



# NavIC/GNSS Signal Monitoring and Performance Evaluation Facility

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# Why Performance monitoring?



- Considering the social, economic and strategic impact of satellite navigation services, it is imperative that the systems operate with adhering to certain performance standards.
  - With performance standards put in place it is also important to independently monitor the compliance to such standards.
- NavIC is a new navigation systems in Indian region.
  - *Performance standards for NavIC are being worked out.*
- A monitoring and performance evaluation facility is being established to ascertain user level performance of NavIC and also to monitor its compliance against upcoming performance standards.
- The Availability of system performance data is crucial for better modelling of error processes in satnav and long term behaviour of space and control segment.
  - *Such a facility can serve to enhance system engineering competence in navigation domain.*

# Objectives

- Performance evaluation and monitoring of NavIC and other GNSS.
- Confirming the compliance to NavIC performance standards (TBD)
- To serve as repository of GNSS performance data
- Generating feedback for NavIC system performance improvement

# Scope

- Receiving raw and processed observations from NavIC/GNSS receivers in real-time
- Real-time monitoring of broadcast navigation parameters
- Generation of PVT performance statistics
- Evaluation of SIS-RE performance
- Tempo-Spatial trend analysis of PVT performance and broadcast parameters
- Generating Daily, Weekly and Quarterly performance reports for NavIC.
- Archival of raw and processed data



# Other use Cases

- Interference Monitoring

- S band: Considering the possibility of terrestrial interference in S band, the facility based on network of receivers shall also aid in providing a measured monitoring of impact on S band services.
- Can cater to other frequency bands also.

