

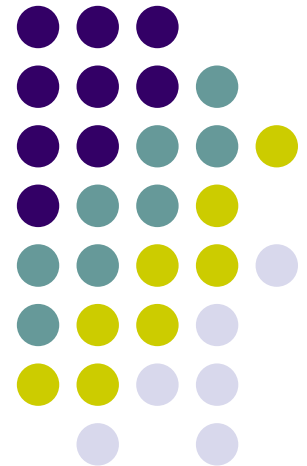
Positioning with Internet-based, Wide-Area, Real-Time GPS (iGPS)

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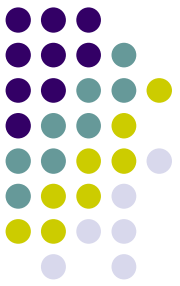
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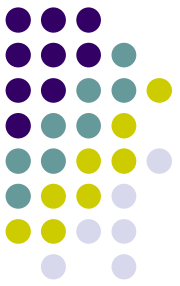
UN/UAE/USA Workshop on the Applications of GNSS
Dubai, UAE: 16-20 January 2011

Introduction



- Positioning: the process of obtaining the 3D position(s) of point(s) of interest robustly in a specified reference system.
- In the US, the National Spatial Reference System (NSRS) is defined and maintained by the National Geodetic Survey (NGS)..... *is a 3D coordinate system that specifies the following six parameters as well as how they change with time:*
 - Latitude, Longitude, Height, Scale, Orientation, and Gravity.
- The NSRS consists of the following components:
 - A consistent, accurate, and up-to-date National Shoreline;
 - The National CORS, a set of Global Positioning System Continuously Operating Reference Stations meeting NOAA geodetic standards for installation, operation, and data distribution; and
 - A network of permanently marked points including the Federal Base Network (FBN), the Cooperative Base Network (CBN), and the User Densification Network(UDN).

Introduction



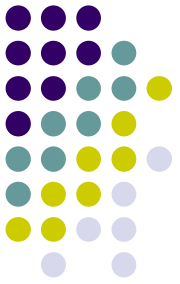
- The demand for robust GPS positioning is continuously increasing to meet the expanding spatial data applications.
- The need for continuously operating reference networks become more crucial to support the growing demand for accurate positioning.
- Such a network benefits the following entities to obtain accurate positions of points using static or Real Time Kinematic (RTK) positioning:
 - surveyors,
 - geodesists,
 - engineers,
 - GIS/mapping professionals,
 - scientists, etc.



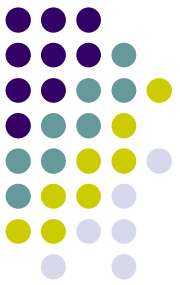
The iGPS Concept

- The iGPS system is a Wide-Area, Real-Time integrated GPS positioning system, consisting of GPS Hardware, software and communication links.
- The communication links: utilize data from permanent reference stations to model errors throughout the coverage area
 - Ultra-high-frequency “UHF” radio.
 - Cellular phone modem.
- This model is used to create virtual reference stations (VRS) near the user’s location which then provide a localized set of standard format correction messages to the rover.

The iGPS Working Principle

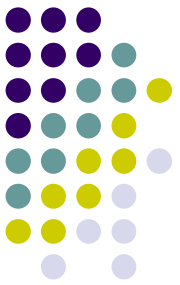


- GPS observation data from a set of fixed reference stations is continuously transmitted to a central server.
- Here the network processor performs integrity checks on all GPS observables, performs quality checks on the data, and correct for cycle slips.
- Once the integrity of the data has been checked, the network processor computes the atmospheric errors by analyzing double difference observations.



Virtual Reference Station (VRS)

- To enable the GPS modeling, the rover must provide its approximate position to the central server via a cellular modem.
- The central server's software interpolates and applies errors corrections and generates a VRS for the individual rover.

