USGS Topographic Maps from *The National Map*

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Introduction

This paper was presented prior to the U.S. Geological Survey (USGS) topographic mapping project's release of "Digital Map – Beta," which was the newest version of USGS's topographic maps. Since then, the project has evolved to releasing in December 2009 the "US Topo" version of the new topographic maps, with integrated contours and water features (hydrography). This paper will address what was presented at DMT'09 and in brackets the current status of the project.

The National Map Vision

The National Map (*http://nationalmap.gov/* and video at *http://gallery.usgs.gov/videos/187*) is a seamless, continuously maintained, nationally consistent set of base geospatial digital data. It provides a foundation for science, land and resource management, recreation, policymaking, and homeland security. It provides geospatial data for downloading and services for Geographic Information System (GIS) users. *The National Map* contributes to the National Spatial Data Infrastructure as public-domain data that support product generation, services, analyses, modeling, and other applications at multiple scales and resolutions. The geospatial data contained within *The National Map* are built on partnerships and standards, and the data are freely available over the Internet.

The National Map is being developed in three phases, 1.0 through 3.0. Phase 1.0 is accomplished; it consisted of initial population of the eight data layers. The eight layers are for imagery, elevation, hydrography, geographic names, land use land cover, transportation, structures, and boundaries. The USGS is directly responsible for the first five layers in this list. Responsibility for the other layers can be found in the Office of Management and Budget (OMB) Circular A-16 (*http://www.whitehouse.gov/omb/circulars_a016_rev*). Phase 2.0 is in progress, and addresses data consistency, integration of the data layers, digital topographic maps, and print-on-demand maps. Phase 3.0 will address a user-centered design, feature-based data structures with ontology-driven data access, intelligent-knowledge base, spatio-temporal data modeling, and increased quality awareness with a user-centered Web interface.

The components of Phase 3.0 are defined in more detail as follows: "User-Centered Design" – the goals of this design process are to: (1) improve usability of the human interface; (2) provide easy access to high-quality maps in various media; and (3) support high-quality printing for all users. "Feature-based data structures" – all data in *The National Map (phase) 3.0* will be accessible as individual features; for example an entire stream, such as Turkey Creek, will be accessible as one feature. Attributes and relationships will be attached to individual features through an ontology. "Ontology-driven data access" – an ontology specifies feature semantics for richer data models. The ontology becomes the basis of data access. The ontology for *The National Map* will include all features, attributes, and relationships with the individual parts of a feature structured in an accessible hierarchy. For example, the source and mouth of a stream will be related in the ontology as will the parts of a terrain feature such as

a canyon, which would include the canyon floor and walls. "Intelligent-knowledge base" – data, methods, procedures, and heuristics combine to provide individual features with "knowledge" of their own behavior. For example, for each feature there will be instructions for how to display it with appropriate symbology at a given scale. Features will include knowledge of their inter-relationships with other features. For example, a stream's bounding hills and ridges will be available by name from the stream feature itself. "Spatio-temporal data modeling" – *The National Map* will be built on a data model that supports changes in geographic features in both space and time. For example, a coastline in 1950 will be different from that of today, yet it is the same feature, and will be structured as the same feature with different geometry and perhaps different attributes in the two time periods. "Quality-awareness" - *The National Map* will be built on a data model that includes resolution and accuracy information on a feature-by-feature basis. That is, each feature will include its own information about data quality.

   The National Map viewer will be improved with scale-dependent symbology, georeferenced displays, attribute queries, and increased national coverage of data. [This new viewer is planned to be released in April 2010. It is now in beta-version testing.]

USGS Geospatial Liaisons

   USGS has liaisons that represent partnerships in all 50 States. The people in these liaison positions cultivate and maintain long-term relationships with partners, develop partnerships and support agreements, advise and consult on geospatial data and technology, coordinate with partners on the Federal, State, and local levels, and are the 'local face' of *The National Map*. For a list of liaisons, their contact information, and the State(s) that they represent, see *http://liaisons. usgs.gov/geospatial/*.

