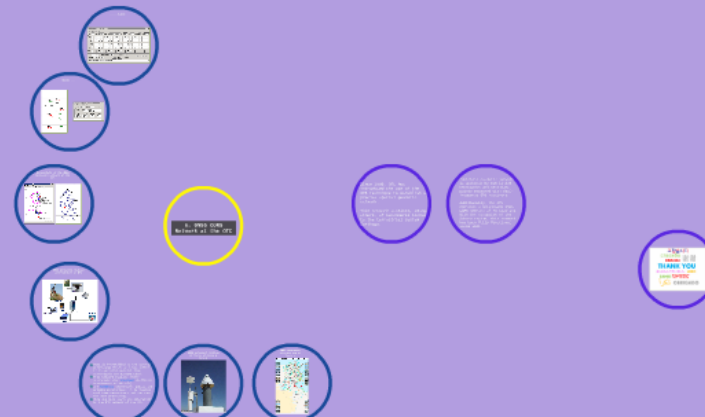
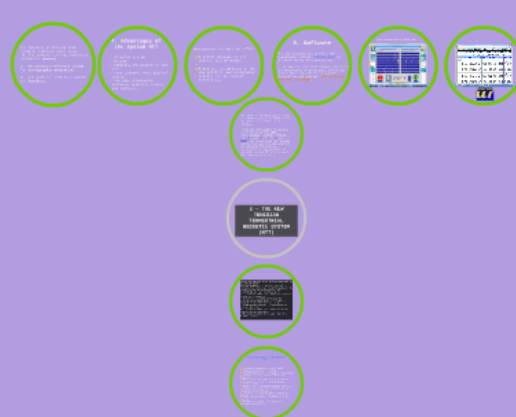
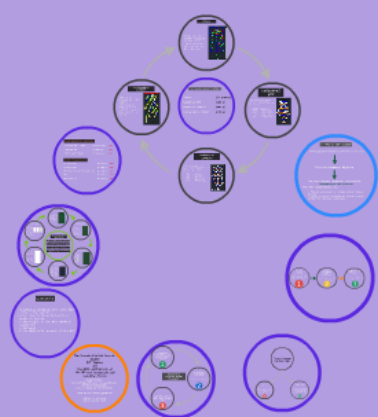




The Terrestrial Unified Geodetic
System
(NTT System)
and
The GNSS CORS Network of
the Office of Topography and
Cadastre - Tunisia

Zouheir FATNASSI
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Geodesy and Topography
Office of Topography and Cadastre

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GGOS Africa Workshop
Nairobi, october 6 2026

Contents

- 1. National Geodetic Infrastructure
- 2. Why a new system ?
- 3. The New Tunisian Terrestrial Geodetic System
- 4. Advantages of the New Geodetic System NTT
- 5. Software
- 6. The GNSS CORS Network of the OTC



National Geodetic Infrastructure

Spatial reference network (28 points)

First Order Spatial Network (600 points)

Primordial Terrestrial Network (312 points)

Second Order Terrestrial Network (~19300 points)

Leveling Network (First, Second and Third order)

Gravimetric Network (Absolute and Relative)

Spatial Network
600 points a
pursuing the
creation of
secondary sp
network of m
than 20000 p

Tun

Between 1978
the Office of
Topography a
(OTC) establ
primary ter
network comp
points, as i
on the map.
network was
through geo-
observations

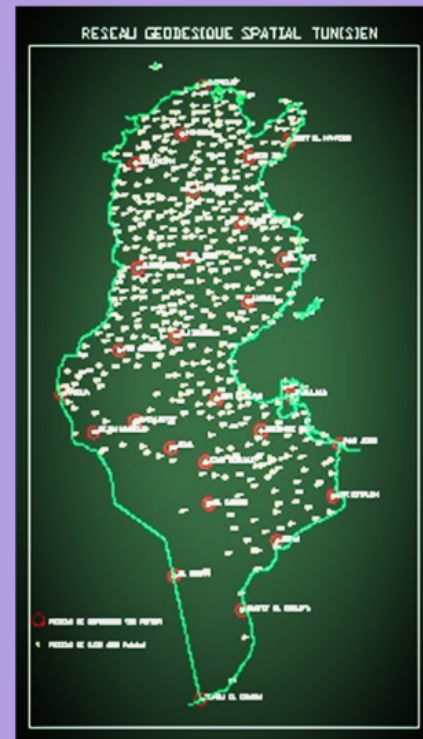
The Spatial Reference Network (28)

To modernize national geodetic infrastructure, the OTC introduced spatial geodesy in 1998 by establishing a network of 28 fundamental reference points spanning the Tunisian territory. The precise coordinates for these sites were computed within the ITRF98 framework.