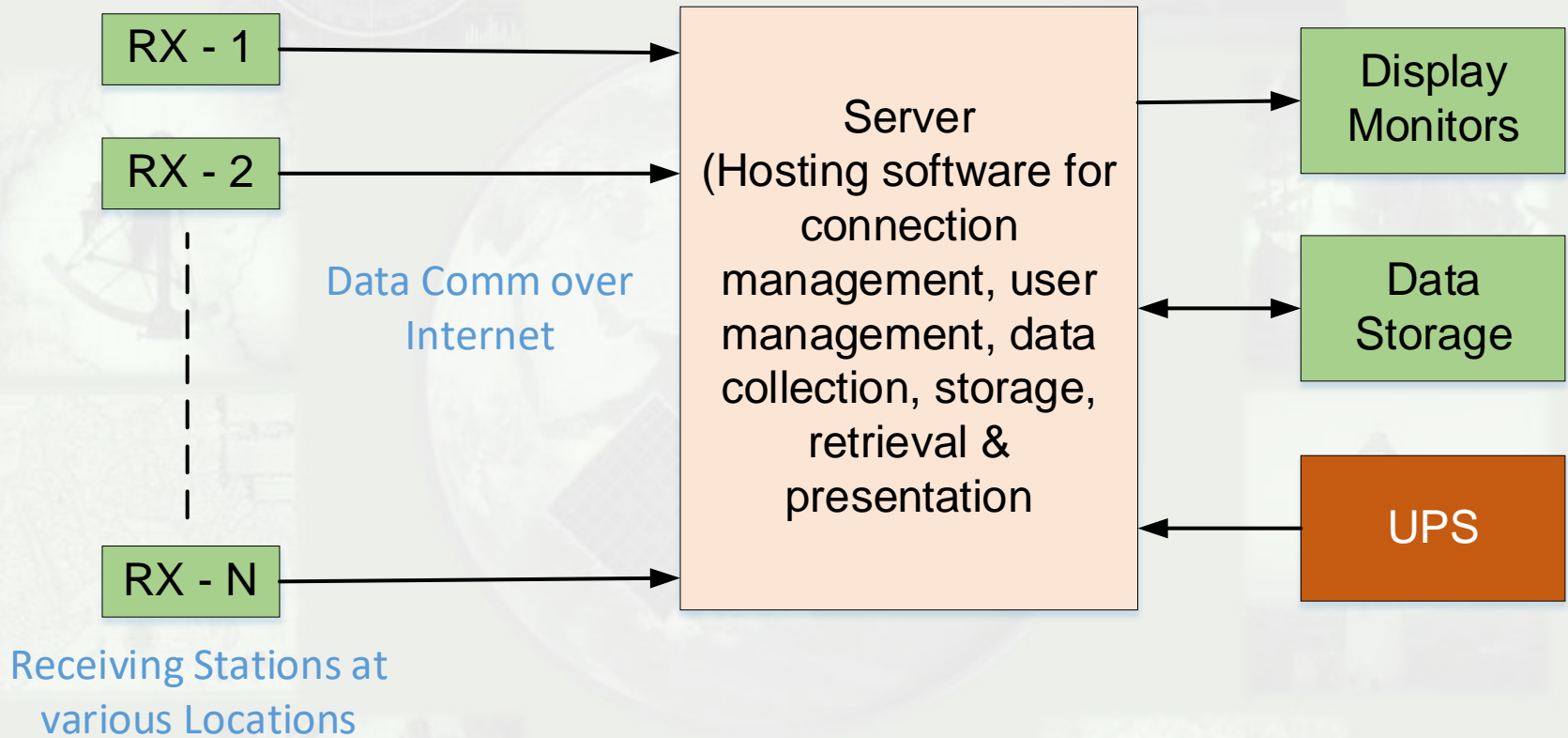
- Reporting of Jamming/Spoofing events

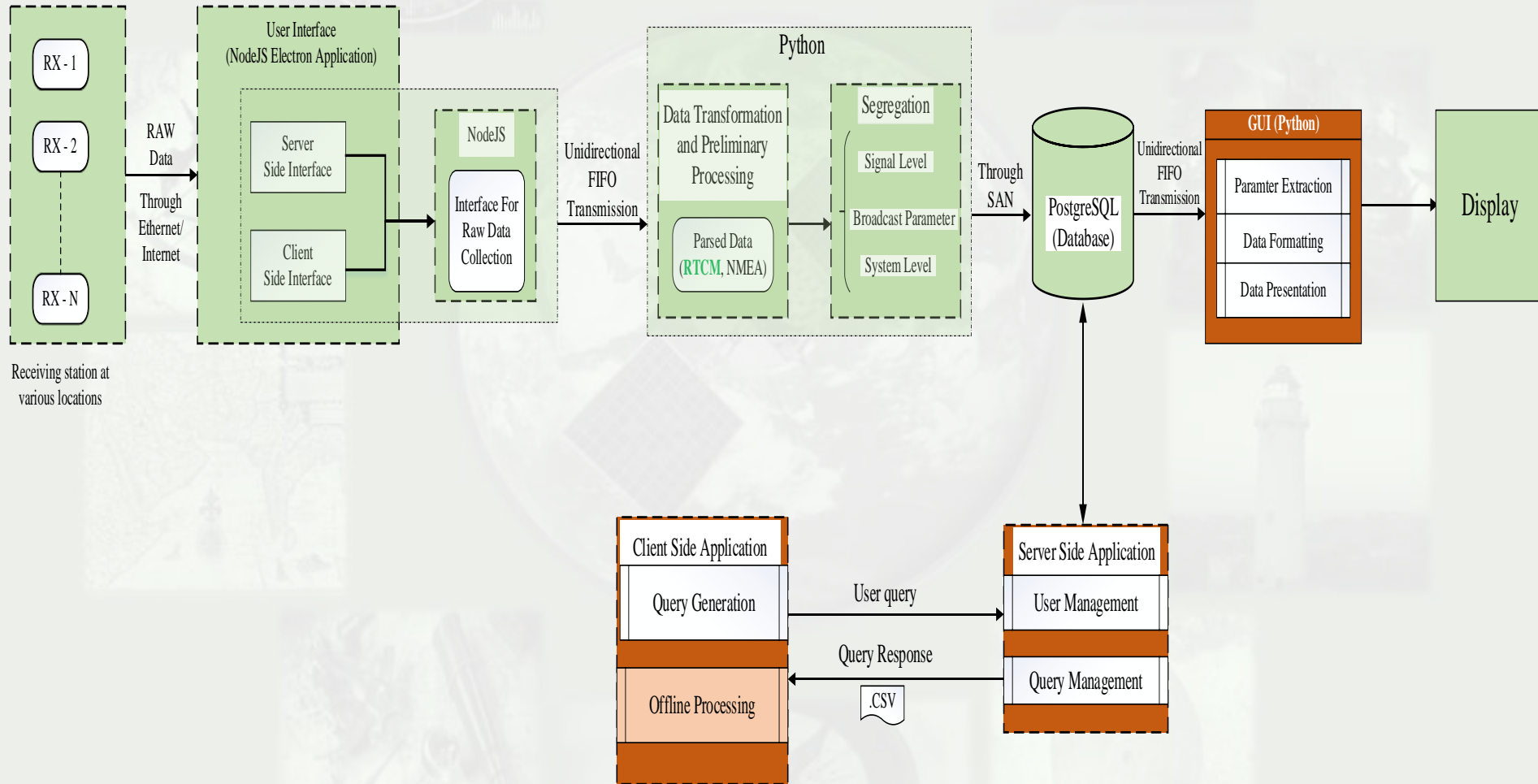
- Based on network of NavIC/GNSS receivers and continuous monitoring thereof incidences of Jamming or spoofing can also be detected and reported upon.

