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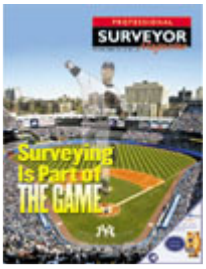

Feature: The National Grid

Tom Terry

Editor's note: This is the first in a series of articles on geoaddressing and the US National Grid (USNG). Geoaddresses are a long overdue component of our national information infrastructure. Originating from a grass roots citizens effort, The Public XY Mapping Project, it evolved through the Federal standards process. The results are a national grid optimized for local applications such as geoaddresses. This initiative will improve public safety and enhance the daily activities of the general public. Recently an FGDC Geoaddressing Sub-Working Group was formed, and a National Information and Support Center for Geoaddressing (NISCG) has been established at George Mason University, VA. This Center approved by the Public XY Mapping Project will serve as a community link to a body of knowledge on the practical issues of implementing the USNG. For more information check www.usnationalgrid.org.

Here's a quiz question for you: What do the following countries have in common? Great Britain, Finland, Ireland, Italy, The Netherlands, New Zealand, Sweden. Answer: They all have an official national coordinate system that assigns a unique geoaddress to any point in the country. Until recently, the United States had no such system, but thanks to a widespread grass roots effort and adoption by the Federal Geodetic Data Committee (FGDC), the United States National Grid (USNG) is a reality.

The USNG is an alphanumeric point reference system that overlays the Universal Transverse Mercator (UTM) numerical coordinate system. A USNG geoaddress consists of three parts, the:

- Grid Zone Designation (GZD); for worldwide unique geoaddresses, two digits plus one letter. Developed from the UTM system.
- 100,000-meter Square Identification; for regional areas, two letters.

- Grid Coordinates; for local areas, always an even number of digits between 2 and 10 depending upon precision.

For example, the geoaddress of the Department of Interior headquarters building in Washington would break down as:

- Grid Zone Designation (GZD) - 18S. The longitudinal grid zone is 18, the latitude belt is S, thus 18S
- 100,000-meter Square Identification - UJ. The digraph system for establishing this designation is retrievable from a USNG-gridded map or GPS receiver.
- Grid Coordinates - An even number of digits giving a point's location within the 100km square. On the map always "read right, then up." (*i.e.*, 22850707, think 2285 easting, 0705 northing.)In sum: 18SUJ22850705. To be completely correct, the geodetic datum would then be added in parentheses (*i.e.*, [NAD 83]).

This format allows a geoaddress to be truncated and abbreviated. For example, stationery letterhead or business cards for the Department of Interior headquarters building might portray the geoaddress to a precision of ten meters as:

Department of Interior
1849 C Street NW
Washington, DC 20006
USNG: 18SUJ22850705 (NAD 83)

A complete USNG geoaddress provides a unique value over the world and is necessary for use with current GPS receivers and Geographic Information Systems (GIS). The USNG geoaddress from the above stationery letterhead is for the building's centroid. On the other hand, a Department of Interior employee might shorten it to tell someone coming to visit from the local area, "Our visitor's entrance is on 1849 C Street NW, at grid 2285 0694." Another geoaddress might identify the north visitor's entrance, and another might identify the loading ramp for delivery vehicles.

Local Area: Reading Grid Coordinates

Grid coordinates or geoaddresses are used to define a particular place within a local area (within a 100 by 100-kilometer area). Coordinates are written along the sides of a map designating specific grid lines. These grid lines are based on UTM values. The two larger numbers are based on the UTM 10,000 and 1,000 digit values and are known as principal digits. See grid lines 22 and 07 circled in **Figure 1**.