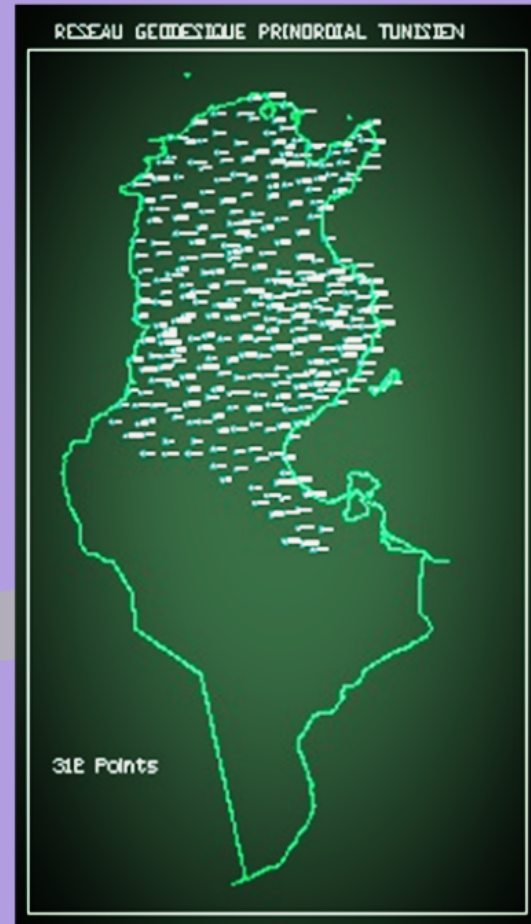
The First Order Spatial Network (600)

Based on the 28 points, The OTC created, between 2000 and 2003, a First Order Spatial Network of 600 points and is pursuing the creation of a secondary spatial network of more than 20000 points



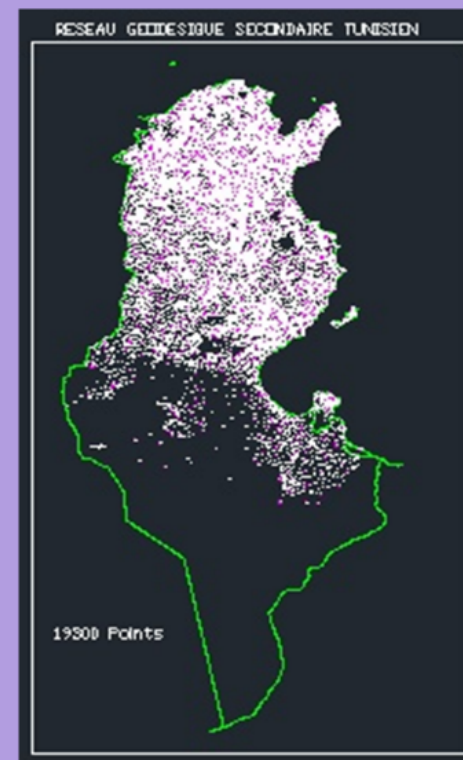
Tunisian Primordial Network (312)

Between 1978 and 1984, the Office of Topography and Cadastre (OTC) established a primary terrestrial network comprising 312 points, as illustrated on the map. This network was adjusted through geo-astronomic observations and referenced to the fundamental datum point of Carthage.



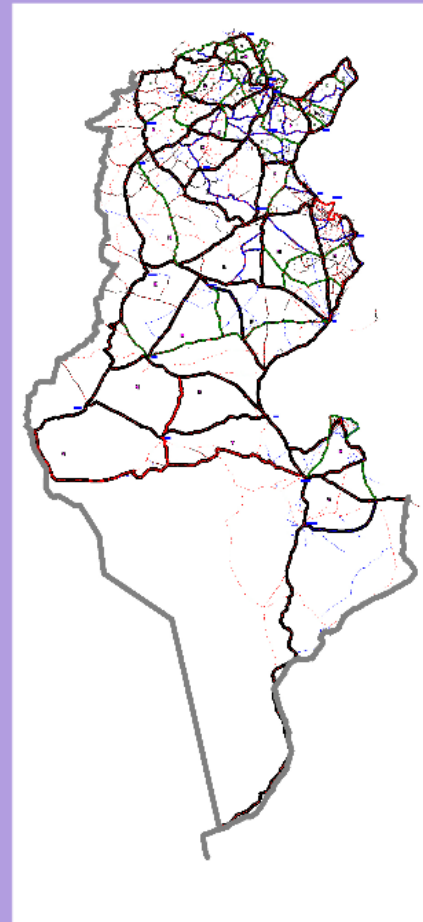
Second Order Terrestrial Network (~23000)

Building upon the 312 points of the primordial geodetic network, the OTC established a nationwide secondary terrestrial geodetic network between 1986 and 2000. This network comprises 19,000 points in total, integrating 8,000 existing points with 15,000 new ones. The entire dataset was globally compensated using the least squares adjustment method.