# Parameters of Interest

Signal Level	Broadcast Parameters	System Level
<ul style="list-style-type: none"> <li>• C/No Statistics</li> <li>• Code Doppler</li> <li>• Carrier Doppler</li> <li>• Code Phase</li> <li>• Carrier Phase</li> <li>• Code-Code</li> <li>• Code-Carrier</li> <li>• Carrier-Carrier</li> <li>• Range Residue</li> <li>• Iono Delay</li> <li>• Tracking Status</li> <li>• Signal Availability</li> </ul>	<ul style="list-style-type: none"> <li>• Clock Correction Parameters</li> <li>• Ephemeris Correction Performance</li> <li>• PVT discontinuity at Parameter updates</li> <li>• Almanac Performance</li> <li>• URA monitoring</li> <li>• IOD Monitoring</li> <li>• Age of data performance</li> <li>• Secondary Messages rate</li> <li>• Iono grid performance</li> <li>• Timing offsets performance</li> <li>• 1A &amp; 1G messaging monitoring</li> <li>• Secondary Throughput performance</li> </ul>	<ul style="list-style-type: none"> <li>• Ranging accuracy &amp; availability</li> <li>• Position accuracy &amp; availability</li> <li>• Velocity accuracy &amp; availability</li> <li>• Time &amp; Frequency dissemination accuracy &amp; availability</li> <li>• DOPs Average and Worst</li> <li>• Overall System Availability</li> <li>• Time To Alarm</li> <li>• Continuity</li> </ul>