To read coordinate values, always read right, then up. Coordinates (geoaddresses) are always given as an even number of digits so you know where to separate the easting and northing components. This allows one to abbreviate to the degree of precision required. Grid coordinates are used to identify features with a point position, such as a neighborhood, soccer field, a particular house, or even something as small as a parking place or in this case the Jefferson Pier. These require different levels of precision. For example:

- 4 digits - 2306 - a precision of 1,000-meters (a neighborhood size area).
- 6 digits - 233065 - a precision of 100-meters (a soccer field size area).
- 8 digits - 23370652 - a precision of 10-meters (the size of a modest home).
- 10 digits - 2337106519 - a precision of 1-meter (a parking spot).

Note how the 10-digit value ends in 19 (2337106519) but the 8-digit grid ends in 2 (*i.e.*, 20). To achieve best accuracy with less precision, 19 is rounded to 20 for 8-digit use (23370652 vs. 23370651) rather than use a truncation of the digits.

In the following example depicted in **Figure 2**, the Jefferson Pier is described as being located at grid 23370652 (think 2337 / 0652). Read right (easting) to grid line 23 (using the principal digits). Then count grid lines up to line 06 (northing). This intersection is known as grid 2306. This four digit value would give the location to within 1,000-meters. Measuring right in meters from line 23, the Jefferson Pier is another 371-meters.

The complete easting component is 23371. For practical reasons, this is rounded off to 370-meters since one can't measure to that granularity on the map anyway. Measuring up in meters from grid line 06, the Pier is another 519 meters. The complete northing component is 06519. Dropping the 1-meter level values (shown as 1 and 9 in this case),

and combining the easting and northing components, so the 8-digit grid component is 23370651. This value is within 10-meters of the pier, quite good enough for this application in the field. Again, because NGS has given the location to within 1-meter, one can alternatively decide to round for better accuracy to:

Grid: 23370652

Regional Area: 100,000-meter Square Identifications

The USNG further divides the world into 100,000-meter squares with two letter values.

Figure 3 depicts Virginia and organization of the 100,000-meter squares in that area.

While the USNG is referred to as an alphanumeric system for the UTM

coordinate system, it is actually much more. The lettering scheme for the 100,000-meter Square Identification is designed such that any two-letter combination will not repeat itself but every 18°. Thus any two-letter prefix to a grid coordinate ensures a unique value within a very large area. For the Jefferson Pier, at UJ23370652, its location is uniquely designated within an area covering most of the East coast of the United States as depicted in **Figure 4**.

World Wide Unique Values; Grid Zone Designations

Working out from a local area, through regional areas, the last level of definition in a geoaddress is the Grid Zone Designation (GZD). The world is divided into 60 UTM Zones, each 6° of longitude wide. The numbering scheme for these begins at 180 longitude, and counts east. The conterminous US is covered by Zones 10 through 19. In a northing direction, the world is divided into 8° belts of latitude. The conterminous US for example is covered by belts R, S, T, and U (FGDC, 2001). Thus the Washington, DC area falls within GZD 18S as depicted in **Figure 5**. This prefix identifies a unique USNG geoaddress for the Jefferson Pier, or any point, over the entire planet. The complete and unique geoaddress is required for GPS receivers.

To review, a complete USNG geoaddress contains three parts for a unique location, such as 18S UJ 2337 0652.

- Grid Zone Designation (*i.e.*, 18S)
- 100,000-meter Square Identification (*i.e.*, UJ)
- Grid coordinates of some even number of digits ranging from 2 to 10 (*i.e.*, 23370652).

In this case, eight digits identify a place about the size of a modest home. One always reads right, then up when plotting or reading coordinates.

A geoaddress may be written as four parts to ease reading (*i.e.*, 18S UJ 2377 0652), but it is customarily written as a single string of values. Note how the horizontal geodetic datum (NAD 83) would be included:

USNG: 18SUJ23370652 (NAD 83)

The Washington, DC area map in **Figure 6** can be used to locate the places in Table 1 as examples. Note the flexibility the national grid provides. Large features such as the airports are provided to a precision of only 1-kilometer, while other features such as the Jefferson Pier are provided to a precision of 1-meter. In both cases, the precision is "good enough" to help a person readily locate the feature either on this medium scale map or on the ground.

About the Author

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