MicroImages MEMO
Information update for the **TNT products**

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Geoprovisioning

Geoprovisioning delivers geodata and its analysis for specific areas on request.

What are the components of a geoprovisioning service?

The sample web site geoprovisioning.com demonstrates the use of MicroImages' two principle commercial software products, TNTmips and TNTserver, to deliver geodata and geospatial processing via the Internet, a LAN, or a VPN. TNTmips is a low-cost geospatial analysis system available for Windows or Mac ($US5000 to $6000). TNTmips has been in continuous development and sold commercially for 25 years and provides a wide variety of image, vector, CAD, shape, and database operations. TNTserver is a low-cost, Windows-based image service that provides viewing access to these same geodata types. TNTserver has been available for 10 years and uses OGC communication protocols, such as a Web Map Service (US$5000) and Web Feature Service (US$5000).

Only TNTmips is needed for your geoprovisioning if it is not necessary to view your geodata to request a geospatial processing activity from your web site. A simple HTML form can be used via the Internet to select a layer from the image, vector, CAD, shape, or database layers available to TNTmips from your networked file server. The completion of the form identifies the geodata layer or layers, the geospatial processing activity, and collects the parameters for that activity. For example, the user of your HTML geoprovisioning client can request a subset area of any geodata layer type you have stored on your file server in a wide variety of popular image, vector, CAD, shape, or database formats. This simple interface permits the user to select the desired geodata layer from a list of those you are making available, enter a latitude and longitude or other location, and specify a format for the subset they are ordering (e.g., a PDF map layout, a GeoTIFF or GeoJP2 image, a shapefile, a DWG CAD file, a Google KMZ file, ...).

If you add a TNTserver to your web site using a simple Windows computer, you can create geoprovisioning applications that require viewing and feature selection procedures. Operations can be performed on areas that are viewed, located, and drawn or selected from your available geodata layers in their native formats or MicroImages' internal format for optimal speed. TNTserver provides your HTML and JavaScript client with access to your images, geometric features, and database records for use in defining the geoprovisioning task. For example, in your software client you can provide views of the image, vector, CAD, shape, or database layers; support drawing a polygon; extract or process the features within the polygon; and deliver the results in the format selected (e.g., a PDF map layout, a GeoTIFF or GeoJP2 image, a shapefile, a DWG CAD file, a Google KMZ file, ...).

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Simple geoprovisioning without geoviewing.

How do you set up a request?

When viewing of the geodata is not required, you can use a simple HTML form, web application, or downloadable program to provide your end user with the interface they use to set up a geoprovisioning task. It would permit them to identify the geodata layer(s) to use, the activity to apply to it, and parameters for this activity. Once your simple client interface has collected this information, it writes them into an XML job file in a specific directory on your web site. The job files in this directory queue up a series of processing tasks for execution by MicroImages' low-cost, commercial TNTmips product. The sample geoprovisioning activities on this MicroImages sample web site use a PHP script to accept the input from the client software and write these into a database and into a job file. However, your web site could use your favorite server-side scripting language such as ASP, Perl, or Python for this step.

How is it executed?

TNTmips is an interactive, fully featured, powerful geospatial analysis system. It also comes with a geospatial scripting language called SML. Developed over 25 years, SML can perform a wide variety of complex, custom image processing and GIS tasks. SML is an extension of the C language providing a large library of classes and functions needed to perform complex geodata access, analysis, and output. Scripts written in SML are used to process geoprovisioning tasks. Sample geoprovisioning scripts are available as models, and MicroImages can be of assistance in creating custom scripts.

TNTmips continuously runs a background process that can automatically detect and execute geoprovisioning tasks. These tasks are defined by the occurrence of XML job files in the directory specified. Each XML job file in the queue defines a task to be performed (i.e., the SML script to run) and its input and output parameters. TNTmips processes each job it finds in this queue (i.e., directory) using the SML script designated in the file. Jobs are run in sequential order, according to a priority code, or using other workload management options. The script writes the output of the job into a zip file, or any other supported geodata format, in a private location on your web site's FTP server. It also sends your user an email to inform them that the results are available and can be downloaded with the link embedded in the email.

Can the types of tasks be mixed?

Several different clients are demonstrated via this MicroImages sample geospatial gateway site at www.geoprovisioning.com. Each client you select at this sample site or prepare for your geoprovisioning site can have a different objective and interface, use a different SML script, and perform a different processing task using its own input and output parameters. As noted above, each use of a client software application for each provisioning request writes a separate XML job file in the queue. When TNTmips gets to that job file in the queue, it identifies and launches the correct script using the parameters specified in the file. If multiple cores and/or computers are available, each new job will be assigned to the next available core/computer. In other words, asynchronous, multicore, distributed processing is supported as well as multi-threaded operations. Using all these features your web site can publish many different HTML or more complex clients providing access to various geodata layers, analyses, and products.

What do I need other than a standard TNTmips product?

