CORS-LIBYA PROJECT

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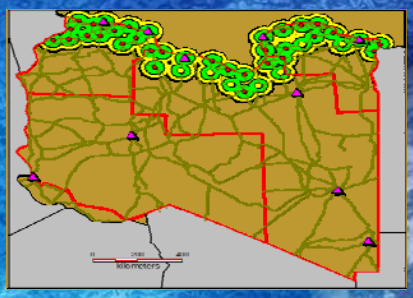

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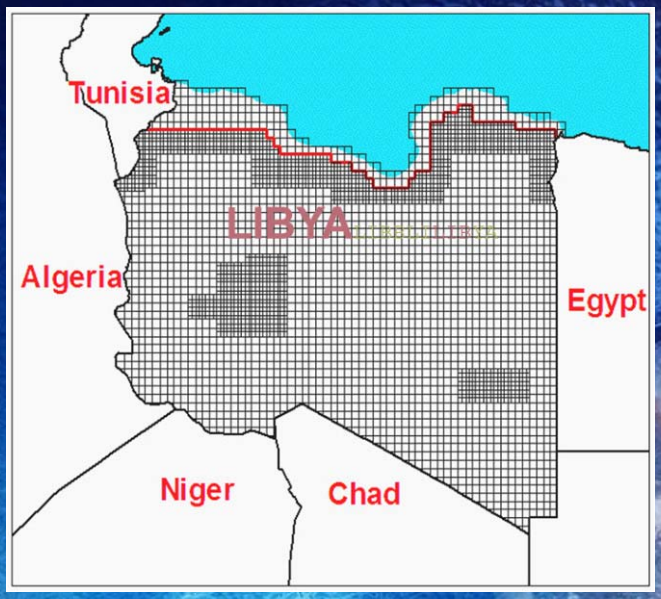

Libyan National Mapping Project

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1. Libya National Mapping Project

TASKS	DESCRIPTION
Work Package-1: Establishment of CORS-LIBYA	Establish CORS along coast line of Libya (50 stations)
Work Package-2: Upgrading Geodetic Control Network and Geoid Determination	a) Establish additional stations (200) b) Survey existing stations (61 +) b) Determine national dm-level geoid
Work Package-3: Establishment of Ground Control Points	Establish ground control points for mapping
Work Package-4: Aerial Photography and Aerial Triangulation	a) Acquire aerial images in two seasons (1,660,000 km2) b) Carry out Aerial Triangulation (if required) or c) Carry out georeferencing
Work Package-5: Orthophoto Mapping	a) Compile DEMs at 5 m grid spacing b) Compile orthophoto maps (1/10K) / 1,660,000 km2

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1. Libya National Mapping Project

Work Package-6: Production of 1/25K, 1/50K, and 1/100K-2000K Digital Topographic Mapping, Color Land Use Thematic Mapping and Navigational / LBS Mapping	a) Compile 1/25K map sheet (280,000 km2) b) QA/QC 1/25K existing maps (95,000 km2) c) Derive 1/50K map sheets from 1/25K sheet (375,000 km2) d) Compile 1/50K map sheets (1,285,000 km2) e) Derive 1/100K map sheet (1,660,000 km2) f) Derive 1/250K – 1/2000K map sheet (1,660,000 km2) g) Compile color land use mapping for all scales above h) Compile 1/25K navigational / LBS maps (10,000 km2) i) Compile 1/100K navigational / LBS maps (1,660,000 km2)
Work Package-7: Establishment of Geodatabase and Portal GIS	Establish geodatabase and metadata consisting of: - Geodetic network points and CORS - Aerial photographs - DEMS and orthophotos - Topographic maps (1/25K -1/2000K) - Landuse thematic maps - Navigational / LBS maps - Other spatial data available in SDL
Work Package-8: Provision of HW / SW and Equipment	a) Provide servers & workstations &PCs b) Provide Softcopy Photogrammetric Systems c) Provide GNSS sets d) Provide 4WD Vehicles e) Provide Scanners, plotters, printers, archival drawers f) Others …
Work Package-9: Training	a) Assist capacity building of SDL b) Conduct training of staff in-house c) Conduct training of staff for B.Sc. degree (10) d) Conduct training of staff for M.Sc. degree (10)

