

# New Work Item: Geographic Coordinate System in Postal Applications

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## Coordinate Systems: Spatial Referencing

- Spherical Coordinate Systems
  - Geographical coordinate system (Longitude & Latitude)
- Rectangular Coordinate Systems
  - UTM (Universal Transverse Mercator)
  - State Plane
- Non coordinate systems
  - **US Public Land Survey (rectangular survey system)**
  - **US Postal Codes**

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## Miscellaneous Systems

- Postal codes such as the United States ZIP code can be used to identify areas.
- Three digit codes identify large areas.
- Five-digit ZIP codes identify smaller areas.

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## Scope

- The standard will be a specification describing requirements and practical implementable solutions for use of the Geographic Coordinate System (geocoding) in postal applications and specifically as postal codes. The standard will provide a technical foundation for a variety of customer and postal applications where knowledge of geographic coordinated could be used for mail sorting, transportation and delivery purposes as well as for monitoring quality of service, data services for customers and similar applications.

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## Justification

- Need for a method of identifying geographic locations corresponding to traditional postal addresses based on a single internationally recognised system of location encoding that is widely used in many non postal applications (e.g. GPS). Such system by definition will have many desirable characteristics including fixed stable indexing for a variety of postal addressing databases and ready availability of commercial hardware and software required by postal applications.
- Many posts use their own internal postal codes to identify all operationally significant location of their networks, but these postal codes represent only a partial solution because they are fluid (when network locations are added or removed), require significant on-going maintenance, not always known to the mailers or sister postal operators. Many other posts especially in developing world do not have a system of postal codes. Besides, postal codes where exist are frequently based on an artificial coding systems that were designed strictly for identification purposed without having any linkage to geographic measurements in mind or carrying any other payload (that could be used for example by GPS).

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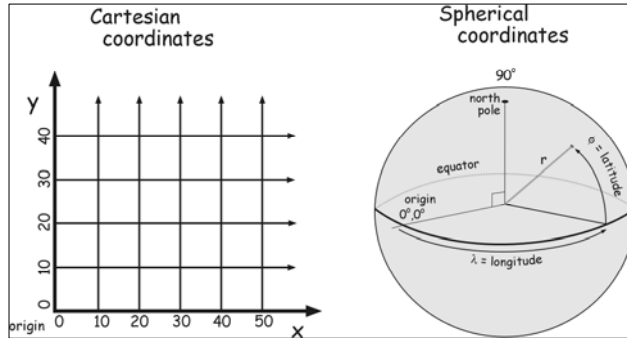
## Intuitive Requirements

- Each identifiable location in postal distribution network (postal location) should be **uniquely identifiable** by a pair of geographic coordinates
  - delivery points, street letter boxes, retail facilities, delivery offices, postal processing plants, transportation facilities, international exchange offices
- Geocoordinates of postal locations should **have constant values** that do not change with time
  - Geographic coordinates may served as pegs for all other identifiers (thus making other identifiers retrievable from geocoordinates and simplifying organization of address data bases)
- **Amount of information** required to express values of geocoordinates **should be minimal** (subject to their uniqueness)
  - Postal codes application
- **Postal geocodes should be simply translatable (computable) into standard geocoordinates used in GPS systems** and vice versa (for compatibility with off-the shelf hardware and software already in use in non postal applications e.g. navigation systems)
- Others?

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# Geographic Coordinate System

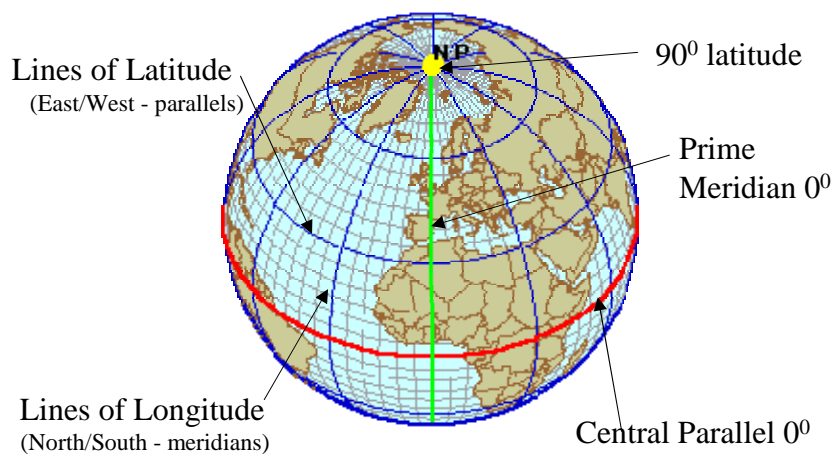
- A geographic coordinate system uses a 3 dimensional sphere to define locations on the Earth.
- Locations are referenced by longitude and latitude.