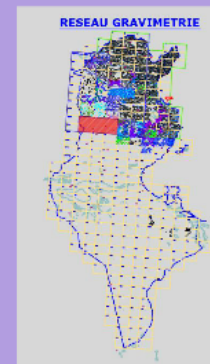
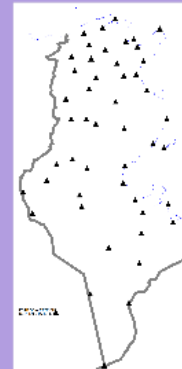
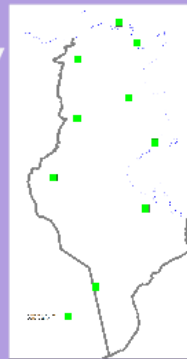
Leveling Network

The OTC maintains a comprehensive leveling network that spans the entire Tunisian territory. This infrastructure consists of a high-precision **first-order network**, a **second-order network**, and a **third-order network**, all engineered to the same high magnitude of precision for consistent and reliable elevation data.



Gravimetric Network

The OTC maintains a national gravimetric network across Tunisia, which includes an absolute reference network (9 points) and a first-order relative network (67 points). A highly detailed densification network is currently under development to further improve national geoid models.



Used Geodetic Systems

Carthage 1934 - 1986	Heterogeneous	GS1
Carthage 1984	Homogeneous	GS2
World System WGS84	Homogeneous	GS3

Used Projections

Lambert North	GS tied to	GS1
Lambert South	GS tied to	GS1
NTT (New Tunisian Triangulation)	GS tied to	GS2
UTM	GS tied to	GS1
WGS84 Zone 32	GS tied to	GS3

Cartography (Scale 1/50000)

Fuseau	(66 papers)
Cadastral UTM	(301 p)
Cadastral Lambert	(305 p)
Cartographic Lambert	(148 p)

Fuseau

Fuseau

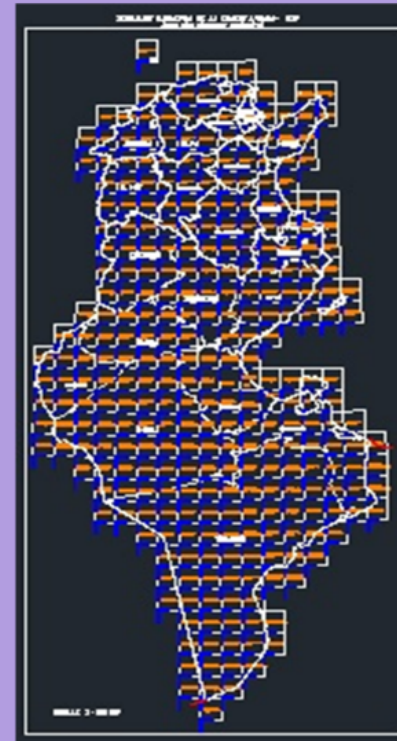
There are 66 Fuseau origins in Tunisia .
The dimensions of a paper are 50 x 40 Kms

A map of Tunisia with a grid overlay. The grid cells are labeled with numbers. Red squares indicate the locations of the 66 Fuseau origins. The map is titled 'OFFICE DE LA TOPOGRAPHIE ET DU CADASTRE' and includes a legend for 'Zone Frontière Algérie' and 'Zone Frontière Libye'. The map is projected in UTM.

Cadastral UTM

311 cadastral UTM papers
scaled 1/50 000 cover
Tunisia . The paper measures
18 x 20 Kms