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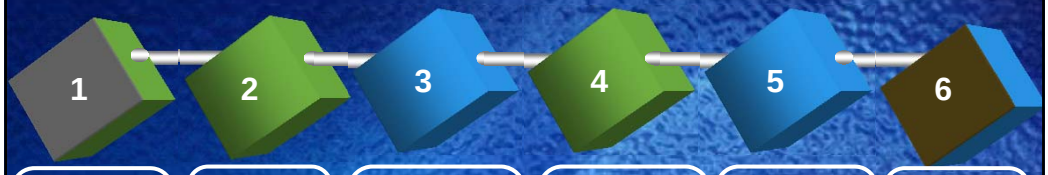
2. Project Objectives



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7/24 RTK Positioning throughout Libya (cm-precision)	Precise navigation at air, sea and land (dm-precision)	Determining transformation models between ELD79 and Global ITRF datum	Modeling Libyan atmosphere (ionosphere and troposphere) and using in meteorological forecasting	Monitoring plate tectonics and early warning activities	Contributing nationwide research and development on space

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CORS-LIBYA Users

- Surveying Department of Libya
- Military Survey Department
- Municipalities
- Ministries
- Engineering companies
- Universities, Research and Development Agencies
- Public
- Others

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2. Project Objectives

- In summary, the aim of this project is to provide fast, accurate, and reliable means for collecting all kinds of geographic data, thus, speeding up the activities of national mapping, cadastre, assuring organized urbanization, constituting the spatial infrastructure for relevant works of e-government, and monitoring plate tectonics. When the project concludes, we will have the ability to acquire coordinate information with a cm-accuracy in a matter of seconds, from any place and at any time in northern Libya, using a methodology regarded as highly economical when compared to classical static surveys, which may require 1 to 2-hour observation times.

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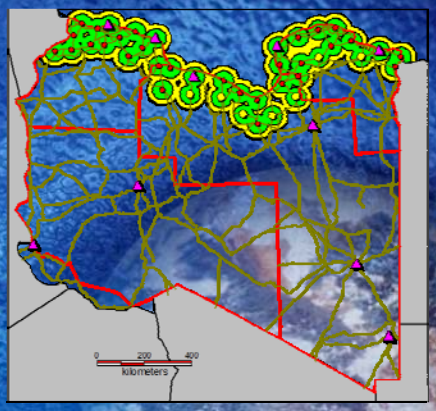
3. Scope of the Project

3.1 Scope

With CORS-LIBYA System it is targeted to enable all users all over Northern Libya to determine positions through RTK. Within CORS-LIBYA Network the coverage of RTK is anticipated to be at most 40 km from the nearest station. Thus, the spacing between CORS stations is thought to be 50-100 km for all Northern Libya.



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In brief, CORS-LIBYA Project will remove the necessity of ground monument construction in the field of mapping in Northern Libya to great extent; will provide the users with high-tech's convenience and products. Each reference station within CORS-LIBYA system will hold the characteristics of CORS Network and will provide the capability of cm-level real-time positioning within its own "jurisdiction" area. The system, at the same time, will be web-based and will assist the users with data post-processing. The CORS-LIBYA system will be integrated into Libya's National Geodetic Network.