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# Latitude and Longitude



courtesy: Mary Ruvane, <http://ils.unc.edu/>

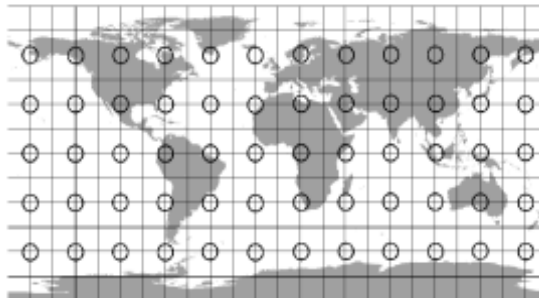
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## Observations

- Universal Coordinate System (lat/lon)
- Lat/lon good for locating positions on surface of a globe
- Lat/lon is not efficient for measuring distances and areas
  - Latitude and longitude are not uniform units of measure
  - One degree of longitude at equator = 111.321 km (Clarke 1866 spheroid)
  - One degree of longitude at 60° latitude = 55.802 km (Clarke 1866 spheroid)

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## Spherical vs. Cartesian Geographical Coordinates



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- Notice the distortion of the circles near the North pole<sub>10</sub>

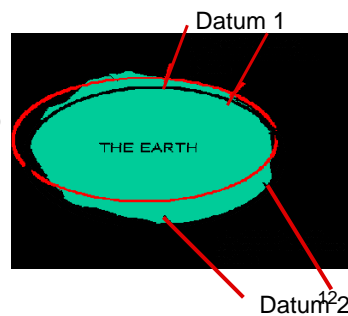
# Challenges

- Various approximations and non uniformities
  - Earth is not a perfect sphere
  - Angular system of longitude and latitude is difficult to use for computing distances and areas
  - On a spherical surface at [sea level](#), one latitudinal second measures 30.82 [metres](#) and one latitudinal minute 1849 [metres](#). [Parallels](#) are each 110.9 [kilometres](#) away. The circles of longitude, the [meridians](#), meet at the [geographical poles](#), with the west-east width of a second being dependent on the latitude. On a spherical surface at sea level, one longitudinal second measures 30.92 [metres](#) on the [equator](#), 26.76 [metres](#) on the 30th parallel, 19.22 [metres](#) in [Greenwich](#) (51° 28' 38" N) and 15.42 [metres](#) on the 60th parallel.
- Datums (sets of values that define position of spheroid relative to the center of earth)
- Hundreds of datums customized for different parts of the world

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## Why Different Ellipsoids?

- Better methods for approximating the surface of the Earth
- Developed from different areas of the Earth
- Just an approximation...
- Those different ellipsoids are datums



## Letter-tracking GPS

- USPS commissioned TrackingTheWorld Inc., a leading global positioning technology firm, to develop a letter-tracking GPS device that would meet the agency's precise needs.

These needs include reporting the positioning of letter mail from anywhere on the planet at customizable time intervals, interfacing with Google Earth, and recording down time, all fitted in a device conveniently and completely unnoticed within a standard size envelope.