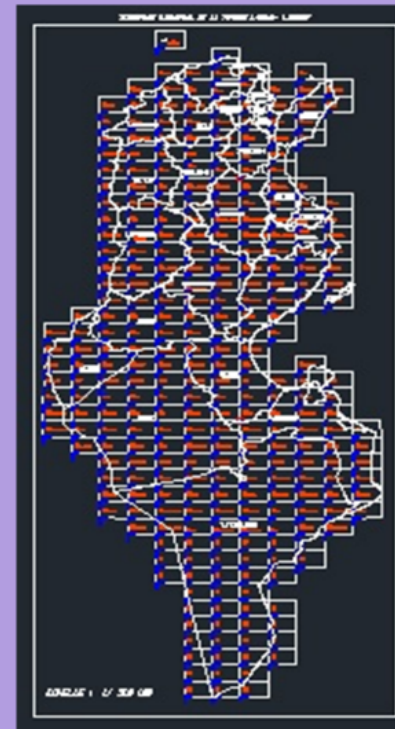
- 1/25000 1052 papers
- 1/10000 4208 papers
- 1/5000 16832 papers
- 1/2000 105200 papers
- 1/1000 420800 papers
- 1/500 1683200 papers



Cadastral LAMBERT

Tunisia is covered by 305
Lambert cadastral papers on the
scale 1/50000 . A paper
measures 32 x 20 Kms

- 1/25000 1052 papers
- 1/10000 6575 papers
- 1/5000 26300 papers
- 1/2000 164375 papers
- 1/1000 657500 papers
- 1/500 2630000 papers



Cartographic LAMBERT

Tunisia is
covered by 253
Lambert
cartographic
maps of scale
 $1/50000$. A map
measures 32 x
20 Kms



2. Why a new system

Heterogeneous Geodetic Systems in Tunisia



Tunisian Geodesy Upgrade



One terrestrial geodetic referential
homogeneous and precise

The OTC requirements are :

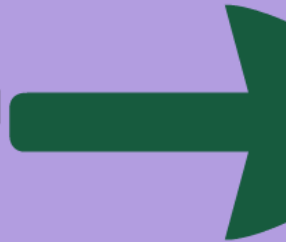
- The non alteration of shapes and surfaces of parcels.
- Preservation of orientations and directions within the required tolerances.



NTT- <<New Tunisian Triangulation>>

In 2003, the OTC adopted the geodetic system resulting from the 1984 network adjustment conducted by IGN-France.

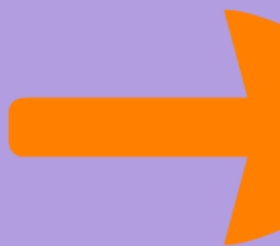
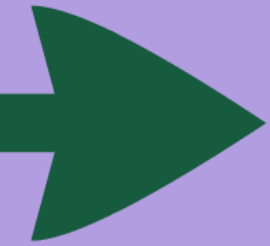
1



*Minister of
Defense Decree
(10th of
February 2009)*

Mandating the official application
for all operators utilizing the
updated geodetic framework.