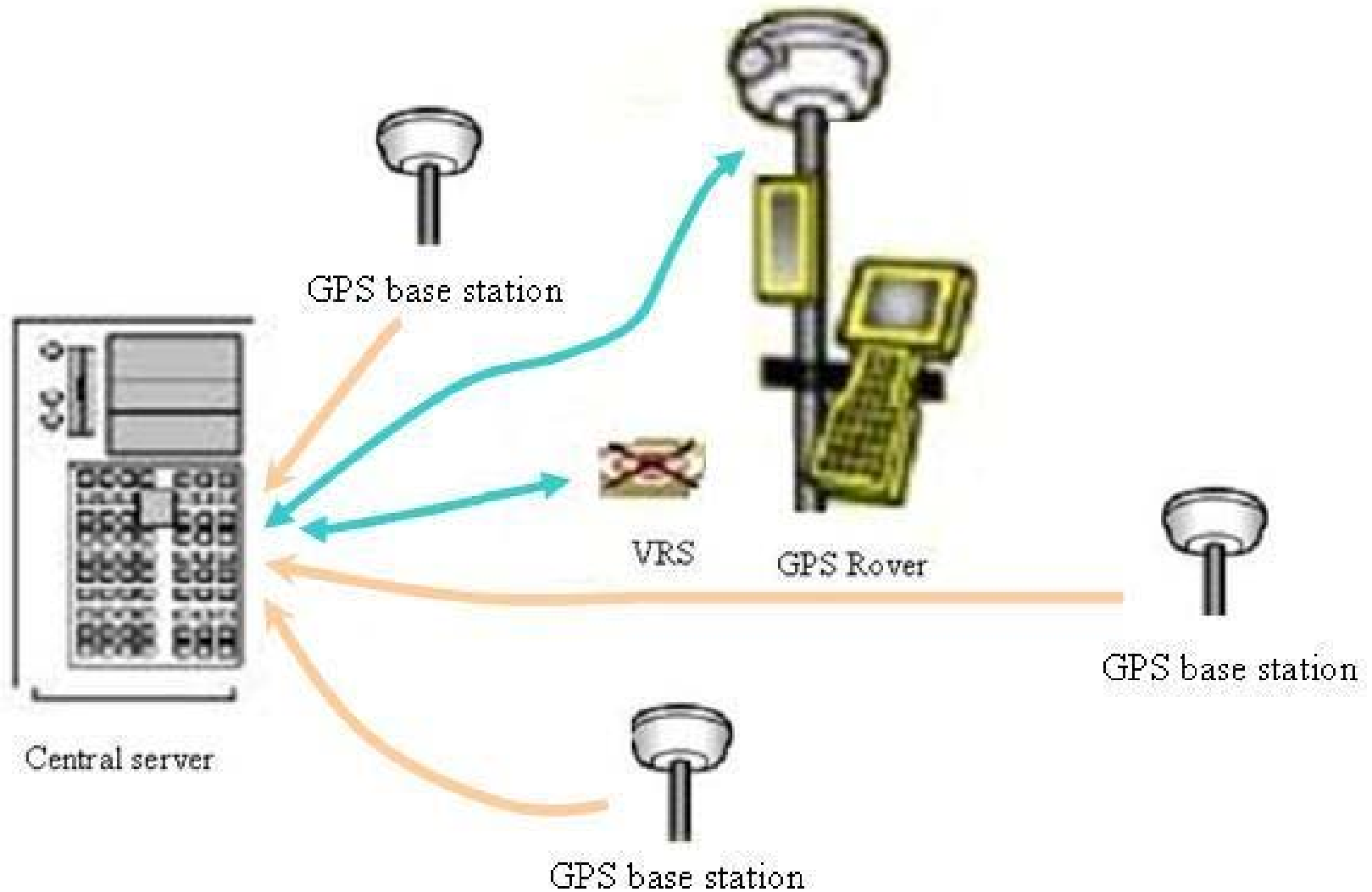


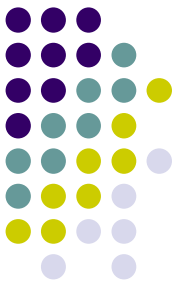
Virtual Reference Station (VRS) “cont.”

- The software then produces a set of standard format corrections as if they were coming from the VRS and transmits them back via cellular modem to the rover.
- Using iGPS technology, a centimeter-level real-time positioning accuracy can be attained, if the rover is within the network.



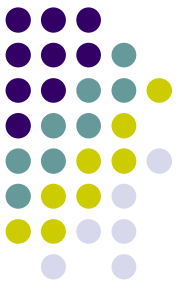
A Typical iGPS Architecture





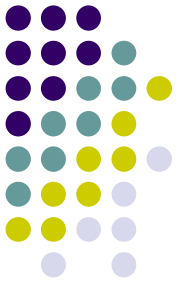
Advantages of iGPS network

- Continuous operation
- Dense network coverage (improved model for atmospheric errors)
- No need for a base station receiver.
- Communications via a cell phone modem or UHF radio “utilizing the GNSS receivers which has existing built-in UHF radio” is possible
- Production time-saving



Closing remarks: Issues with iGPS elevations/height

- Still localization needs to be carried out especially for topographic surveys or if precise elevations/heights are sought....still some issues with elevations/height.
 - Localization is performed prior to carrying out RTK-GPS surveys to fit the observed GPS positions to the local datum at the survey site. Mathematically, localization is a coordinate transformation between global and local systems performed to adjust the observed GPS ellipsoid elevations to the local vertical datum hence accounting for geoid undulations.
- To address the elevations/height issues, *Height modernization* is needed.
 - Height Modernization is a program in NOAA's National Geodetic Survey that GPS and other new technologies to increase the accuracy of elevation measurements that comprise the vertical portion of the National Spatial Reference System



Thank You!