The Nigerian Geocentric Datum (NGD2012): Preliminary Results

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Key words: NIGNET, ITRF, Geocentric Datum, GNSS, Nigerian Primary Geodetic Network,

SUMMARY

The Office of the Surveyor General of the Federation (OSGoF) holds more than a century-old proud record of serving the needs of the Government, the military, the industry and the general public. It is promoting itself to be a centre of excellence for all survey and mapping activities in Nigeria. It also aims to provide an efficient and high quality land surveying and mapping services that include the dissemination of geodetic information in line with the national requirements and the federal government transformation agenda. The current national mapping in Nigeria relates to the old systems of the Nigerian Primary Triangulation Network of 1960s. These traditional survey control systems were referenced to a non-geocentric datum, based on Clarke 1880 ellipsoids. Both fit well regionally but not globally. In order to fully support the Global Navigation Satellite Systems (GNSS) activities and modern positioning infrastructures, a more accurate control system in the form a geocentric datum is needed. The establishment of the Nigerian Permanent GNSS Network (NIGNET) which began in 2008 has provided the impetus for the adoption of the geocentric datum in all geodetic activities. With the data products obtained from the International GNSS Service (IGS) stations, the coordinates of the NIGNET stations have been derived using 2-year continuous GPS data. Following this, GPS observations were carried out on the passive primary control stations; these were strengthened and now superseded the old networks. The final outcome from this exercise is an accurate set of coordinates for NIGNET and 60 GPS stations in Nigeria referred to the International Terrestrial Reference Frame 2008 at epoch 1 January 2012. Collectively these coordinates represent the basis for the Nigerian Geocentric Datum (NGD2012). This paper is intended to provide the results of the definition and realization of a geocentric datum for Nigeria and the establishment of the new Nigerian Primary Geodetic Network (NPGN).

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1. INTRODUCTION

The Office of the Surveyor General of the Federation is responsible for the maintenance of the national reference system on which all survey and mapping is based. Historically, datum have been established in many regions around the world since the 19th Century using conventional surveying techniques and procedures. Most of them were confined to small areas of the globe, fit to limited areas to satisfy national mapping requirements. In Nigeria, the conventional geodetic datum, the Minna Datum is based on the Clarke 1880 modified, which is regional in nature and generally not aligned with global geocentric coordinates frames.

Current trend indicates that many countries have implemented and adopted a geocentric coordinate frame for their geodetic datum. Such earth centred geocentric datum is difficult to define until the recent development of space based measuring systems. This is made possible because the space based positioning satellites revolve around the centre of mass of the earth and are therefore related to an earth centred or geocentric datum.

All modern GNSS use geodetic reference systems closely aligned with ITRF (e.g. the US GPS system's WGS84). The latest realisation of ITRF (ITRF2008) has a precision of a few millimetres and forms a robust basis for any regional or national geodetic datum. As the ITRF continues to stabilise, it is anticipated that differences between future realisations of ITRF will differ from one another by less than a few millimetres at a common epoch. Transformations from instantaneous ITRF to a fixed reference epoch of ITRF are straightforward using a measured ITRF site velocity for each station, defining the geodetic network, by using a deformation model; or by using a model of rigid plate motion to compute a site velocity (Altamimi *et al.*, 2007). A centimetre accurate geodetic datum forms the spatial foundation for any economic activity reliant on spatial data (cadastral surveys, urban and regional planning, land administration, resource extraction, agriculture, engineering, transport, asset management and navigation) as well as environmental monitoring, search and rescue operations and geophysical hazard mitigation (Abdulkadir, et al, 2003). Sharing of data is possible without the need for any transformation, if all users (e.g. different government departments and the private sector) are using the same datum. The resulting economic savings and benefits are immense.

In line with this development, the Federal Government of Nigeria through the Office of the Surveyor General of the Federation (OSGoF) set up surveying infrastructure throughout the country known as the Nigerian Permanent GNSS Network (NIGNET). The NIGNET is a network of GNSS Continuously Operating Reference Stations (CORS). Currently, there are 13 permanent NIGNET tracking stations operating 24 hours a day, which can provide positional solutions including movement in their relative positions due to tectonic plate activity. This network of permanent GPS tracking stations is known as the Zero Order Geodetic Network and it complies with international standards to provide the highest precision for positioning in Nigeria.

The adoption of a geocentric datum is therefore, inevitable considering that satellite positioning systems would have widespread use in this millennium and the positions referenced to the existing datum would not be compatible with such satellite derived positions. Furthermore, the adoption of a global geocentric datum would make datum unification a reality. Such a datum would allow for a single standard for the acquisition, storage and the use of geographic data, thus ensuring compatibility across various GIS applications (Abdulkadir, et al., 2003).

Nigeria has therefore joined the rest of the world to replace the traditional geodetic passive networks which are the basic infrastructure for Surveying and Mapping in any country. The eventual purpose is national development, security and defence, which is in line with the government's endeavour to improve its delivery mechanism. The NIGNET therefore, forms the National Geodetic Datum, which is a centimetre accurate geodetic datum forming the spatial foundation for any economic activity reliant on spatial data (cadastral surveys, urban and regional planning, land administration, resource extraction, agriculture, engineering, transport, asset management and navigation) as well as environmental monitoring, search and rescue operations and geophysical hazard mitigation.

