of latitudinal and longitudinal errors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>Percentage availability of SVs</td>
<td></td>
<td>The availability of service is computed at any user location as the percentage of time an SV can be used for position computation. This metric has been calculated by examining the status of Alert flag and URE index of each SV at every 30 s interval.</td>
</tr>
<tr>
<td>Carrier-to-Noise ratio</td>
<td>Received C/N₀ in L5 band</td>
<td>Received C/N₀ in S band</td>
<td></td>
</tr>
<tr>
<td>Satellite Geometry</td>
<td>Dilution of Precision</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
IRNSS 1G was not available for performance evaluation since October 05, 2019.
CHAPTER 2

SOUTHERN REGION

2.1. SIGNAL IN SPACE ACCURACY

**Horizontal Position Error**

- HPE in January
- HPE in February
- HPE in March

**3-D Position Error**

- PE in January
- PE in February
- PE in March

**Circular Probability of Error**

- Scatter Plot for January
  CEP: 2.0 m
- Scatter Plot for February
  CEP: 2.0 m
- Scatter Plot for March
  CEP: 2.0 m

*Figure 1: Position accuracy across southern region*

**NOTE:**
2.2. **Satellite Availability**

![Graphs showing satellite availability in January, February, and March.](image)

*Figure 2: Percentage availability of number of SVs for SPS service in southern region*

2.3. **Dilution of Precision Statistics**

![Graphs showing DOP statistics in January, February, and March.](image)

*Figure 3: DOP statistics across southern region*

**NOTE:**
2.4. **Carrier to Noise Ratio**

**C/N₀ in L5 band**
- C/N₀ in January
- C/N₀ in February
- C/N₀ in March

**C/N₀ in S band**
- C/N₀ in January
- C/N₀ in February
- C/N₀ in March

*Figure 4: Received C/N₀ across southern region*

**NOTE:**
CHAPTER 3
WESTERN REGION

3.1 SIGNAL IN SPACE ACCURACY

Horizontal Position Error

HPE in January
HPE in February
HPE in March

3-D Position Error

PE in January
PE in February
PE in March

Circular Probability of Error

Scatter Plot for January
CEP: 2.2 m
Scatter Plot for February
CEP: 2.2 m
Scatter Plot for March
CEP: 2.2 m

Figure 5: Position Accuracy across western region

NOTE:
3.2 SATELLITE AVAILABILITY

*Figure 6: Percentage availability of number of SVs for SPS service in western region*

3.3 DILUTION OF PRECISION STATISTICS

*Figure 7: DOP statistics across western region*

**NOTE:**
3.4 Carrier to Noise Ratio

C/N₀ in L5 band

C/N₀ in January

C/N₀ in February

C/N₀ in March

C/N₀ in S band

C/N₀ in January

C/N₀ in February

C/N₀ in March

Figure 8: Received C/N₀ across western region

NOTE:
CHAPTER 4

CENTRAL REGION

4.1 SIGNAL IN SPACE ACCURACY

Horizontal Position Error

3-D Position Error

Circular Probability of Error

NOTE:
4.2 **Satellite Availability**

![Graphs showing satellite availability](image)

**Figure 10**: Percentage availability of number of SVs for SPS service in central region

4.3 **Dilution of Precision Statistics**

![Graphs showing DOP statistics](image)

**Figure 11**: DOP statistics across central region

**NOTE:**
4.4 Carrier to Noise Ratio

**C/N₀ in L5 band**

- C/N₀ in January
- C/N₀ in February
- C/N₀ in March

**C/N₀ in S band**

- C/N₀ in January
- C/N₀ in February
- C/N₀ in March

Figure 12: Received C/N₀ across central region

**NOTE:**
CHAPTER 5

NORTHERN REGION

5.1 SIGNAL IN SPACE ACCURACY

**Horizontal Position Error**

- HPE in January
- HPE in February
- HPE in March

**3-D Position Error**

- PE in January
- PE in February
- PE in March

**Circular Probability of Error**

- Scatter Plot for January (CEP: 2.4 m)
- Scatter Plot for February (CEP: 2.4 m)
- Scatter Plot for March (CEP: 2.4 m)

Figure 13: Position Accuracy across northern region

**NOTE:**
5.2 Satellite Availability

![Graphs showing satellite availability in January, February, and March](image)

**Figure 14:** Percentage availability of number of SVs for SPS service in northern region

5.3 Dilution of Precision Statistics

![Graphs showing DOP statistics for January, February, and March](image)

**Figure 15:** DOP statistics across northern region

**Note:**
5.4 Carrier to Noise Ratio

<table>
<thead>
<tr>
<th>C/N₀ in L5 band</th>
<th>C/N₀ in S band</th>
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</thead>
</table>

- **C/N₀ in January**
- **C/N₀ in February**
- **C/N₀ in March**

Figure 16: Received C/N₀ across northern region

**NOTE:**
CHAPTER 6

EASTERN REGION

6.1 SIGNAL IN SPACE ACCURACY

<table>
<thead>
<tr>
<th></th>
<th>Horizontal Position Error</th>
<th>3-D Position Error</th>
<th>Circular Probability of Error</th>
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<td>HPE in January</td>
<td><img src="image" alt="HPE.png" /></td>
<td><img src="image" alt="PE.png" /></td>
<td>Scatter Plot for January CEP: 2.9 m</td>
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<tr>
<td>HPE in February</td>
<td><img src="image" alt="HPE.png" /></td>
<td><img src="image" alt="PE.png" /></td>
<td>Scatter Plot for February CEP: 2.9 m</td>
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<tr>
<td>HPE in March</td>
<td><img src="image" alt="HPE.png" /></td>
<td><img src="image" alt="PE.png" /></td>
<td>Scatter Plot for March CEP: 3.1 m</td>
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**Figure 17:** Position Accuracy across eastern region

**NOTE:**
6.2 Satellite Availability

Availability of NSAT in January
Availability of NSAT in February
Availability of NSAT in March

Figure 18: Percentage availability of number of SVs for SPS service in eastern region

6.3 Dilution of Precision Statistics

DOP in January
DOP in February
DOP in March

Figure 19: DOP statistics across eastern region

NOTE:
6.4 Carrier to Noise Ratio

C/N₀ in L5 band

C/N₀ in January

C/N₀ in February

C/N₀ in March

C/N₀ in S band

C/N₀ in January

C/N₀ in February

C/N₀ in March

Figure 20: Received C/N₀ across eastern region

NOTE: