Geodetic Control Network / Continuously Operating Reference Station (CORS) in Brunei Darussalam

Act. Surveyor General
Survey Department, Ministry of Development
Brunei Darussalam
Presentation Outline

- Introduction
- History of Satellite Survey at Survey Department
- The new Geocentric Datum & CORS infrastructure in Brunei Darussalam
- Brunei CORS service
- Activities and Contribution
- Way Forward
- Concluding Remarks
Introduction

- Brunei Darussalam has a total area of 5,765 sq.km

- Population is estimated 411,000 people with a growth rate of 1.9%.

- Oil and gas industries are the major contributor to the national economy.

- A new geocentric datum for Brunei Darussalam 2009 (GDBD2009) was established using GPS space geodetic technology based on the ITRF2005 reference frame.

- The GDBD2009 is related to ITRF2005 through the inclusion of the 8 GPS stations of the Brunei Darussalam Zero Order Network and have been processed together with more than fifty IGS stations around the world.
History of Geodetic Control Survey

**Borneo Triangulation 1948 (BT48)**

- **1934 to 1937**: The original survey by Directorate of Colonial Surveys (DCS), Bridges 1937
- **In 1947**: Readjustment of triangulation (including Sabah & Sarawak) was undertaken by the to establish a local geodetic reference system known as Borneo Triangulation 1948 (BT48)

This reference system had its origin at Bukit Timbalai and uses the Modified Everest as the reference ellipsoid.

**Applicable for Northern Borneo**
Some of the Primary Triangulation Stations: (a) Bukit Agok; (b) Bukit Telingan; (c) Bukit Tunggulian; (d) Bukit Bedawan; (e) Bukit Sagan A; (f) Bukit Miri; (g) Bukit Lambir and, (h) Bukit Bub Rumah.

2002 - 2003: GPS campaign was carried out on 17 stations which include some primary & secondary triangulation stations

(a) to establish a new GPS network, and monuments

(b) to analyze the existing geodetic network

(c) To determine the new 3 transformation parameters between WGS84 & BT48

Ref: Morgan, 2004).
The new Geocentric Datum & CORS infrastructure
2009: Establishment and Realization of GEOCENTRIC DATUM in Brunei Darussalam (GDBD2009)

GPS Data Collection at 18 BT 48 stations connected to Zero Order Network, Malaysian GNSS Network and more than 50 IGS stations.
Results from establishments  Brunei Geocentric Datum

1. GDBD2009 coordinates for 18 stations including 8 Brunei CORS stations

2. Computation of Transformation Parameters;
   a. GDBD2009 to BT48 and Reverse Bursa-Wolf 7-Parameter
   b. GDBD2009 to WGS84 and Reverse (3-Parameter)
   c. WGS84 TO BT48 (Bursa-Wolf 7-Parameter)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dx</td>
<td>689.59370 m</td>
<td>Dx</td>
<td>0.13513 m</td>
<td>Dx</td>
<td>597.1257 m</td>
</tr>
<tr>
<td>Dy</td>
<td>-623.84046 m</td>
<td>Dy</td>
<td>0.12670 m</td>
<td>Dy</td>
<td>-624.202 m</td>
</tr>
<tr>
<td>Dz</td>
<td>65.93566 m</td>
<td>Dz</td>
<td>0.02497 m</td>
<td>Dz</td>
<td>2.1991 m</td>
</tr>
<tr>
<td>Rx</td>
<td>-0.02331”</td>
<td>Rx</td>
<td>-1.45741”</td>
<td>Rx</td>
<td>-1.45741”</td>
</tr>
<tr>
<td>Ry</td>
<td>1.17094”</td>
<td>Ry</td>
<td>-0.84837”</td>
<td>Ry</td>
<td>-0.84837”</td>
</tr>
<tr>
<td>Rz</td>
<td>-0.80054”</td>
<td>Rz</td>
<td>1.79984”</td>
<td>Rz</td>
<td>1.79984”</td>
</tr>
<tr>
<td>Scale</td>
<td>-5.88536 ppm</td>
<td>Scale</td>
<td>-10.4358 ppm</td>
<td>Scale</td>
<td>-10.4358 ppm</td>
</tr>
</tbody>
</table>

a  

b  

c
Brunei CORS service
Nine (9) GNSS CORS that form the Zero Order Network of Brunei Darussalam are:

1. KBEL
2. LABI
3. MURA
4. LAMU
5. LIAN
6. TEMB
7. TUTO
8. UKUR
9. LABU
The CORS Signal Coverage for RTK users

CORS signal coverage within 35 km radius
GNSS CORS NetWork Services and products

http://www.survey.gov.bn/web/survey_department/

- **Data Availability**
  - The CORS data are available in RINEX 2.0 format.
  - With accuracies of 1 to 3 cm horizontally and 3 to 6 cm vertically

Data rate – Optional 0.1-60 sec.
Data from the CORS are available in 24/7
The operational status of the CORS will be available on its webserver-
http://202.160.30.98/

Data download is made through Internet FTP only and need to be subscribe
## GNSS CORS NetWork Services and products

<table>
<thead>
<tr>
<th>No</th>
<th>Types of Service</th>
<th>Price (BND)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Virtual RINEX data</td>
<td>50.00</td>
<td>For 1 day, unlimited file size</td>
</tr>
<tr>
<td>2</td>
<td>Real Time Kinematic (RTK)</td>
<td>1,000.00</td>
<td>Annual fees, need to register to Survey Dept.</td>
</tr>
<tr>
<td>3</td>
<td>Real Time Kinematic (RTK)</td>
<td>100.00</td>
<td>Monthly fees, need to register to Survey Dept.</td>
</tr>
<tr>
<td>4</td>
<td>Fitted Geoid</td>
<td>5.00</td>
<td>For per station</td>
</tr>
</tbody>
</table>
GNSS CORS Network Services and products

RTK system provides the following levels of GNSS correction & data

a) VRS Correction

Within the limits of RTK network: provide RTK GNSS corrections with accuracies of 1 to 3 cm horizontally and 3 to 6 cm vertically. Distance dependent errors are considerably minimised with utilisation of the RTK network.

b) Single Base Real-Time Correction

This correction is provided for area within 30 km from the RTK single reference station with an accuracy of 1 to 3 cm horizontally and 3 to 6 cm vertically.

c) Network Base DGPS Correction

This correction provides better than 50 cm accuracy for the whole of Brunei Darussalam.
Height Modernization System (HMS) Project in 2010

Precise Leveling

GNSS Data

Gravity data

BRUNEI GEOID

Geoid Computation – Computation of Geoid for determination N value (Geoid height) are based on combination of Precise Levelling data, GNSS and Gravity data.
WEB BASE GEOID INTERPOLATION CALCULATOR

Survey Department Brunei Darussalam

Single Point Calculation

Please enter your coordinates:

Latitude: 4° 42' 38.5823" (4.7107)
Longitude: 115° 4' 22.9738" (115.0730)

Ellipsoidal Height: 65.181 m

I agree with the terms and condition.  

Process
WAY FORWARD

- Future Brunei CORS Extension - 1 CORS per year till 2025
- Migration to One Government Network (OGN) – to avoid communication problem
Regional Participation

- ASIA – PACIFIC REFERENCE FRAME PROJECT
  (Campaign Date: 4/10 to 10/10 2009)
  (Campaign Date: 12 to 18 Sept 2010)
  (Campaign Date: 11 to 17 Sept 2011)
  (Campaign Date: 06 to 13 Sept 2015)
  (Campaign Date: 18 to 25 Sept 2016)
• Require long term maintenance: enclosure to house power supplies, batteries, a computer and telecommunications equipment.

• Communication Problem (Internet Interruption) - Migrate to One Government Network (2016)

• Invites private sectors to work together with the Survey Department (PPP).
Conclusion

- Brunei GNSS- CORS is the current available infrastructure for application that require high level of positioning accuracy.

- GNSS CORS need to be utilized fully, to benefit local Government and Private Agencies.

- GNSS education should be a better choice for Long Term Strategic Plan 2035 which include education, Economy, Security, Institutional development, Business development, Infrastructure and Environmental.
Thank You