In order to realize the adoption of a geocentric datum, OSGoF conducted research on the implementation of geocentric datum for mapping and cadastral survey. This paper presents the results and detailed information and procedure in the data processing of the Nigerian Permanent GNSS Network (NIGNET) and GPS observations carried out on some established GNSS Monuments in the country.

2. THE BENEFITS OF A GEODETIC DATUM BASED ON ITRF

An ITRF based geocentric datum or CORS network will among others; (Dodo, et al, 2011)

i. Provide direct compatibility with GNSS measurements and mapping or geographical information system (GIS) which are also normally based on an ITRF based geodetic datum

ii. Allow more efficient use of an organization' spatial data resource by reducing need for duplication and unnecessary translation

iii. Help promote wider use of spatial data through one user friendly data environment

Reduce the risk of confusion as GNSS, GIS and navigation systems become more widely used and integrated into business and recreational activities

3. IMPLEMENTATION OF GEOCENTRIC DATUM FOR NIGERIA

The depiction of three-dimensional position is most conveniently represented by a regular mathematical model instead of the geoid, which is the equipotential surface of the earth's gravity field that coincides with the mean sea level. Currently, the best mathematical model is an ellipsoid defined with orientation and position as well as size and shapes to fit the globe. Modern geocentric datum has its origin (0, 0, 0) fixed at the Earth's centre of mass and the directions of their axes are defined by convention (Dodo, et al, 2011). The International Earth Rotation Services (IERS) maintains this present day terrestrial reference system through an International Terrestrial Reference Frame (ITRF), which is defined by adopting the geocentric Cartesian coordinates and velocities of global tacking stations derived from the analysis of VLBI, SLR, and GPS data (Bock, 1998). The implementation of geocentric datum for Nigeria will required the connection to such reference frame (ITRF). The following stages of realization of the geocentric datum include:

i. GPS data collection for the Zero Order Geodetic Network.
ii. Data processing and adjustment of Zero Order Geodetic Network.
iii. Computation of the new geocentric datum coordinates at a specific epoch.
iv. Derivation of transformation parameters.

4. COORDINATION OF NIGNET TO ITRF2008 AS A ZERO ORDER GEODETIC NETWORK

ITRF2008 is the new realization of the International Terrestrial Reference System. The ITRF2008 has a precision of a few millimetres and forms a robust basis for any regional or national geodetic datum. ITRF is realised through a set of station coordinates of global terrestrial fiducial points based on over fifty-four sites and it combines solutions from four space techniques including Global Positioning System (GPS), Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR), and Doppler Orbitography by Radio-positioning Integrated on Satellite (DORIS). The present estimated accuracy of the coordinates is about 2 to 5mm in position and 1 to 2mm/yr in velocity. The stability of the frame over 10 years is reported to be accurate to better than 0.5 ppb in scale or equivalent to a shift of about 3mm in station height and 4mm in origin (Altamimi, et al, 2007).

Many countries have modernised their geodetic datum to a geocentric realisation of ITRF. Table 1 shows selection of countries which have already adopted an epoch of ITRF as the basis for their national datum.

Table 1: ITRF aligned datum of some selected countries (Dodo, et al, 2011)

Country	**Datum**	**Realisation**	**Reference Epoch**
Australia	GDA94	ITRF92	1994.0
China	CTRF2000	ITRF97	2000.0
Indonesia	DGN1995	ITRF2005	1995.0
Japan	JGD2000	ITRF2000	2000.0
Malaysia	GDM2000	ITRF2000	2000.0
New Zealand	NZGD2000	ITRF96	2000.0
Papau New Guinea	PNG94	ITRF92	1994.0
South Korea	KGD2002	ITRF2000	2002.0

The realization of the Nigerian Geocentric Datum (NGD2012) is based on a network of permanent GPS tracking stations (CORS), which fits into the global ITRF geodetic framework. Currently, NIGNET consists of eleven (11) active permanent GPS tracking stations (Figure 1), which were established by OSGoF) for geodetic surveying and geodynamic determination. These stations form the so-called Zero Order Geodetic Network.

4.1 Data Acquisition

The links to ITRF2008 were made by acquiring GPS data from Nine (9) International GNSS Service stations (IGS) as shown in Table 2 below. The data were acquired at the period with those of NIGNET. These stations served as the fiducial points.

Table 2: IGS Stations used

Station ID	Station location	Country	Appro. Lat (N)	Apro. Long (N)	Ellipsoidal Height (m)
HARB	Pretoria	Republic of south Africa	-25^0 53' 12.84''	27^0 42' 27.00''	1555.0000
NKLG	Libreville	Gabon	00^0 21' 14. 04''	09^0 40' 16.56''	31.4800
RABT	Rabat	Morocco	33^0 59' 53.16''	353^0 08' 44.52''	90.1000
RBAY	Richards bay	South Africa	-28^0 47' 43.80''	32^0 04' 42.24''	31.7927
SUTH	Sutherland	South Africa	-32^0 22' 48.72''	20^0 48' 37.80''	1799.7659
CAGZ	Capoterra	Italy	39^0 08' 09.24''	08^0 58' 22.08''	238.0000
MAS1	maspalomas	Spain	27^0 45' 49.32''	344^0 22' 0.22''	197.3000
NOT1	Noto	Italy	36^0 52' 33.96''	14^0 59' 23.28''	126.2000
SFER	sanfernando	Spain	36^0 27' 51.48''	353^0 47' 39.84''	85.8000

