NavIC (IRNSS)
STANDARD POSITIONING SERVICE
PERFORMANCE REPORT

APRIL-JUNE 2021

SATELLITE NAVIGATION PROGRAM
U.R. RAO SATELLITE CENTRE
INDIAN SPACE RESEARCH ORGANIZATION
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ABBREVIATIONS

SPS  Standard Positioning Service
HPE  Horizontal Position Error
PE   Position Error
CEP  Circular Error Probability
DRMS Distance Root Mean Square
SV   Space Vehicle
NSAT Number of Satellites
DOP  Dilution Of Precision
CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION
The performance of the Signals In Space (SIS), 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 April, May and June 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>
</tr>
</thead>
<tbody>
<tr>
<td>3-D Position Error</td>
<td>Circular Error Probability (CEP)</td>
</tr>
</tbody>
</table>

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.

| Availability | Percentage availability of SVs |

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.

<table>
<thead>
<tr>
<th>Carrier-to-Noise ratio</th>
<th>Received C/N₀ in L5 band</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Received C/N₀ in S band</td>
</tr>
</tbody>
</table>

| Satellite Geometry | Dilution of Precision |

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

SOUTHERN REGION

2.1. **Signal In Space Accuracy**

**Horizontal Position Error**

- HPE in April
- HPE in May
- HPE in June

**3-D Position Error**

- PE in April
- PE in May
- PE in June

**Circular Probability of Error**

- Scatter Plot for April
  CEP: 1.53 m
- Scatter Plot for May
  CEP: 1.59 m
- Scatter Plot for June
  CEP: 1.52 m

**Figure 1**: Position accuracy across southern region
2.2. **Satellite Availability**

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

2.3. **Dilution of Precision Statistics**

Figure 3: DOP statistics across southern region
2.4. **Carrier to Noise Ratio**

- **C/N0 in L5 band**
  - C/N0 in April
  - C/N0 in May
  - C/N0 in June

- **C/N0 in S band**
  - C/N0 in April
  - C/N0 in May
  - C/N0 in June

**Figure 4:** Received C/N0 across southern region
CHAPTER 3
WESTERN REGION

3.1 SIGNAL IN SPACE ACCURACY

**Horizontal Position Error**

- HPE in April
- HPE in May
- HPE in June

**3-D Position Error**

- PE in April
- PE in May
- PE in June

**Circular Probability of Error**

- Scatter Plot for April: CEP: 2.35 m
- Scatter Plot for May: CEP: 2.22 m
- Scatter Plot for June: CEP: 2.27 m

Figure 5: Position Accuracy across western region
3.2 Satellite Availability

![Availability of NSAT in April](image1)

![Availability of NSAT in May](image2)

![Availability of NSAT in June](image3)

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

3.3 Dilution of Precision Statistics

![DOP in April](image4)

![DOP in May](image5)

![DOP in June](image6)

*Figure 7: DOP statistics across western region*
3.4 Carrier to Noise Ratio

C/N₀ in L5 band

C/N₀ in April

C/N₀ in May

C/N₀ in June

C/N₀ in S band

C/N₀ in April

C/N₀ in May

C/N₀ in June

Figure 8: Received C/N₀ across western region
CHAPTER 4

CENTRAL REGION

4.1 SIGNAL IN SPACE ACCURACY

<table>
<thead>
<tr>
<th>Horizontal Position Error</th>
<th>3-D Position Error</th>
<th>Circular Probability of Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE in April</td>
<td>PE in April</td>
<td>Scatter Plot for April</td>
</tr>
<tr>
<td>HPE in May</td>
<td>PE in May</td>
<td>Scatter Plot for May</td>
</tr>
<tr>
<td>HPE in June</td>
<td>PE in June</td>
<td>Scatter Plot for June</td>
</tr>
</tbody>
</table>