As far as methodologies are concerned, the fundamental two activities are as follows:

•CORS-LIBYA System Design (Station Location, Monumentation, Site Preparation,

•Software/Hardware.etc.; CORS-LIBYA System Installation and Operation

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3.2 Task

The scope of work consists of five major tasks presented below;

- •CORS Design and Monumentation
- •CORS Site Preparation
- •Selections of CORS GNSS Receivers and Antenna
- •Establishment of CORS Control Center (CC) and Selection of CC Software
- •Establishment of CORS Infrastructure and Communication

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4. Methodology

4.1 System Design

- 24 hours broadcasting (RTK ve post-process)
- 50 - 100 km spacing between CORS stations
- Selection of points on solid and logistically suitable places
- Selection of points with the consideration of plate tectonics in Turkey
- Modeling atmosphere over the entire country

Communication

CORS – Control Center Communication

- ADSL
- GPRS / EDGE

Control Center – Rovers Communication

- GSM GPRS / EDGE – NTRIP
- GSM, RADIO

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The establishment of a total of 50 CORS is estimated to cover the northern region of Libya. CORS coverage using 45 tentatively selected stations and 60-100 km interstation distances.

In view of the requirements above, CORS-LIBYA system design will include:

- Determination of station locations;
- Determination of GNSS receivers of CORS Network;
- Determination of software packages of CORS Network;
- Determination of CORS control center; and
- Determination of the requirements of Communication and power (electricity, phone, internet...etc).

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With CORS-LIBYA, it is targeted to enable all users all over Northern Libya to determine positions through RTK. Within CORS-LIBYA Network the coverage of RTK is anticipated to be at most 40 km from the nearest station. Thus, the spacing between CORS stations is thought to be 60-100 km. The most extensive usage of CORS stations will be in urban areas. Furthermore, when keeping in mind the other necessities of CORS stations, like energy, communication...etc., then the selection of station locations will be dependent on the following criteria:

- Shall be in urban centers;
- Shall be on solid foundation (away from landslides); and
- Shall have electricity and communication facilities, including Internet access.

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The main characteristics to be sought in the GPS receivers that will be deployed at CORS stations are:

- Must be dual-frequency GNSS receiver with choke-ring antenna or equivalent;
- Must be compatible with GPS, GLONASS and "the coming soon" GALILEO
- Must be web-based; and
- Must be capable of all kinds of communication (e.g. radio, GSM / GPRS/ Edge, Thuraya, NTRIP, Internet...etc).

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A pre-requisite of the CORS software would be its ability to correct for ionospheric, tropospheric, multi-path and orbit effects and facilitate the usage of these corrections for RTK positioning up to 50 km away from CORS network stations. The selected software will be required to enable the implementation of three famous techniques being used worldwide:

- MAC (Master Auxiliary Concept)
- FKP (Flachen Korrectur Parameter) – for linear area correction parameters,
- VRS (Virtual Reference Stations).

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The administration of CORS-LIBYA system will be conducted from one center. The entire data of CORS-LIBYA stations will be automatically forwarded to this center, where all CORS Network calculations will be conducted and corrections passed to users.

For the sake of communications, RTCM 3.0 or higher and more advanced protocols will be used, thus radio, GSM, GPRS / EDGE, NTRIP (Network Transport of RTCM through Internet Protocol) communications will be assured.

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4.2 CORS Monumentation

It is participated that most reference stations will be established on the roofs of government buildings (such as municipalities, universities, hospitals, etc.). Some public lands with open sky and communication infrastructure will also be considered.

All reference stations will be monumented by using either

- solid steel structure on roofs,
- concrete pillar on soil – ground.

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Installation of CORS Points

- Concrete pillar on soil,
- On Roof and Terraces: steel pillars (galvanized).

- **85 x 2 m pillars (including soil)**
- **58 x 3 m pillars**
- **3 x 4 m pillars**

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4.3 Site Preparation

Upon the conclusion of CORS station constructions, receivers and accessories will be setup and installed. The accessories consist of external batteries & chargers, fans, switches, lightning and surge arrestors, Router.

The CORS sites require the connection of electricity and telephone / ADSL line. They will be installed properly and connected to the accessories in the cabinet.