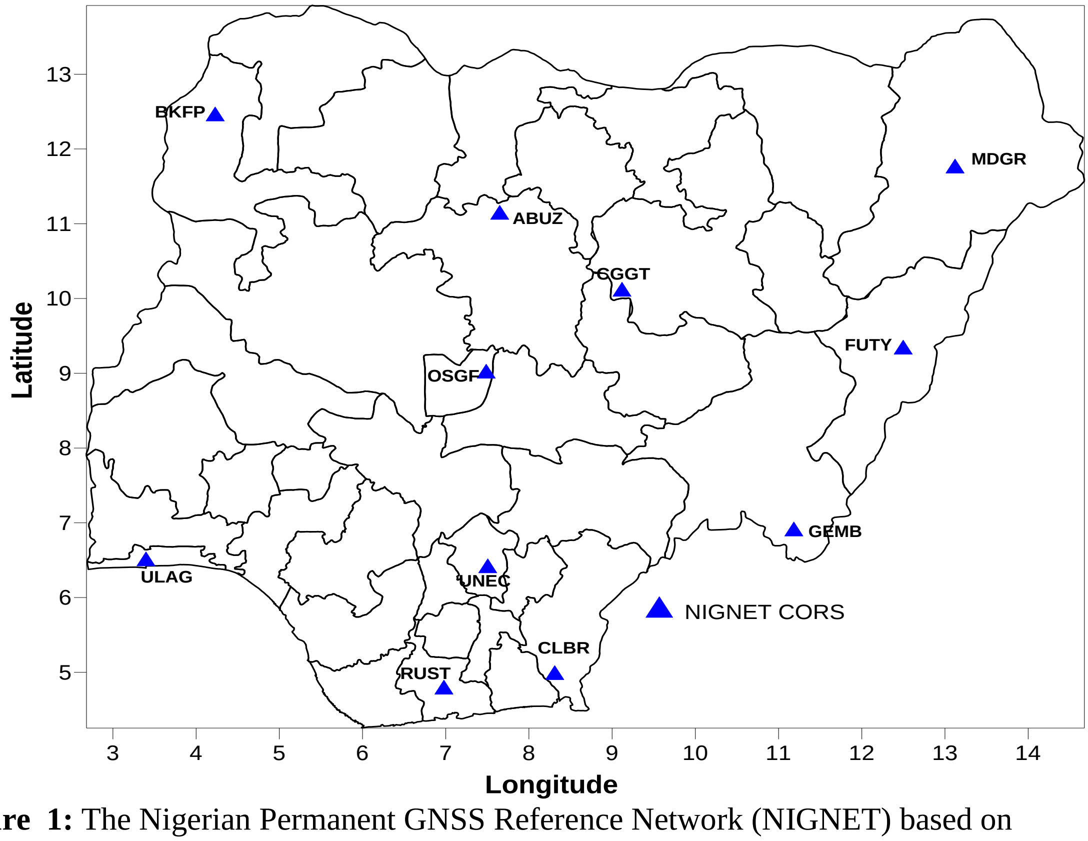

Figure 1: The Nigerian Permanent GNSS Reference Network (NIGNET) based on ITRF2008 [@ Ref Epoch. 1. JAN. 2012]

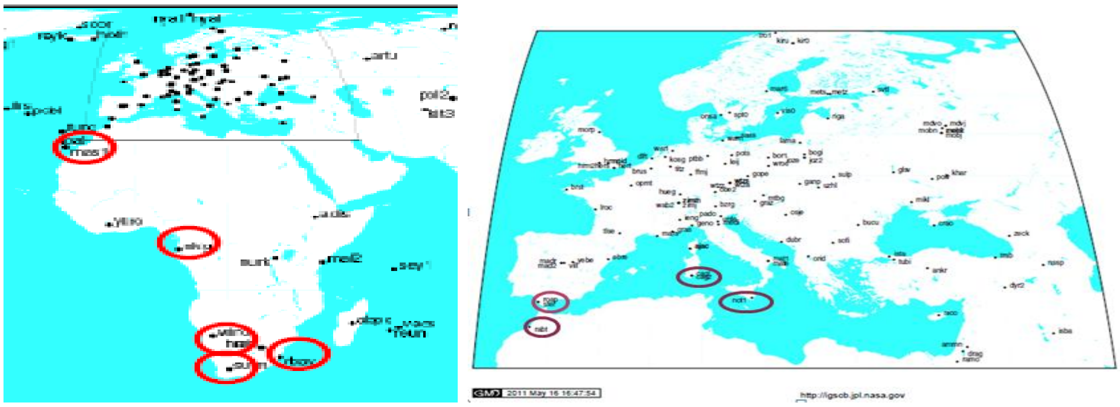

Figure 2: IGS Stations used as Reference station for NIGNET (IGS, 2012)

4.2 GPS Campaign

The data were grouped in campaigns and sessions according to year of observation as shown in Table 3

Table 3: GPS Campaigns grouped for processing

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	√	√	√	√	√	√	√	√	√	√	√	√
2011	√	√	√	√	√	√	√	√	√	√	√	√
2010 session	19	28	31	30	31	30	31	31	30	31	30	31
2011 session	31	28	31	30	31	30	31	31	30	31	30	31

In Table 3, there are 12 campaigns in both 2010 and 2011, thus a total of 24 campaigns. Each campaign is divided into sessions. Example, in January campaign for 2010 and 2011, there are 19 sessions in 2010 and 31 sessions in 2011 respectively.