If you already own a TNTmips and have a web site, you do not have to use a TNTserver or any other MicroImages product to set up a geoprovisioning site. A sample client is shown that prepares a PDF map layout, but does not require a visual selection of the area-of-interest. This kind of client can be easily built in simple HTML and does not require a TNTserver to access any image or query for any features. It uses a vector layer with state-township-range-section polygons that define the land subdivision scheme used to reference rural land ownership, location, and use in the USA. Your client application could use a vector layer defining unique land subdivisions or a database with overlapping project areas. This HTML client page with a form(s) and/or style sheet is used to collect the text input to define the area needed, specify the TNTmips analysis of it, and the desired output format.

Geoprovisioning with HTML geoviewing.

There is a wide variety of graphical techniques that you can use in your HTML web client to add spatial viewing and geodata selection to your site's geoprovisioning activities. For example, rather than using a drop-down text list or menu, use a simple outline map of states, provinces, counties, shires, municipalities, townships, land sections, cadastres, crop fields, or ... The user of your client can click on this graphic to select an area of interest. A simple example of this technique is illustrated by the USA map at the top of www.microimages.com/geodata/StateOrtho.htm.

Much more complex, hierarchical graphic structures, including GIF or JPEG images, can be employed in your HTML client to guide your user into the selection of the geodata layer, the geographic area of interest, and other spatial and graphical choices. A more complex example of a predominately HTML-based client interface to this sample MicroImages geoprovisioning site is also illustrated at www.microimages.com/geodata/StateOrtho.htm. Just as described above, these more elaborate HTML-based clients simply write out an XML job file for a TNTmips script to execute.

Geoprovisioning using a WMS for geoviewing.

What is needed to add remote image viewing and feature selection?

TNTserver is a low-cost, commercial product that can serve up images using the Web Map Service (WMS) and geometric features via the Web Feature Service (WFS) protocols of the Open Geospatial Consortium (OGC). TNTserver delivers your images and geometric features to any end-user client software (i.e., your web application, executable program, ...) that is compliant with the standard WMS and/or WFS protocol. It is used in geoprovisioning to permit the user of your client software to select layers, view, zoom in/out, select features, query, and move around in the published image, digital elevation model, CAD, vector, shape, and spatial database layers.

How geoprovisioning uses geoviewing.

A TNTserver will permit your client software to view any geodata layer it is publishing as an image using its OGC certified WMS protocol for image viewing and WFS protocol for access to geometric elements using the OGC GML (Geography Markup Language). HTML, JavaScript, and OpenLayers were used to build the views in the web applications demonstrated on this MicroImages sample geoprovisioning site. The client software provides its user with a view for layer selection and navigation and a variety of tools to draw on the

view, select areas and elements interactively, and communicate them back to your geoprovisioning site. All these are communicated back to the web server and become part of the specifications for the job in the XML job file. TNTmips then processes each job as outlined above. TNTmips and TNTserver are separate products, and TNTserver only communicates with TNTmips via the job the client software logs into the job directory.

Use a web client to view the geodata and define the geoprovisioning tasks.

The software clients available to the end user of this geoprovisioning site provide several examples of progressively more complex web applications assembled using HTML, JavaScript, and the OpenLayers WMS viewer. At this sample site these client programs access a TNTserver operating on a simple Windows-based computer to let you visually select an area or features of interest that you wish to process and order, that is, have geoprovisioned. The client also lets you select the input and output parameters for the processing of your order.

Geospatial analysis oriented geoprovisioning.

More complex analysis processes can be performed using TNT geoprovisioning with or without a TNTserver for viewing. A sample client is shown that permits you to draw a polygon to define the area-of-interest. This polygon is sent back from this client and stored in the XML job file. TNTmips uses the polygon stored in the job file to extract the irregularly-bounded area of interest and fills the remainder of the bounding rectangle with a no-data value (a null or constant value consistent with the output format selected). With minor modifications this script could also request that a TNT buffer zone operation be performed on the polygon that is drawn to enlarge or decrease this irregular area-of-interest by a value entered into the client.

Another example would be using a simple HTML client to build a query to send into a TNTmips job file to provision a shapefile of all the selected road types that intersect all the rivers of a selected type. This query client does not require any TNTserver as it uses only TNTmips to identify the intersecting features in a specified vector layer and write them to the provisioned shapefile. If you wished to expand this client to view the vector layer and draw a polygon to limit the area for this action, then a TNTserver would be required.

Geoprovisioning using Google Maps for geoviewing.

Using a TNTserver.