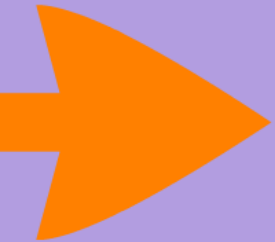
2

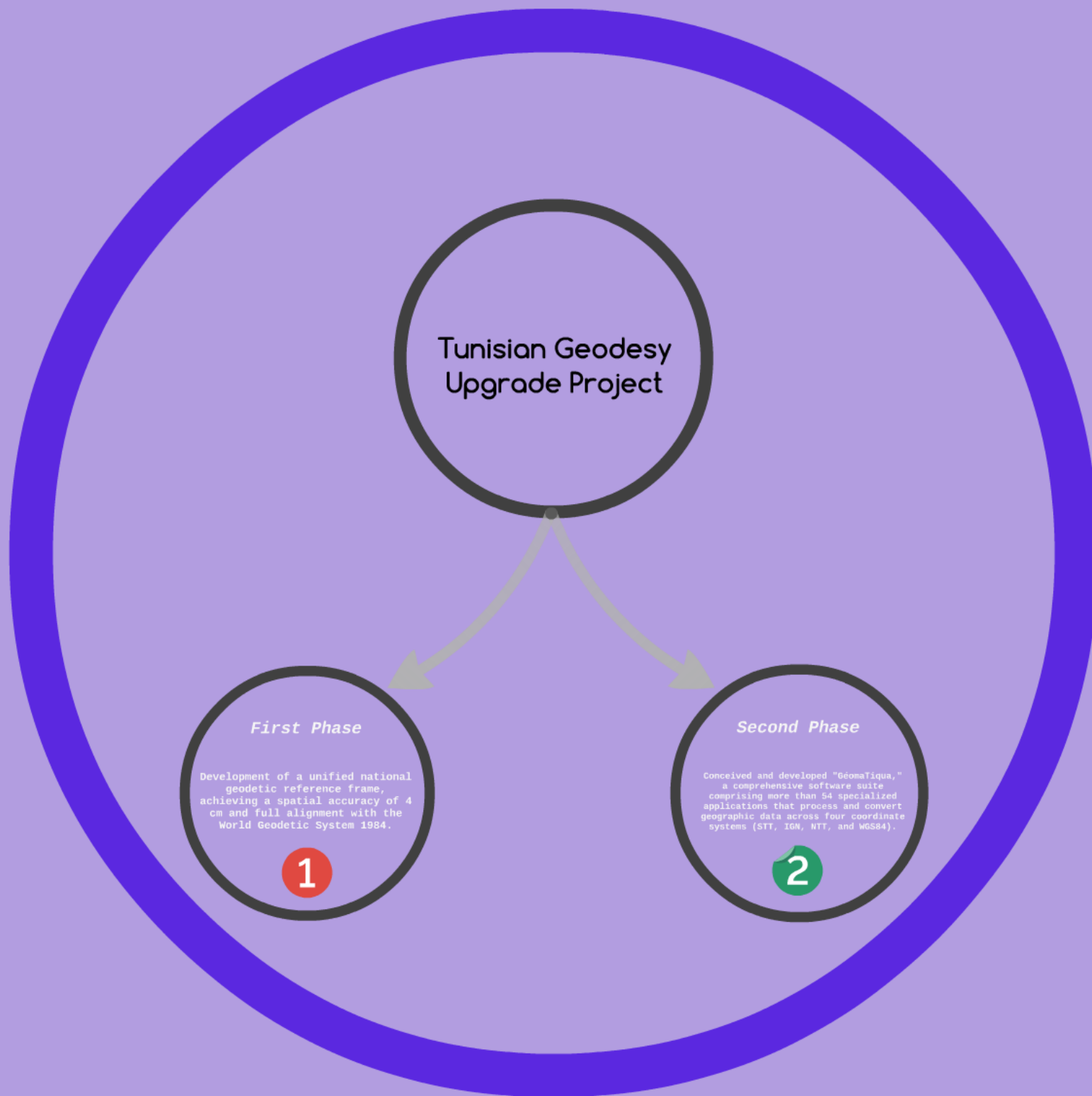


*National project to
upgrade the Tunisian
Geodesy*

Since October 2004, Data entry,
calculus and research and
development

3





Tunisian Geodesy Upgrade Project

First Phase

Development of a unified national geodetic reference frame, achieving a spatial accuracy of 4 cm and full alignment with the World Geodetic System 1984.

1

Second Phase

Conceived and developed "GéomaTiqua,"
a comprehensive software suite
comprising more than 54 specialized
applications that process and convert
geographic data across four coordinate
systems (STT, IGN, NTT, and WGS84).

2

*Coordinate
Transformation from
ancient systems
Terrestrial*

1

**Coordinate
Transformation
flowchart**

*Transformation
Parameters*

Precision with RMS
of 4 cm

Applying the third-order
polynomial method across the
entire Tunisian territory, based
on 1:50,000 scale maps.

2

*Coordinates in
the new system
NTT*

3

*Coordinate
Transformation from
ancient systems*
Terrestrial

1

Transformation Parameters

Precision with RMS
of 4 cm

*Applying the third-order
polynomial method across the
entire Tunisian territory, based
on 1:50,000 scale maps.*

2

*Coordinates in
the new system*
NTT

3

3 – THE NEW TUNISIAN TERRESTRIAL GEODETIC SYSTEM (NTT)

The 10Th of February 2009 Minister of Defense decree has defined the foundations of Geomatics in Tunisia.

With the development of spatial positioning systems **GNSS** (**GPS**, **GLONASS**, **GALILEO**, **BEIDOU**, ...), **Network Real Time Kinematic NRTK** and single base RTK surveys become more and more demanded and the passage from spatial coordinates to the terrestrial geodetic system NTT will respect the required precision.

4. Advantages of the System NTT

- Oriented System.
- Scaled.
- Compensated network in one bloc.
- More coherent with spatial system .
- The new coordinates preserve geometric shapes and surfaces .

Arrêté du ministre de la défense nationale du 10 février 2009.

Article premier - Le système national de référence terrestre unifié de la géodésie, de la projection cartographique et du nivellement est défini comme suit :

A- Le système national de référence terrestre unifié de la géodésie :

- le système national géodésique des coordonnées géographiques : la Nouvelle Triangulation Tunisienne (N.T.T.),
- l'ellipsoïde associé : l'ellipsoïde de Clarke 1880 (F),

B- Le système national de référence de la projection cartographique :

l'Universal Transverse Mercator (U.T.M.)
fuseau 32 Nord.