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4.4 CORS LIBYA Reference Stations

Each of the CORS set will consist of one receiver, one GNSS antenna and other accessories specified in the RFP. CORS-LIBYA reference stations will provide all type of GNSS today's and future signals according to the GNSS signals modernization program and GLONASS.

GNSS receivers at reference stations run continuously. The raw measurement data are usually logged internally in the receivers in files of the required length. CC software running on the server controls the receivers and downloads the data files automatically at regular intervals. Receivers can also stream raw data continuously to the server instead of logging data or even stream raw data at the same time as they are logging data, provided that it safeguards the loss of data.

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In conformance with the RFP, the main features of CORS systems are:

- Must be dual-frequency GPS receiver with choke-ring antenna or equivalent;
- Must be compatible with GPS, GLONASS and "the coming soon" GALILEO
- Must be web-based; and
- Must be capable of all kinds of communication (e.g. radio, GSM / GPRS/ Edge, Thuraya, NTRIP, Internet...etc)
- Must have a Control Center with network-based software package

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4.4.1 Reference Stations

Communications will be over ADSL primary and ADGE secondary. The router will establish its ADSL connection to the internet and then immediately open up a VPN tunnel to the CC. Once the VPN tunnel is up, a GRE tunnel will be created inside this VPN tunnel. This technique has the following advantages:

- We do not care what the IP address of the reference station router is which means we could be using the EDGE wireless interface or the ADSL, makes no difference,
- It is secure, outsides cannot tamper, change or view the data,
- GRE tunnels support multi-cast and routing updates whereas IPSec VPN tunnels on their own do not.

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The Router at CC will NOT initiate VPN tunnels to the reference station but will only listen, waiting for the reference stations to contact it to initiate the VPN tunnels. This is so as the reference station could have:

1. Dynamic IP addresses on ADSL and EDGE,
2. Static IP on ADSL and dynamic on EDGE,
3. One static IP on ADSL and a different static IP on EDGE.

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4.4.2 Reference Receivers System Accuracy

•The receiver shall provide full-wavelength precise carrier phase on L1 and L2 in the presence of A/S;

•The receiver must have precision better than 15 mm rms value both on L1 and L2 based on 24 hour observation;

•When the correct number of satellites is visible, there are minimal or no obstructions, there is minimal multipath or ionospheric activity and the reference station position is correct, the system must yield :

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Static / Fast Static mode:

Horizontal:	5 mm +	1.0 ppm RMS
Vertical:	10 mm +	1.0 ppm RMS

RTK mode:

Horizontal:	10 mm +	1.0 ppm RMS
Vertical:	20mm +	1.0 ppm RMS

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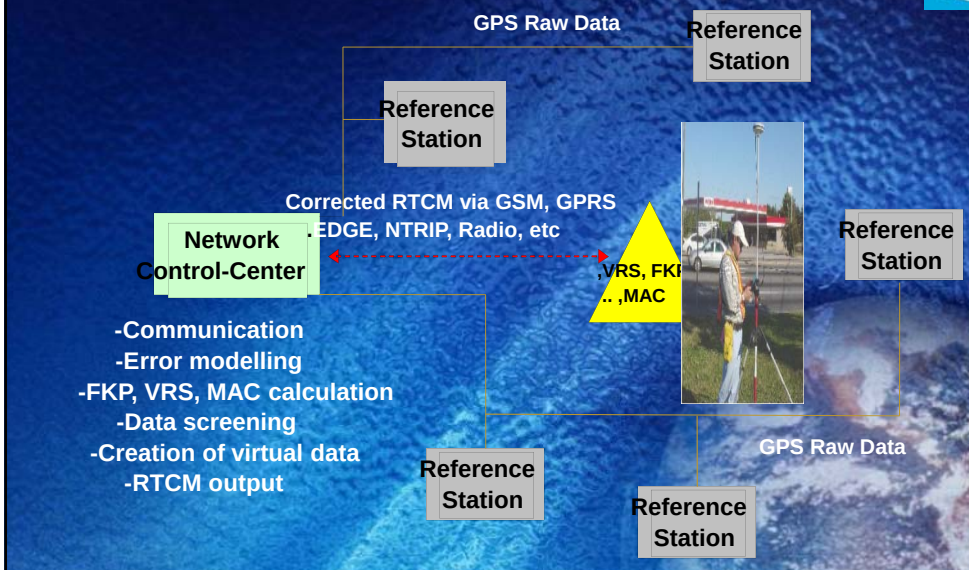
4.5 CONTROL CENTER