Very large collections of raster, vector, CAD, shape, or database files can be assembled into a single state, province, or national layer for use in TNTserver. Rasters are mosaicked and output into MicroImages' proprietary tileset structure. Geometric data types are merged into single optimized layers. Google Maps can be used to view and use these layers when they are published using the Open Geospatial Consortium's ISO certified WMS and WFS protocols. MicroImages has prepared multiple examples of software clients that demonstrate how you can use Google Maps to view your geodata prepared by a TNTmips system and published by a TNTserver. These include:

Home Page. The home page of MicroImages' web site illustrates a small Google Maps insert that can be used to zoom to a location near you to view any of MicroImages' 2006 state orthophoto tilesets or DigitalGlobe's global image base.

iTNTmap. An iPhone and iTouch version of Google Maps is available to view MicroImages' state orthophotos, DigitalGlobe's global image base, or any ArcIMS or Web Map Service (WMS) layer. If it is accessed from a web browser, it simulates its operation on an iPhone/iTouch device. If accessed from the handheld device, it automatically recognizes the device and uses it.

TNTmap. Use this image browser to locate geodata published on the Internet as WMS layers, view them in Google Maps and Google Earth, and save the access to these layers as a layout (context) for use in HTML or other web clients.

Online Maps: Uses Google Maps, Google Earth, or MicroImages' viewers to display any area at any scale from about 50 terabytes of USA imagery at 1- to 2-meter detail and elevation data ranging from 10- to 90-meter detail. This HTML structure provides a sample interface to graphically select from any of these state or other tileset layers. It also uses icons to demonstrate how it can create a KML file that automatically launches the web application with the data it has collected, in this case the geodata layer of interest, thus simplifying your geoprovisioning client.

Google Maps provides a viewer already familiar to your user to navigate the globe and view your geodata layers. Simple MicroImages extensions to Google Maps permit your user to draw polygons, select features, ..., and create XML job files for geoprovisioning by a professional TNTmips product as outlined above. Any of these clients can be modified to permit your user to navigate around the world with Google Maps, select the areas covered with your geodata, overlay and view these layers, and draw outlines or select features on your layers. A form or other interface is then used to define what SML script TNTmips should apply to the layer(s), polygons, selected points, ... to geoprovision for that user.

Using a Google Maps Tile Overlay.

Google Maps is a web application for viewing small (256 by 256 pixel) PNG or JPEG fimage files organized into a directory structure of tiles of matching scales. This rigorous structure has been designed to maximize the speed of viewing Google's standard map and image content stored in distributed fashion through the web. The Google Maps application can also display your geodata layers, geolocated pictures, and other georeferenced materials identified by their URLs. Several free TNT web applications demonstrate how you can view your own map and image layers as overlays in Google Maps using MicroImages' sample tilesets. However, Google Maps will present your layers *much faster* if the structure of your layers matches their rigorous, native tile structure:

identical directory structure,
matching tiers of files for the scale range covered by your layer,
256 by 256 pixel files at each scale required,
files names or other indexes to match Google's fixed ground location of tiles
JPG tiles for image or other non-transparent layers,
PNG tiles for geometric layers used as transparent overlays, and
Mercator projection with WGS84

TNTmips 2009 raster mosaic can assemble your geodata pieces in different formats, projections, scales, … into a tileset that meets all of these criteria. (Note, all TNT modified Google Maps viewers currently access MicroImages tilesets; sample geodata dem-

onstrating the increased performance of Google Maps tile overlays is currently being prepared.)

Advantages. The advantage of using your large geodata sets in Google Maps' tile overlay structure is that the Google Maps structure is optimized for their product and the widely distributed components of their standard layers. Matching their structure means faster viewing, panning, and zooming in their familiar interface. It is easy to manipulate even when it is being used to view your geodata. Also, no special geodata management service, such as TNTserver, is needed to display Google Maps tile overlays of image and transparent map overlays. Furthermore, MicroImages and others provide rectangle, polygon, point selection, measurement, and other tools and complete client models for you to use or modify into your custom web applications.

Disadvantages. The disadvantage of a Google Maps tile overlay is that your geodata must be significantly modified and restructured in advance for optimal viewing. Since images are JPG tiles instead of JP2 tiles, more image distortion is present and the Google Maps tile overlays will be several times larger than a TNT tileset with a comparable JP2 lossy distortion. This tile overlay is also not suitable for automated image, elevation, or feature processing as part of your geoprovisioning activity or other uses in TNTmips.

Using a hybrid approach. A hybrid geoprovisioning approach would overcome the disadvantages of using Google Maps tile overlays or TNT tilesets. A Google Maps tile overlay can be used for fast viewing and area selection in your web application that submits the results (e.g., layer name and polygon boundary) as an XML-defined geoprovisioning job to TNTmips. TNTmips uses these parameters collected by your Google Maps based client to perform the required processing on matching objects stored in any TNT object type. For example, to extract the matching subset of a vector object or perform an analysis within the defined area using the matching flat or tileset multiband raster object. In ither words, your end user accesses a modified, but familiar, Google Maps viewer to interact with your geodata presented from a Google Maps tile overlay prepared in TNTmips. The Google Maps web application then submits the job to a TNTmips to process your corresponding, original geodata and make these results available for downloading. For example, TNTmips 2009 can build and use multiband tilesets with lossless JP2 or other tile formats that can be used in image analysis.