4.3 NIGNET Station Availability

Two years (2010 and 2011) NIGNET data were screened for station data availability. The RINEX file were screened for each station and tabulated according to GPS week. Table 4 shows an extract of the Station data availability according to GPS Week

Table 4: Sample RINEX Data Availability X: Data not availably √: Data Available

Month	**GPS WEEK**	**ABUZ**	**BKFP**	**CGGT**	**CLBR**	**FUTY**	**GEMB**	**MDGR**	**OSGF**	**RUST**	**ULAG**	**UNEC**
January	**1564**	X	X	X	X	X	X	X	X	X	X	X
	1565	X	X	X	X	X	X	X	X	X	X	X

	1566	X	X	X	X	X	X	X	X	X	√	X
	1567	X	X	X	X	X	X	X	√	X	√	X
	1568	√	√	X	X	X	X	X	√	X	X	X
February	**1568**	√	√	√	X	X	X	X	√	X	X	√
	1570	√	√	√	X	√	√	X	√	√	√	√
	1571	√	√	√	X	√	√	X	√	√	√	√
	1572	√	√	√	X	√	√	X	√	√	√	√
March	**1573**	√	X	√	X	√	√	X	√	√	√	√
	1574	X	X	√	X	√	√	X	√	√	√	√
	1575	√	X	√	X	√	√	X	√	√	√	X
	1576	X	X	√	X	√	√	X	√	√	√	X
	1577	X	X	√	X	√	√	X	√	√	√	X

5. DATA PROCESSING

5.1 Software used

The Bernese GPS Scientific Software version 5.0 is used in the data processing. The software is developed by a team of geodetic scientists at the Astronomical Institute University of Berne (AUIB) in Switzerland. It has been rated to be one of the high accuracy GPS processing software resulting from its high performance and flexibility in scientific research (Dach et, al, 2007).

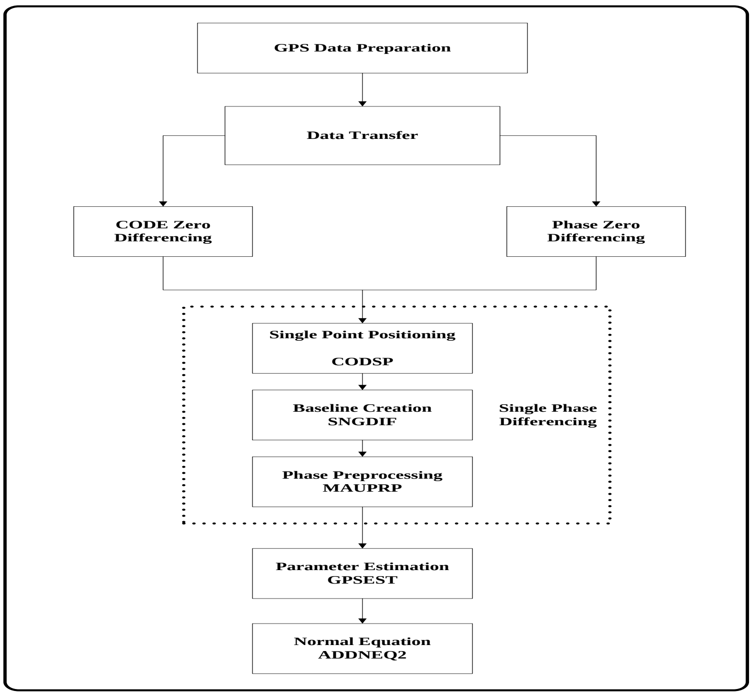

Figure 3: Data processing procedure employed in the Bernese GPS Scientific Software version 5.0 (Dodo, 2009).

5.2 Processing Parameters

The GPS data processing is divided into three parts namely (a) Pre-processing (b) Daily Adjustment and (c) Weekly combination. Daily pre-processing was preformed to eliminate satellite clock biases, estimate receiver clock correction, and to screen for cycle slips. Quasi Ionosphere Free strategy has been used for the ambiguity fixing with the average resolved ambiguity at around 75%. The daily solutions of independent baselines were computed using carrier phase double difference with Dry Neill Mapping Function for troposphere that was estimated for every two hours. Analyses of the weekly solutions were carried out to exclude bad station solutions based on both free and heavily constrained (with respect to the 9 IGS stations) network adjustment.