Characteristics of the System *NTT*

- ★ *Reference ellipsoid* : Clarke 1880Fr.
- ★ *Fundamental Point* : Carthage
- ★ *Azimuth direction* : Carthage-Bir Bou Regba
- ★ *Scaling* : by the bases of Tunis and Medenine
- ★ New angular observations + old angular observations for old preserved points (before 1978).
- ★ Observation of **8 Laplace points** (latitude, longitude and astronomic azimuth) and of 24 distances in 8 triangles.
- ★ Fixation of **5 old points** (observed with Doppler) with standard deviation of 0.50 m.
- ★ Least squares global compensation (312 points).
- ★ *Projection System* : U.T.M (Universal Transverse Mercator)

Homogeneous system that offer:

- ★ A better passage to the spatial system WGS84,
 -
- ★ A perfect integration of the new geodetic and topographic surveys in the spatial referential.

5. Software

The OTC designed the geodetic and topographic software "GéomaTiqua" to automate survey data processing.

It allows for the simultaneous conversion and processing of geographic information across four key coordinate systems: terrestrial and spatial (**STT or Fuseau, IGN, NTT, and WGS84**).

Some screenshots of Géomatiqua



...

.....suite

GéomaTiqua [Mode de compatibilité] - Logiciel Géomatique

Fichier Accueil Insertion Mise en page Formules Données Révision Affichage Développeur

Import IRL CFC 020 Tunis Localisation & MEP

MFUSEAU Parcelle Rue Carte Report

Office de la Topographie et du Cadastre
3, Avenue Mohamed Ali Akid, 1003 Cité Olympique - Tunisie

Table des coordonnées dans le système terrestre national et dans le système mondial

Nom de l'affaire : F SECTEUR A BENI MAAGLE CFC 021 TUNIS M

Nom du Point	ZL	Coordonnées STI		Coordonnées IGN		Coordonnées NTI		Coordonnées WGS84		Feuille Géographique	
		X STI	Y STI	X IGN	Y IGN	X NTI	Y NTI	X WGS84	Y WGS84	N°F	Nom Feuille
8	ST	47239,828	-97098,681	597098,681	347239,828	680488,452	3732719,161	680536,694	3733184,099	148	Houmet_Es_Souk FG
33	ST	47279,799	-97148,427	597148,427	347279,799	680537,862	3732759,584	680586,105	3733224,522	148	Houmet_Es_Souk FG
32	ST	47302,329	-97131,167	597131,167	347302,329	680520,398	3732781,968	680568,640	3733246,908	148	Houmet_Es_Souk FG
31	ST	47312,688	-97127,520	597127,520	347312,688	680516,659	3732792,298	680564,902	3733257,238	148	Houmet_Es_Souk FG
34	ST	47312,785	-97142,959	597142,959	347312,785	680532,101	3732792,531	680580,346	3733257,473	148	Houmet_Es_Souk FG
35	ST	47304,996	-97181,108	597181,108	347304,996	680570,332	3732785,076	680618,576	3733250,015	148	Houmet_Es_Souk FG
36	ST	47303,305	-97190,608	597190,608	347303,305	680579,850	3732783,468	680628,095	3733248,407	148	Houmet_Es_Souk FG
37	ST	47242,675	-97219,706	597219,706	347242,675	680609,491	3732723,075	680657,737	3733188,011	148	Houmet_Es_Souk FG
38	ST	47228,616	-97200,226	597200,226	347228,616	680590,128	3732708,840	680638,372	3733173,777	148	Houmet_Es_Souk FG
39	ST	47208,681	-97178,851	597178,851	347208,681	680568,922	3732688,711	680617,165	3733153,647	148	Houmet_Es_Souk FG
5	ST	47188,012	-97150,521	597150,521	347188,012	680540,765	3732667,785	680589,008	3733132,722	148	Houmet_Es_Souk FG
6	ST	47191,657	-97142,669	597142,669	347191,657	680532,878	3732671,362	680581,121	3733136,299	148	Houmet_Es_Souk FG
8	ST	47239,828	-97098,681	597098,681	347239,828	680488,452	3732719,161	680536,694	3733184,099	148	Houmet_Es_Souk FG