# Hardware Architecture









# Data Processing

**Select Constellation**    NavIC

**Select PRN**    10

**Select X-Axis**    utc\_time

**Select Y-Axis**    RMS\_error

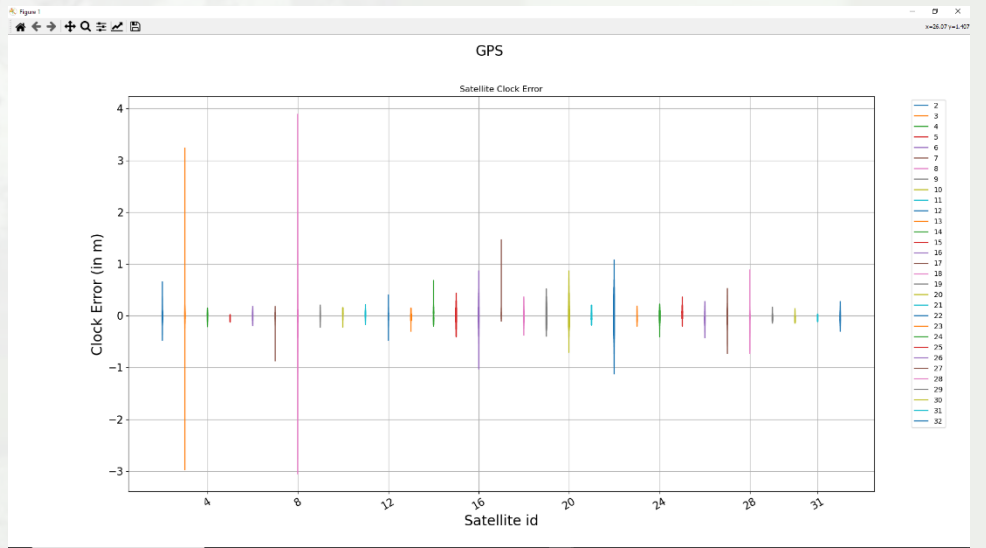
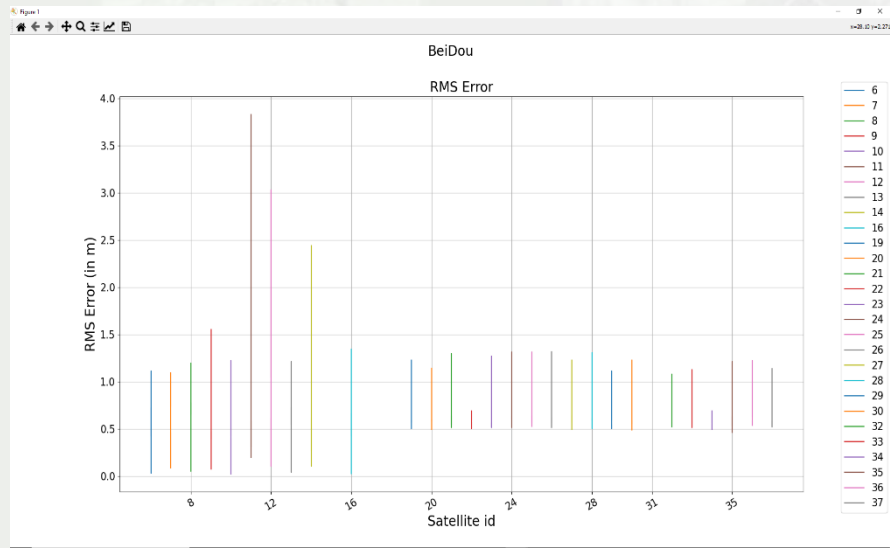
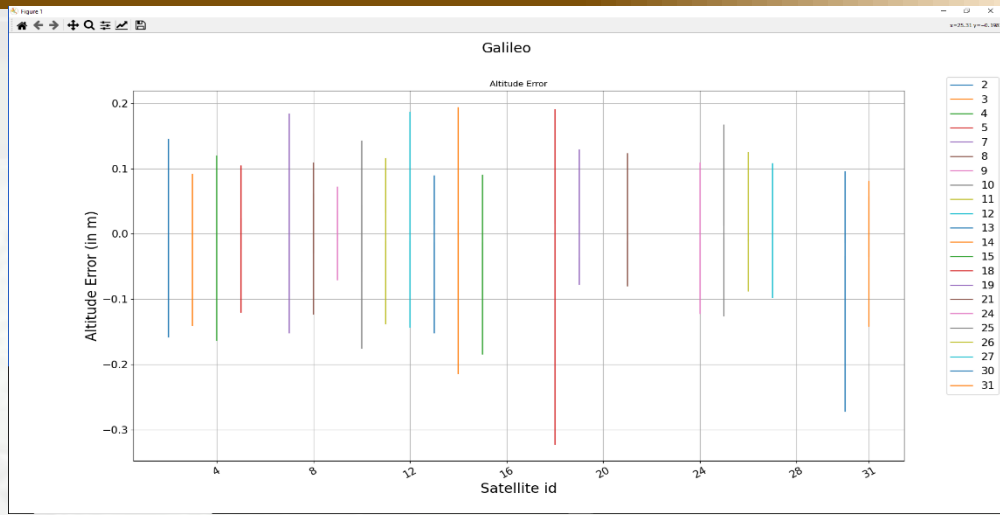
**Select Graph Type**    scatter