**Horizontal Position Error**

<table>
<thead>
<tr>
<th>Month</th>
<th>HPE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>3.2</td>
</tr>
<tr>
<td>May</td>
<td>3.1</td>
</tr>
<tr>
<td>June</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**3-D Position Error**

<table>
<thead>
<tr>
<th>Month</th>
<th>PE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>3.2</td>
</tr>
<tr>
<td>May</td>
<td>3.1</td>
</tr>
<tr>
<td>June</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Circular Probability of Error**

- **April:** CEP: 1.77 m
- **May:** CEP: 1.8 m
- **June:** CEP: 1.76 m

**Figure 9:** Position Accuracy across central region
4.2 Satellite Availability

Availability of NSAT in April

Availability of NSAT in May

Availability of NSAT in June

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

4.3 Dilution of Precision Statistics

DOP in April

DOP in May

DOP in June

Figure 11: DOP statistics across central region
4.4 **Carrier to Noise Ratio**

**C/N₀ in L5 band**

- C/N₀ in April
- C/N₀ in May
- C/N₀ in June

**C/N₀ in S band**

- C/N₀ in April
- C/N₀ in May
- C/N₀ in June

**Figure 12:** Received C/N₀ across central region

**NOTE:**

Occasional drop in C/N₀ is observed due to local interference.
5.1 Signal In Space Accuracy

Figure 13: Position Accuracy across northern region
5.2 **Satellite Availability**

![Graphs showing satellite availability in April, May, and June.]

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

5.3 **Dilution of Precision Statistics**

![Graphs showing DOP statistics in April, May, and June.]

Figure 15: DOP statistics across northern region
5.4 Carrier to Noise Ratio

**C/N₀ in L5 band**
- C/N₀ in April
- C/N₀ in May
- C/N₀ in June

**C/N₀ in S band**
- C/N₀ in April
- C/N₀ in May
- C/N₀ in June

*Figure 16: Received C/N₀ across northern region*

**NOTE:**
Occasional drop in C/N₀ is observed due to local interference.
## 6.1 Signal in Space Accuracy

### Horizontal Position Error

<table>
<thead>
<tr>
<th>Month</th>
<th>HPE Error Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td><img src="image" alt="HPE April" /></td>
</tr>
<tr>
<td>May</td>
<td><img src="image" alt="HPE May" /></td>
</tr>
<tr>
<td>June</td>
<td><img src="image" alt="HPE June" /></td>
</tr>
</tbody>
</table>

### 3-D Position Error

<table>
<thead>
<tr>
<th>Month</th>
<th>PE Error Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td><img src="image" alt="PE April" /></td>
</tr>
<tr>
<td>May</td>
<td><img src="image" alt="PE May" /></td>
</tr>
<tr>
<td>June</td>
<td><img src="image" alt="PE June" /></td>
</tr>
</tbody>
</table>

### Circular Probability of Error

<table>
<thead>
<tr>
<th>Month</th>
<th>Scatter Plot</th>
<th>CEP (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td><img src="image" alt="Scatter April" /></td>
<td>2.99 m</td>
</tr>
<tr>
<td>May</td>
<td><img src="image" alt="Scatter May" /></td>
<td>2.92 m</td>
</tr>
<tr>
<td>June</td>
<td><img src="image" alt="Scatter June" /></td>
<td>2.84 m</td>
</tr>
</tbody>
</table>

Figure 17: Position Accuracy across eastern region
6.2 Satellite Availability

Availability of NSAT in April
Availability of NSAT in May
Availability of NSAT in June

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

6.3 Dilution of Precision Statistics

DOP in April
DOP in May
DOP in June

Figure 19: DOP statistics across eastern region
6.4 Carrier to Noise Ratio

**C/N₀ in L5 band**

- **C/N₀ in April**
- **C/N₀ in May**
- **C/N₀ in June**

**C/N₀ in S band**

- **C/N₀ in April**
- **C/N₀ in May**
- **C/N₀ in June**

Figure 20: Received C/N₀ across eastern region