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Communications between the CC – CORS receivers and CC – rovers can be via telephone (i.e. fixed line, GSM, satellite systems), Internet, or Radio. However, the most useful and economic communication is Network Transport of RTCM via Internet protocol known as NTRIP.

So, RTK/DGNSS RTCM V3.0/3.1 data can be distributed to rovers using the following means:

- Internet (GPRS, UMTS)
  - bidirectional or uni-directional;
  - NTRIP;
- Fixed and mobile phones (GSM, Thuraya…etc);
- Broadcast media;

VHF, TV, Radio, Satellite communication.

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CORS network software and CC shall also give the results on followings;

Computations of Corrections and Distribution of RTK / DGNSS Data

- Filing data and FTP Distribution of RINEX data
- Supervising the system's operation
- Data analysis
- Operation reports
- Handling problems
- Post-processing services

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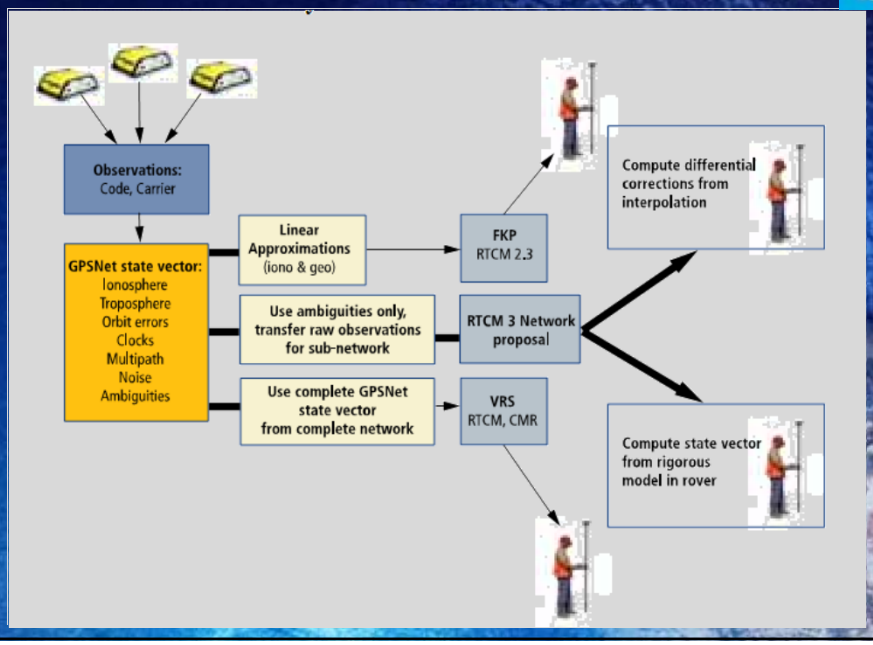
CORS-LIBYA and RTK Positioning Techniques



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5 Conclusion

Libya has recently started national mapping requiring significant geodetic positioning. It is required to carry out such and other geodetic positioning and surveys rapidly, economically and precisely.

CORS-LIBYA System will provide cm-level positioning in real time 24 hours daily throughout the coastal region of Libya. Project is in tendering process and will be completed in six months after contract signing.

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THANKS
FOR
YOUR ATTENTION
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