New Topographic Maps From *The National Map*

   The National Map is the source for the features presented on USGS's new topographic maps. Therefore, the topographic maps are a derivative product made from geospatial data residing in *The National Map*. These geospatial data are available for viewing, services, and download from *The National Map* viewer. [*The National Map* viewer, at *http:// viewer.nationalmap.gov/viewer/*, has user-definable instances of base maps upon which other GIS data services can be mashed-up in the viewer. At the time this paper was given the new topographic map was about to be released as the "Digital Map – Beta." This version of maps is still available from the USGS Store, at http://store.usgs.gov. As of December 2009,

the US Topo, at http://nationalmap.gov/ustopo/index.html, with integrated contours and water features, was released and these products are now being generated. The US Topo maps are also available from the USGS Store or for emergency response personnel and organizations, from the Hazards Data Distribution System.] Following are *The National Map* sources for the feature types that will eventually appear on the US Topo maps:

- orthoimage – National Orthoimage Quadrangle Dataset (DOQ)

- elevation – National Elevation Dataset (NED)

- hydrography – National Hydrography Dataset (NHD)

- transportation - National Transportation Dataset (NTD)

- boundaries – National Boundaries Dataset (NBD)

- structures – National Structures Dataset (NSD)

- vegetation – National Land Cover Dataset (NLCD or MRLC (Multi-Resolution Land Cover or Characteristics))

- names – Geographic Names Information System (GNIS).

Grids and quadrangle-level metadata for the topographic maps are not a data theme in *The National Map*. Instead, they were generated to be part of the digital topographic maps.

New Topographic Maps – A Description

   The new topographic maps, in two versions - the "Digital Map - Beta" and the US Topo, will be a set of nationally consistent maps that can be used electronically or plotted onto paper. [Between 2010 and 2011, the USGS will complete national coverage that will comprise the "Digital Map-Beta" and the US Topo maps. The US Topo maps will replace the "Digital Map – Beta" maps in 2012.] The new maps will be a digital GeoPDF-formatted file with each feature type shown on a separate layer. The GeoPDF is not the generic PDF version, but a proprietary product of TerraGo Technologies, Inc. The digital maps will be georeferenced and will contain user-interaction tools. They will be accessible on-line from a home or office computer at no cost. They will be interactive, contain richer content that is quality assured to standards, and will be functionally superior to the Digital Raster Graphic (DRG) maps that USGS generated in past years. These new topographic maps will remain in the public domain, require no copyright, and will have features symbolized from authoritative data. Generally, the authoritative data come from Federal agencies. USGS is the authority for imagery, elevation, hydrography, geographic names, and land use - land cover

data. The maps will be plottable or lithographically printable to map scale or any other scale the user chooses. USGS is committed to improving these maps over time.

New Topographic Maps – The Strategy

USGS will create this new generation of topographic maps by following the 3-year National Agricultural Imagery Program (NAIP) collection cycle. Thereby, each topographic map, in the lower 48 States, will be updated once every 3 years with the latest NAIP imagery and *The National Map* data. People who want more current geospatial data can obtain them directly from *The National Map.* The initial production will start in 2009 with "Digital Map – Beta" products containing a digital orthophoto image, roads, and names. [The "Digital Map – Beta" product was released in June 2009. Approximately 13,000 maps were made that year.] In the following years the content of these maps will be enhanced as the geospatial data become available in *The National Map* and technical processes are improved or implemented. For example, in 2010, contours integrated with hydrography will be added to the map. [This was accomplished and included in the US Topo maps, which were released in December 2009.] In years to come, USGS plans to add layers containing high-resolution scans of historical topographic maps for each quadrangle.

New Topographic Maps – Longer Term Issues

In many cases, there are no national-coverage public-domain data to use in making the new topographic maps. Feature types or data themes (layers) for which this is a problem include boundaries, Public Land Survey System (PLSS), vegetation, structures, and transportation features other than roads. [USGS is now working through its partnership office liaisons to discover suitable data.]

Data integration of digital geospatial data is very costly, time consuming, and difficult to achieve. The lack of integration among the data layers and within a data layer causes poor registration and feature joins. [USGS is now deliberating on what data in *The National Map* should be integrated.]

Relief portrayal is easily enhanced using modern GIS software. [USGS is now investigating how best to make topographic relief more easily understood and interpreted.]

USGS would like to bundle the historical maps with the new topographic maps. However, whenever a raster layer is added to the digital file, it significantly increases the file size. [USGS is now investigating ways to manage the file size while adding additional content to the new topographic maps.]

Scanning Historical Maps

USGS will create a high-quality scan of all published USGS topographic maps, at all scales and in all editions. [Today, USGS is scanning historical versions of each topographic map.] The intent is for these high-quality scans to become an archive and to be freely available to the public. USGS will use partnerships to facilitate collaborative-scanning projects and to minimize duplication of effort.

New Topographic Maps as a Geologic Base Map

USGS's Graphics Project, that is responsible for making topographic maps, proposed a proof-of-concept test, beginning in October 2009, to use the new topographic maps as a base for geologic mapping. [This project is now in the planning phase.] The test will be targeted at providing an improved digital base map on which geologic features can be mapped.