Table 5: Processing Parameters

RINEX data at 30 second sampling rate
IGS final orbit
24 hours sliding window processing
ITRF 2008 reference frame
Cut-off satellite elevation angle at 3^0
Quasi-Ionosphere free (L_3) ambiguity free
Saastamoinen Troposphere model
IGS fixed stations
Neil Mapping Function
Free network adjustment
Constrain Network adjustment
Ocean Tide Loading for each station [FE2004]

6. RESULTS AND ANALYSIS

The final combined solution for the year 2010 and 2011 consists of 104 weekly solutions and 19 stations (8 IGS stations and 11 NIGNET stations). Two strategies were employed to obtain optimum results and to check for outliers in the final adjustment. The two strategies are as follow:

6.1 Free Network Adjustment

The objective of the free network adjustment with the introduction of Helmert transformation was to adjust the weekly normal equation freely and transform them using the nine (9) IGS station for determining the NIGNET station coordinate; while the Eleven (11) NIGNET Stations were subsequently used to determine the sixty (60) GPS monument station coordinates. This process allowed for the internal reliability investigation and to detect outliers. With the introduction of reference velocity for the fixed stations, the final coordinates for all stations were transformed to the middle of the observation epoch. i.e. 1 January 2012.

```
================================================================================
Program : HELMR1                                   Bernese GPS Software Version 5.0
Purpose : Helmert Transformation
Campaign: C:\HELMERT                               Default session: 2280 year 2012
Date    : 21-Aug-2012 16:54                        User name      : DODO2
================================================================================

JUN2010 CAMPAIGN:SESSION 7
--------------------------------------------------------------------------------


FILE 1: FEBRUARY 2010 CAMPAIGN: SESSION 6
FILE 2: ITRF2008 FOR GPS

TRANSFORMATION IN EQUATORIAL SYSTEM (X, Y, Z):
RESIDUALS IN LOCAL SYSTEM (NORTH, EAST, UP)


----------------------------------------------------------------------
| NUM |        NAME        | FLG |        RESIDUALS IN METERS        |   |
----------------------------------------------------------------------
|     |                    |     |                                   |   |
|   1 | CAGZ               | W I |   -0.0160    0.0379    0.0178 | * |
|   2 | HARB               | W I |    0.0003    0.0004    0.0004 |   |
|   3 | MAS1               | W I |   -0.0001   -0.0004    0.0013 |   |
|   4 | NKLG               | W I |    0.0000   -0.0008   -0.0008 |   |
|   5 | NOT1               | W I |    0.0013    0.0393    0.0272 | * |
|   6 | RABT               | W I |    0.0000    0.0009   -0.0009 |   |
|     |                    |     |                                   |   |
----------------------------------------------------------------------
|     | RMS / COMPONENT    |     |    0.0002    0.0008    0.0011 |   |
----------------------------------------------------------------------


NUMBER OF PARAMETERS  :     7
NUMBER OF COORDINATES :    12
RMS OF TRANSFORMATION :     0.0010 M

PARAMETERS:

TRANSLATION IN  X     :          0.0405 +-  0.0013 M
TRANSLATION IN  Y     :         -0.0755 +-  0.0041 M
TRANSLATION IN  Z     :         -0.0529 +-  0.0027 M
ROTATION AROUND X-AXIS:  -  0  0  0.00097 +-   0.00004 "
ROTATION AROUND Y-AXIS:     0  0  0.00216 +-   0.00010 "
ROTATION AROUND Z-AXIS:  -  0  0  0.00288 +-   0.00015 "
SCALE FACTOR          :          -0.0034  +-   0.0002 MM/KM


NUMBER OF ITERATIONS  :     3
```

Figure 4: RMS of Residuals for IGS Station (Free Network Adjustment)

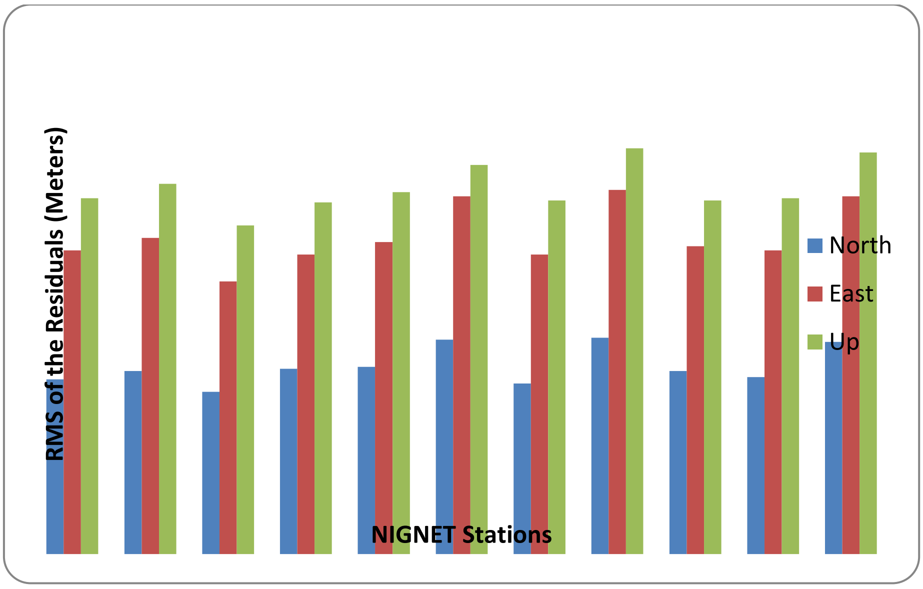

Figure 5: RMS of Residuals for NIGNET Station (Free Network Adjustment)

Comparison of IGS stations coordinates were made in order to determine the accuracy of the network with respect to the IGS stations. With the final combined coordinate from the network adjustment projected to 2 January 2012 (IGS and NIGNET stations), the reference coordinates for the IGS stations were transformed on the same epoch as the adjusted coordinates. In Figure 4, the accuracy of the NIGNET network compare to the ITRF2008 is 0.2 to 0.8 mm in the horizontal and 0.11 mm in the height component

From figure 5, it can be concluded that the accuracy for NIGNET stations with respect to the ITRF2008 reference frame with free network strategy is 7.5 to 17.5 mm in the horizontal component and 16 to 20 mm in height component.