Synthèse OK

11:19 16/03/2015

Video Demo



6. GNSS CORS Network at the OTC

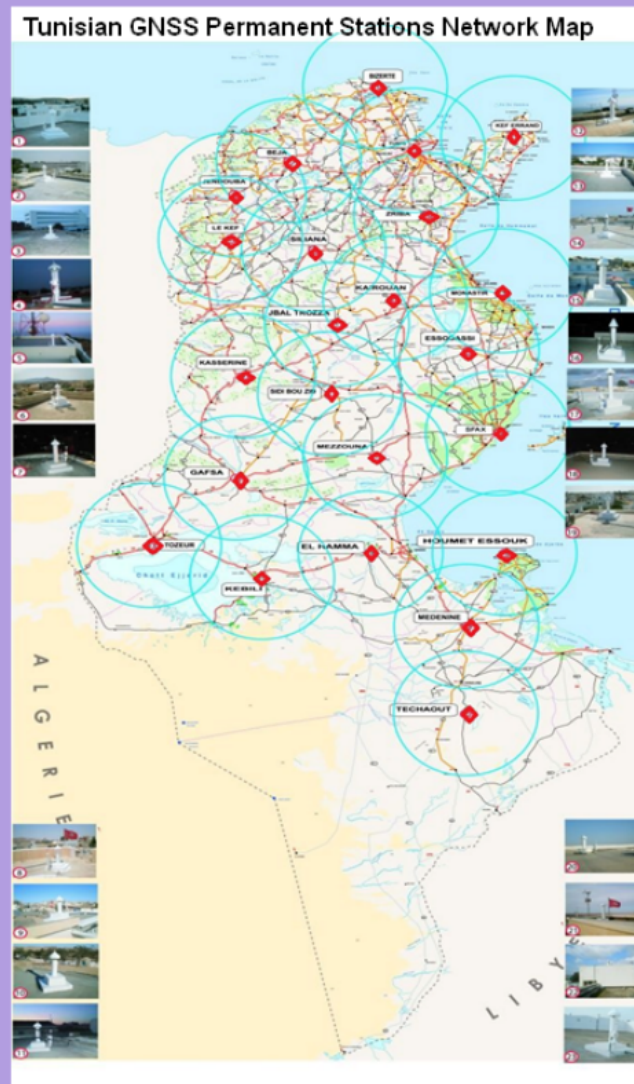
Since 1998, OTC has introduced the use of the GPS technique to establish a precise spatial geodetic network.

This network consists, among others, of benchmarks linked to the terrestrial system Carthage.

Tunisia's geodetic network is anchored by IGS-linked benchmarks and secondary points measured with dual-frequency GPS receivers.

Additionally, the OTC operates a nationwide GNSS CORS network of 23 stations. With the exception of the Sahara region, this network has been fully functional since 2011.

