



המרכז למיפוי ישראל  
APN - Active Permanent Network  
רשת תחנות GNSS קבועות בישראל

# THE PERMANENT GNSS NETWORK AND ITS RTK APPLICATION IN ISRAEL

Einat SALMON  
Survey of Israel (SOI)

TS 1C – CORS-RTK I  
Einat Salmon  
The permanent GNSS Network and its RTK Application in Israel

FIG Working Week 2009  
Eilat, Israel, 3-8 May 2009



המרכז למיפוי ישראל  
APN - Active Permanent Network  
רשת תחנות GNSS קבועות בישראל

## Introduction

- The first Israeli permanent network stations – GIL (GPS Israel), was founded in 1996 in a combined effort of the Israeli Geological Survey, Israeli Space Agency, Survey of Israel (SOI) and Tel-Aviv University.
- During 2002 the Permanent Network Stations' responsibility for the operation was transferred to the Field division of the Survey of Israel

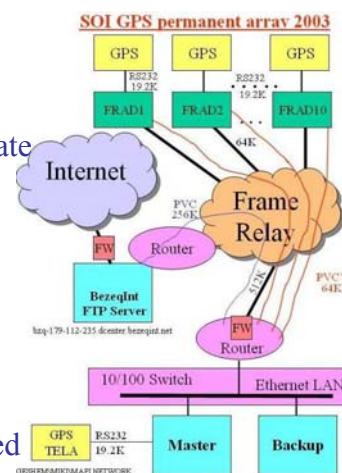
## Updating the Israeli Reference station network and modifying it to the surveying revolution.

- By the end of 2002 the Israeli network contained 11 reference stations.
- The data was transferred by old fashioned models of technological means.
- The data was saved in unsecured and non user friendly FTP site.
- The information sampling rate intervals was 30 seconds.



## Updating the Israeli Reference station network and modifying it to the surveying revolution.

- The system automation became effective after the turning point began during 2002 when it was decided to completely automate the system.
- A control center was built.
- Management programs were installed.
- The information supplied to surveyors on the web site has been transformed to an organized web site.
- Data sampling rate was gradually increased from 30 seconds to 5 seconds between epochs.



## Updating the Israeli Reference station network and modifying it to the surveying revolution.

- VRS software was added, allowing condensing the information for remote areas (far from a permanent station).
- Throughout the years 8 reference stations were added, on stable structures, mainly for geodetic utilization.
- It was decided to rename the network as APN (Active Permanent Network).



המרכז למיפוי ישראל  
**APN - Active Permanent Network**  
 רשת תחנות GNSS קבועות בישראל

## Declaring new based network Israel 2005

- In the past the Israeli network accuracy (ITM-Israel transvers Mercator) was about 10cm.
- Due to the accuracy of the basic control points, the inconsistencies between neighboring projects which are based on different control points could reach the order of up to 10-15 cm.
- The SOI set its goal of achieving accuracy of 5 cm at 95% confidence level.
- It was decided to use the APN as the base points for surveying in Israel.
- On 1/10/2004 SOI defined a new attribution system for the APN. It was set as fixed coordinates of the permanent GPS stations.
- The new system is called IGD05 (Israel Geodetic Datum 2005).
- Seven parameters were published for transformation from IGD05 system to the Israeli coordinates grid.



## Publishing new surveying regulations

- SOI began writing new surveying regulations for defining new points grade.

Measured exclusively by SOI

- G0 – The APN network
- G1 – 150 Geodetic-geodynamic control points
- G2 – ~1200 stable, GNSS suitable, control points

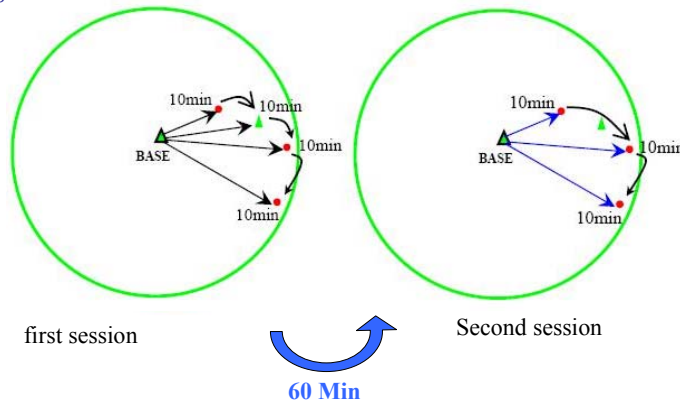
Measured by private surveyors as well as SOI

- S1 - determined by GNSS measurements only
- S2 - determined by GNSS and EDM measurements



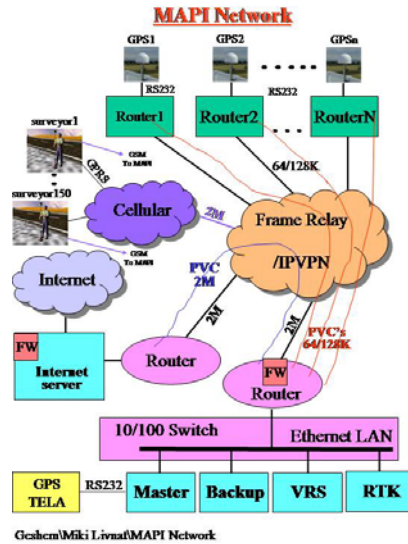
## Publishing new surveying guidelines

- SOI published new guidelines, annex to the existing surveying regulations established in 1998, enabling the surveyors to use a single GPS receiver for measuring details, boundaries of lots for cadastral purposes and control points