6.2 Heavily Constrained Adjustment

The heavily constrained adjustment was to adopt the specific reference frame in ITRF2008. In Figure 6, the result shows that, the RMS in easting component is larger than the northing components

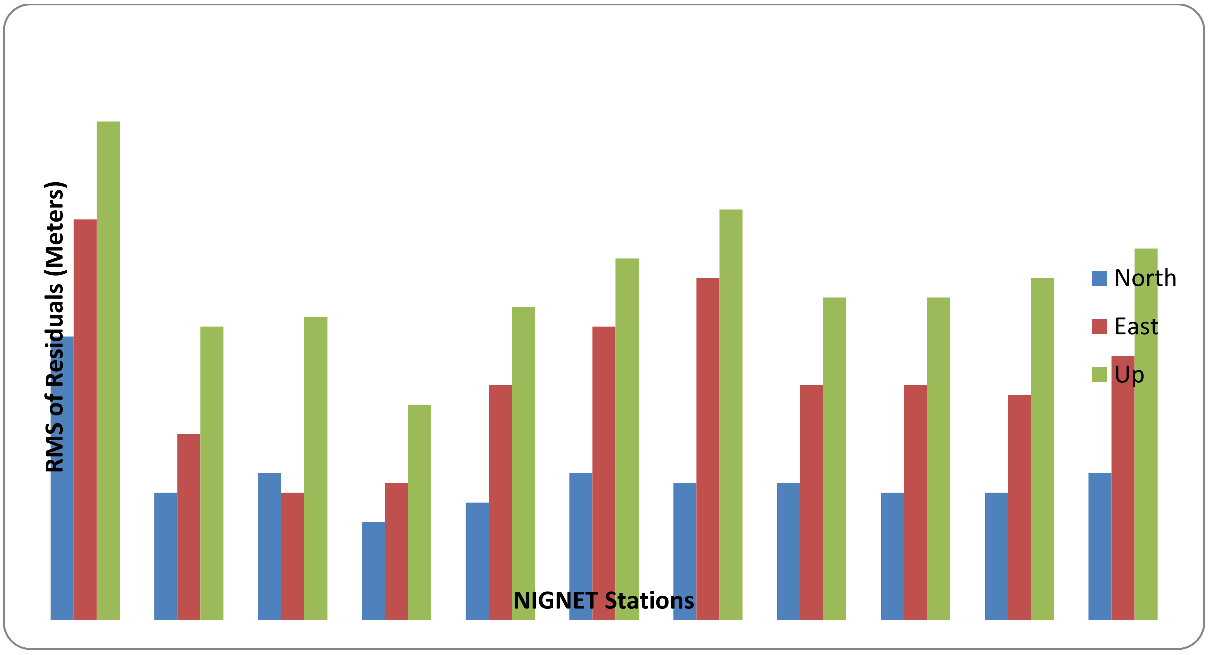

Figure 6: RMS of Residuals for NIGNET Station (Heavily Constrained Network Adjustment)

The figures also show that the accuracy of station coordinates is between 1 to 4 mm in horizontal component and 2 to 5 mm in the height component. Comparison between coordinates obtained from the free network adjustment and heavily constrained adjustment were made. The two coordinates set fits nicely with the RMS of 0.2 mm, 0.2 mm and 0.3 mm for the north, east and up component respectively. The transformation parameter for dx is 0.7 mm, dy is 1.8 mm and dz is 1.6 mm.

The translations component shows that the coordinates between the two strategies are almost identical. With the above statistic, the coordinates of the heavily constrained adjustment based on ITRF 2008 was adopted as the final coordinates (Epoch 01.01.2012) for the Zero Order Geodetic Network.

NUM	NAME	FLG	RESIDUALS IN METERS			
1	ABUZ	I I	0.0003	0.0000	0.0000	
2	BKFP	I I	0.0003	0.0000	0.0002	
3	CGGT	I I	-0.0002	-0.0001	0.0003	
4	CLBR	I I	0.0000	0.0000	0.0004	
5	FUTY	I I	-0.0003	-0.0003	0.0002	
6	GEMB	I I	-0.0001	0.0005	0.0002	
7	MDGR	I I	0.0001	-0.0003	-0.0005	
8	OSGF	I I	-0.0001	0.0000	-0.0002	
9	RUST	I I	0.0000	0.0001	-0.0003	
10	ULAG	I I	0.0000	0.0001	-0.0002	
11	UNEC	I I	0.0000	0.0000	-0.0001	
	RMS / COMPONENT		0.0002	0.0002	0.0003	