**Statistical Analysis**    Plot Graph

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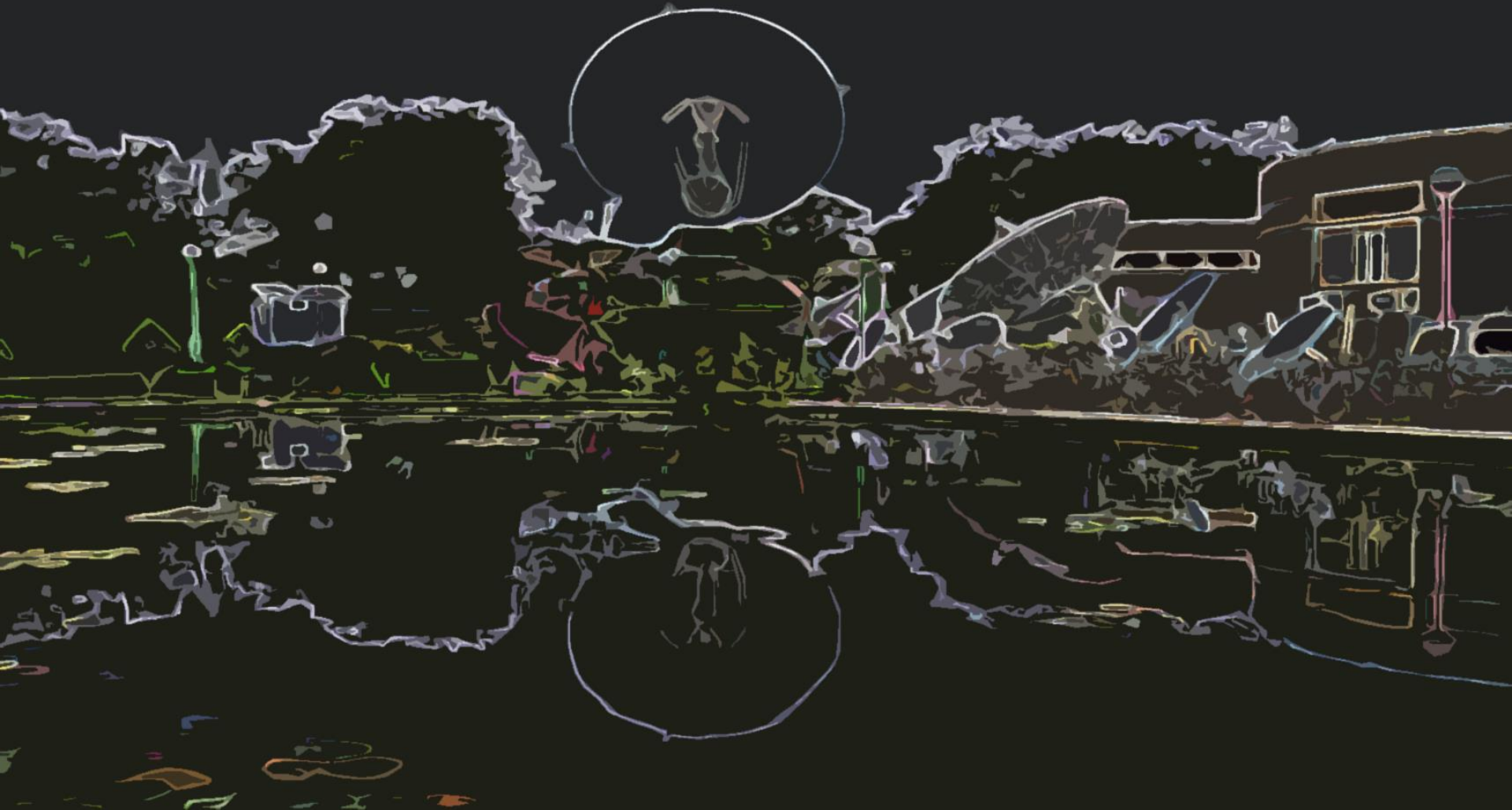
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0000  249.000000  249.000000  249.000000
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std  2.246896  1.904490  4.271251
min  -16.489794  -24.010200  0.010200
max  -0.403368  -0.037130  0.983892
stdv  -0.024704  0.127246  2.936054
75%  0.247471  0.403368  2.944224
max  7.051619  0.318469  20.037661

1 Sigma: [0.4024004 0.4024948 0.57470737]
2 Sigma: [0.8048007 0.8049897 0.9014088]
3 Sigma: [0.9972010 0.9973865 0.9995179]
        
```



# Way Ahead

- **Hardware:**
  - Augmenting the monitoring receivers with new GNSS signal/services
- **Software:**
  - Interference analysis and monitoring software
- **Deployment:**
  - Establishing monitoring receivers over various locations in country
  - Arrangement for data collection with other existing monitoring receivers (within and outside country)
- **Generation of NavIC/GNSS performance evaluation reports on regular basis**
- **We based interface for dissemination of achieved data**



**Thank You for Your Kind Attention**

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