GNSS permanent stations map of Tunisia

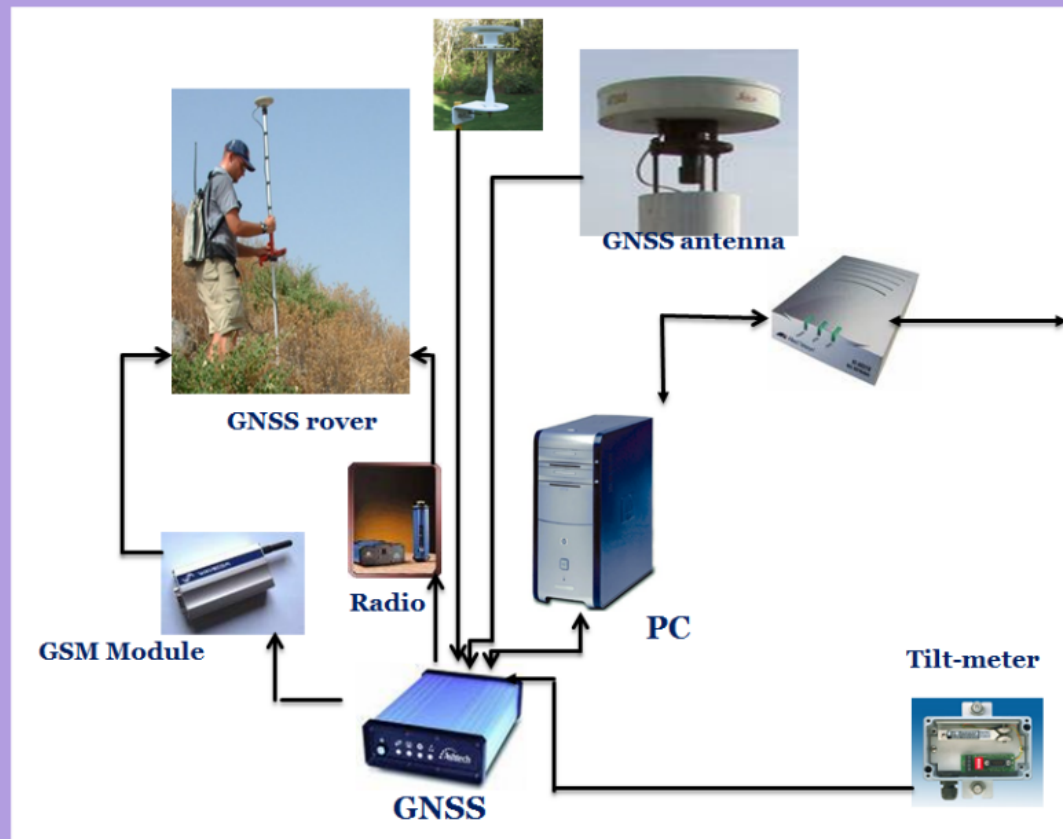


GNSS permanent station
of Tunis (Antenna &
Meteo)

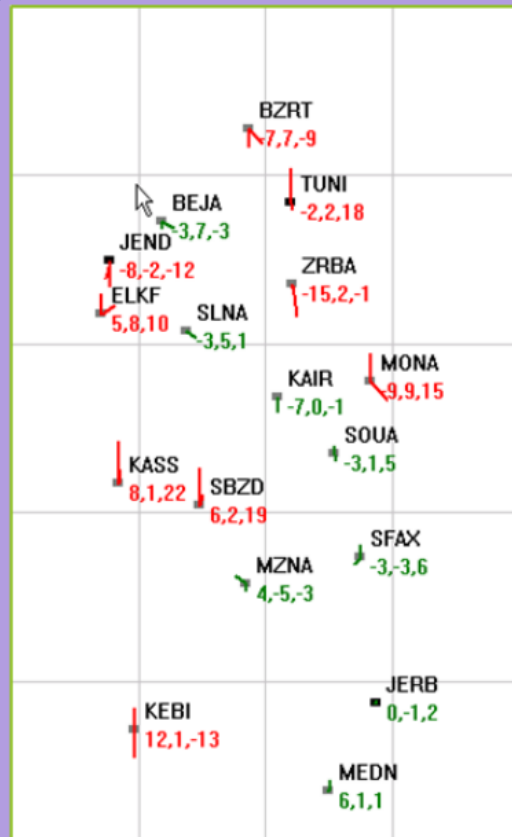


- Data is transmitted to the central processing server in Tunis, where it is analyzed and real-time corrections are disseminated.
- This network enables every authorized user **internal** (Different Departments of the OTC)
- and **external** (Surveyors, public and private enterprises, ...) to receive real time corrections and raw data for post-processing.
- More and more users are interested in the RTK network of the OTC.

GNSS permanent station architecture at OTC



Suite....



Geo++@ METEO_IN - Meteo Data Input

Project Run/Pause Setup Help

Owner: METEO_IN RCV_ID: JEND Running

Input

Sensor Source: 192.168.213.2:4001

Sensor Type: Paroscientific MET3/3A,MET4/4A Meteo Senc

Time [s]	Press. [hPa]	Temp. [°C]	Humid [%]
132878.00	997.85	24.38	33.6
12:54:38.00	± 0.08	± 0.10	± 2.0

next RXM output record in: 22s

.....Suite

Geo++@ SOKKIA_IN - Sokkia Input [TUNI]

Project Alarm Options Help

Week: 1948 Time [s]: 132835.000 Date / Time: 2017-05-08 12:53:55.000 RCV_ID: TUNI #SVs: 9+8 Delay[s]: -17.8 Point: 0000

PRN	G25	G12	G29	G24	G32	G2	G14	G6	G31	R11	R21	R22	R12	R10	R2	R20	R3	R23	R26								
CNO L1	52	52	51	51	49	49	45	45	42	49	47	49	46	44	39	31	31										
L2	50	48	46	48	44	44	39	39	35	48	47	48		38	38	39	34										
LLC L1	27	3	5	2	2	14	5	13	0	1	7	0	0	2	0	2	5										
L2	28	4	13	2	3	14	16	19	0	1	12	0		2	0	2	5										
Elev.	58+	52-	46+	48-	34=	35+	25+	15-	9+	60-	59-	54+	41+	18-	10-	10-	6=	2+	14-								
Ephem.	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐
Health	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐

GNSS Antenna height [m]: 0.1900 ☐ Kinematic ☒ Static connected to 192.168.90.100:2110

Epochs rcvd: 263498 sent: 263498 Connected

Synchronizing System Clock: Correcting +103ms (small soft sync)

고맙습니다
спасибо 谢谢
GRACIAS
THANK YOU

ありがとうございました MERCI

DANKE धन्यवाद

شُكراً OBRIGADO