NUMBER OF PARAMETERS : 7
NUMBER OF COORDINATES : 33
RMS OF TRANSFORMATION : 0.0002 M

PARAMETERS:

TRANSLATION IN X : -0.0007 +- 0.0011 M
TRANSLATION IN Y : -0.0018 +- 0.0015 M
TRANSLATION IN Z : 0.0016 +- 0.0017 M
ROTATION AROUND X-AXIS: 0 0 0.00001 +- 0.00004 "
ROTATION AROUND Y-AXIS: - 0 0 0.00005 +- 0.00005 "
ROTATION AROUND Z-AXIS: - 0 0 0.00005 +- 0.00005 "
SCALE FACTOR : 0.0001 +- 0.0002 MM/KM

NUMBER OF ITERATIONS : 2

Figure 7: RMS of Residuals for NIGNET in both Free and Constrained Adjustment

7. Coordination of the Nigerian Primary Geodetic Network (NPGN)

GPS observations were carried out on some existing Nigerian Primary Triangulation stations, while some stations were re-established. These GPS geodetic network together with its reference frame must be continually upgraded to provide accessibility to high accuracy GPS control. Thus, a GPS campaign was carried out from October 2010 to April 2011. A total of 60 stations were observed for a period of 48 hours to form the strengthening network. These stations were even distribution through out the GPS Network so as to connect the existing Nigerian Primary Triangulation Network to the Zero Order Geodetic Network (NIGNET) and thus defining a new Nigerian Primary Geodetic Network (NPGN) based on NGD2012 reference frame.

The observed data from the sixty (60) GPS monuments were processed using the same NIGNET stations processing procedure. The strengthening of the network involved two stages of network adjustment namely, the free network and the heavily constrain network adjustment. In the constrained adjustment, NIGNET stations held fixed to adjust the observed baseline vectors to obtain the link station's coordinates to conform to NGD2012.

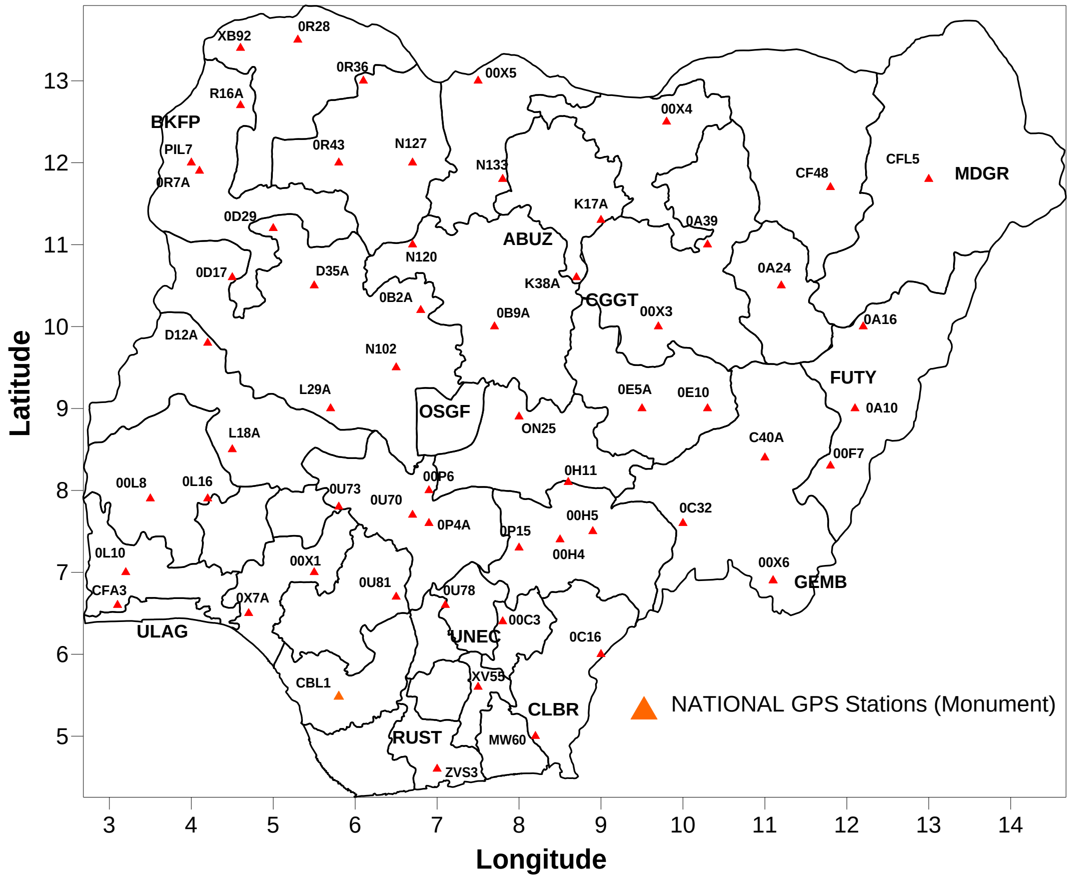

Figure 8: The New Nigerian Primary Geodetic Network based on ITRF2008 [**@ Ref EPOCH. JANUARY 1ST 2012]**

Quality assessment for network shows that differences less than 10 mm is achieved. Only one station in NPGN could not be processed due to poor data quality. The final heavily constrained adjustment used 11 NIGNET stations as fixed with the introduction of their respective standard deviation from the previous adjustment (Fixed NIGNET stations). This strategy allowed the GPS vectors to rotate throughout the network.