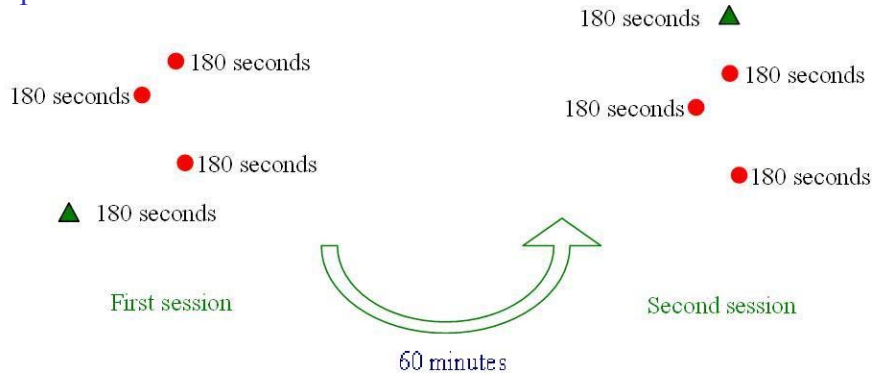
## Upgrading the reference stations network with RTK-DGPS application

- During 2006 the permanent stations array was upgraded and the RTK-DGPS application was added.
- Two additional servers which log information at 1 second intervals were installed.
- The stations information was transferred to a cellular network server and forwarded to the surveyors equipped with a cellular modem on site.
- The communication is enabled by one of the following methods: VRS, FKP and direct connection to reference station.



## המרכז למיפוי ישראל APN - Active Permanent Network רשת תחנות GNSS קבועות בישראל The reference stations network for cadastral measurements

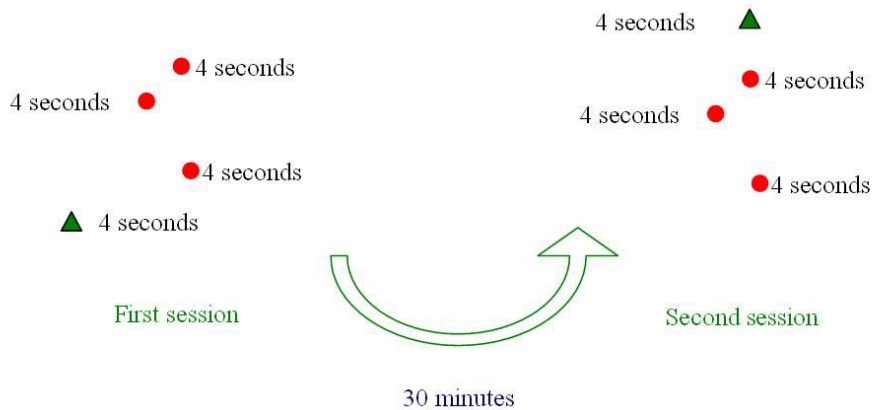
- One of the main goals set by SOI is to establish a coordinate based cadastre, and Israel network 2005 sets a foundation for that purpose.
- Technical guidelines for measuring S2 control points using RTK were published.





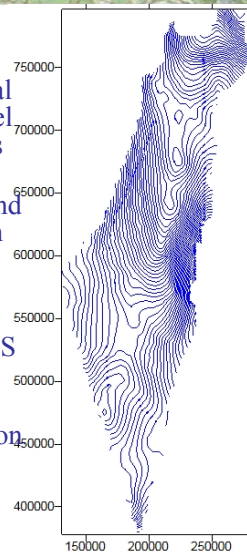
## The reference stations network for cadastral measurements


- Technical guidelines for measuring border points and details using RTK were published.



## Statutory (Official) Geoid Undulation Model

- It was decided to move towards 3D Geodetic Control network.
- Since using the GNSS, receivers provide an ellipsoidal height, a nation wide Official Geoid Undulation model was published and suited to convert ellipsoidal heights to orthometric heights.
- The RTK tool enables measuring ellipsoidal heights and receiving orthometric heights online in the field and in addition to examine the results online against control points.
- Technical guidelines were published for determining vertical control points using permanent and virtual GPS stations and the Official Geoid Undulation Model.
- Technical guidelines were published by the SOI for measuring vertical control points using RTK application.







רשת תחנות GNSS קבועות בישראל

## Survey economical aspects

- Reference Stations Applications Benefits are:
  - \$ using only one RTK receiver
  - \$ Often a single person can perform the job.
  - \$ The permanent stations method saves valuable time of searching for control points in the surveying area.
  - \$ In the past, large surveying companies used both instruments for surveying, nowadays they can use each instrument separately and double their production.
- The rate of the post processing data from the reference station web site is 12¢ (cents) per minute of information.
- RTK information cost about 25 cents per minute;

רשת תחנות GNSS קבועות בישראל

## Summary and future plans

- After the permanent stations achieved a state of the art technology the advantages of using the APN are:
  - Uniformity
  - Accuracy
  - Reliability
  - Simplicity
- The survey of Israel will continue developing and improving the APN remaining up to date with technology and measurement techniques.



המרכז למיפוי ישראל  
APN - Active Permanent Network  
רשת תחנות GNSS קבועות בישראל



**Thank you for your attention !**

TS 1C – CORS-RTK I  
Einat Salmon  
The permanent GNSS Network and its RTK Application in Israel

FIG Working Week 2009  
Eilat, Israel, 3-8 May 2009