When housed in a standard number 10 business envelope, the G.P.S. Letter Logger flows through mail sorting and delivery systems as unnoticed as any typical piece of mail, all the while gathering and reporting important logistical information that allows the Postal Service to analyze the efficiency of its systems. "If the G.P.S. Letter Logger records extended down time in a particular location, that lets the inspector know that there is a potential problem,"

- The driving forces behind G.P.S. Letter Logger are the combined functions of a powerful and highly efficient microprocessor developed by Texas Instruments and a low-power consumption uBlox ANTARIS 4 GPS module.
- Merely a quarter of an inch thick, and with the surface area of a tri-folded sheet of paper, G.P.S. Letter Logger technologically exceeds the capabilities of a similar Siemens product in that the user can adjust the G.P.S. Letter Logger's GPS reporting frequencies. "G.P.S. Letter Logger's reporting is fully customizable. Users can choose to receive reports every 2, 5 or 10 minutes or select tilt mode which reports only when a tilting movement is detected
- G.P.S. Letter Logger will operate up to 20 hours in a pre-determined timed configuration or up to two weeks in tilt mode using a slim 1100mAh battery.

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## Techniques

- United States Patent Application 20080046169  
February 21, 2008 (assignee - Microsoft)
  - Compact text encoding of latitude/longitude coordinates
- Hierarchical Triangular Mesh (HTM)
  - method to subdivide the surface of a sphere into spherical triangles of similar, but not identical, shapes and sizes. The Hierarchical Triangular Mesh (HTM) is a quad-tree that is particularly good at supporting searches at different resolutions, from arc seconds to hemispheres. The subdivision scheme is universal, providing the basis for addressing and for fast lookups. The HTM provides the basis for an efficient geospatial indexing scheme in relational databases where the data have an inherent location on either the celestial sphere or the Earth. The HTM index is superior to cartographical methods using coordinates with singularities at the poles.
- Encoding of latitude/longitude coordinates adaptive to the density of the of postal network locations (or density of the population)
- DAG codes (relation to geosystems ?)
- These and other methods would have different efficiencies and trade-offs

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## Development Strategy

- Overview and analysis of postal applications and their requirements
  - Sorting, Transportation, Delivery
- Overview and analysis of different technical approaches (methods)
- Selection of the optimal approach
- Documenting optimal approach
- Standard to be developed by a working group reporting to CEN TC331 and UPU SB PEG
- Participants (as of today):
  - Canada Post, An Post, CEN/PB

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## Planning and Milestones

- Forming working group April – June 2008
- Starting work September 2008
- Committee Draft June 2009

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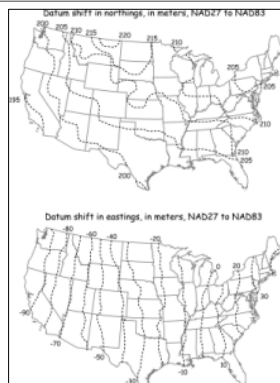
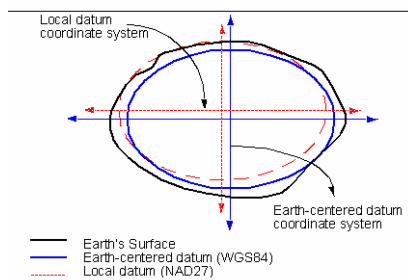
## Recommendation

- Approve “Geographic Coordinate System in Postal Applications” as a new work item

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## Datum

- The ellipsoid is a mathematical model that describes the shape of the Earth.
- A datum defines the position of the ellipsoid relative to the center of the Earth
- provides a frame of reference for measuring locations on the surface of the Earth
- aligns its spheroid to closely fit the Earth’s surface in a particular area



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# Datums

- North American Datums
  - NAD27 (North American Datum of 1927)
  - NAD83 (North American Datum of 1983)
- World Datums
  - WGS84 (World Geodetic System of 1984)
    - Used for GPS
- Other Datums
  - European Datum of 1979
  - Ordnance Survey Datum of Great Britain, 1936
  - Australian Geodetic Datum, 1984



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## Common Datums used in U.S.

- North American Datum 1927 (NAD27)
  - Uses the Clarke 1866 spheroid
  - Reference point is located at Meades Ranch, Kansas
  - Based on ground survey information in the 1800's
- North American Datum 1983 (NAD83)
  - Uses GRS80 (Geodetic Reference System) spheroid
  - Ellipsoid model from geocentric perspective
  - Based on ground surveys and satellite information
- WGS 1984
  - Most recently developed datum/ framework for measurements worldwide
  - Earth centered, or geocentric, perspective
  - This is the datum used by all GPS satellites
  - **Nearly identical to NAD83...therefore NAD83 is compatible with data collected in GPS using WGS84!**

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