Table 10: Extract of Summary result of the mean RMS of the combination of the daily solutions into unique weekly solutions for 10 stations

No.	Station ID	Root Mean Square Error (RMS) @ Ref. Epoch 01. JAN.2012		
		North (m)	East (m)	Ellip.Height (m)
1	**00F7**	**0.00100**	**0.00205**	**0.00340**
2	**00H4**	**0.00178**	**0.00640**	**0.01143**
3	**00H5**	**0.01040**	**0.00303**	**0.04180**
4	**00L8**	**0.00456**	**0.00136**	**0.00127**
5	**00P6**	**0.00295**	**0.00120**	**0.00164**
6	**00X1**	**0.00685**	**0.00338**	**0.00568**
7	**00X3**	**0.00430**	**0.00104**	**0.00118**
8	**00X4**	**0.00120**	**0.00519**	**0.02440**
9	**00X5**	**0.00157**	**0.00693**	**0.00533**

10	**00X6**	**0.00250**	**0.00710**	**0.00820**

The new NPGD has been successfully established with connection to the Zero Order Geodetic Network and its coordinates referred to the ITRF2008 Epoch 00.0 with an accuracy of 1 to 10 mm.

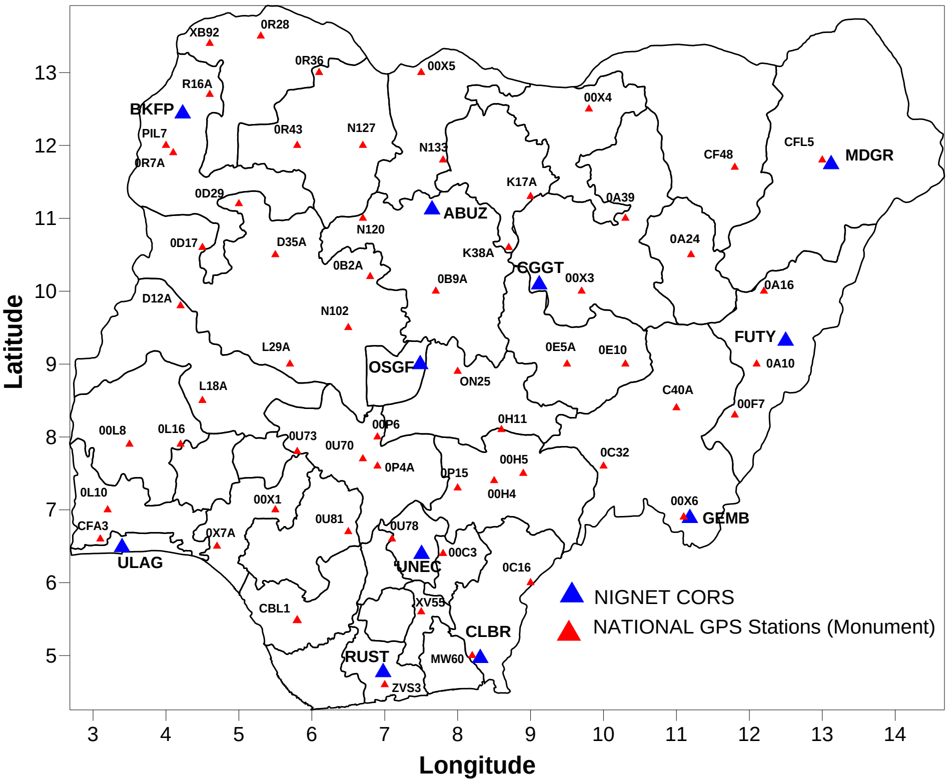

Figure 8: The NIGNET and Nigerian Primary Geodetic Network (GPS Monuments) [@ ref epoch. January 1st 2012]

8. CONCLUSION

The Nigerian Geocentric Datum NGD2012 is a fulfilment of the African Reference Frame (AFREF) vision. With an accuracy of 10 mm defined in ITRF2008, it formed the backbone for all surveying and mapping activities. The new NGD2012 will be maintained and managed through the Nigerian Permanent GNSS Network of Continuously Operating Reference Stations (CORS), these form the Zero Order Geodetic Network and thus a high accuracy, homogeneous and up-to-date datum will always be available to the nation. It is undeniable that the NGD2012 will provide an internationally compatible system for all spatial data. This in turn will generate greater benefit in the application of satellite positioning particularly GPS in the country. With the country enjoying vigorous development and the government supporting the growth of the spatial information industry, the challenge is for the OSGoF to evolve strategies and structure such that it is well positioned to continue to serve the needs of the nation. It is hoped that in this new millennium of an ever-increasing demand for geodetic products, OSGoF will continuously formulate and undertake its modernisation programmes by introducing more innovative strategies in areas of surveying and mapping. Undoubtedly, with this effort OSGoF will be in position to achieve its mission and objectives in line with Federal Government Transformation agenda.

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