

# Bing Maps Structures

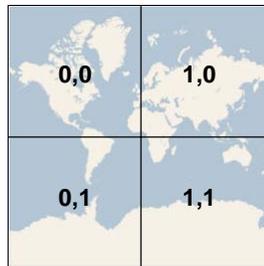
You can create custom web tilesets for use in Microsoft Bing Maps using the Auto Mosaic and Export Raster Tilesets processes in TNTmips. Microsoft refers to these tilesets as “Custom Tile Layers”. Each custom tile layer consists of a set of uniformly-sized tile files (256 by 256 pixels). Each of these tiles is aligned on a fixed global grid in the Spherical Web Mercator projection. Each tile is an image or map of the ground at a predetermined, fixed zoom level. Thus every pixel in every tile at any zoom level represents a single fixed ground location. The number of tiles in the tileset (and its stored size) depend upon the size of the area depicted, the resolution of the source imagery or map, and the number of zoom levels created for viewing the tileset.

Tilesets with a hierarchical directory structure created in the Export Raster Tilesets and Mosaic processes in TNTmips can be used in either Google Maps or Bing Maps. When you make a tileset with hierarchical structure for either Google Maps or Bing Maps, these processes automatically create separate HTML files to enable viewing the tileset in both Google Maps and Bing Maps.

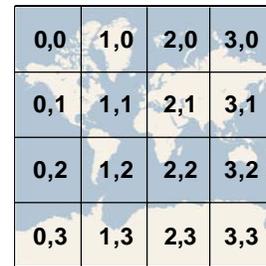
Bing Maps Zoom Level	Pixel Size at Equator
1	78 km
2	39 km
3	19.6 km
4	9.8 km
5	4.9 km
6	2.4 km
7	1.2 km
8	611 m
9	306 m
10	153 m
11	76 m
12	39 m
13	19 m
14	10 m
15	5 m
16	2.4 m
17	1.2 m
18	60 cm
19	30 cm
20	15 cm
21	7.5 cm
22	3.7 cm
23	1.9 cm
24	9.3 mm

Microsoft uses this same conceptual structure in the imagery and maps it loads from its web sources, which accounts for its rapid response. This rigid pre-rendered pyramid of grid-aligned tiles ensures fast retrieval and display in Bing Maps. Only a few tiles need to be located and read from the server for any particular view, regardless of the size of the tileset. You can maintain a custom tile layer on a local drive for private use or publish it on the Internet to it make publicly available. In either case, Bing Maps can quickly and efficiently load the tiles from your overlay for display with its native layers.

Zoom Level 1: 4 tiles



Zoom Level 2: 16 tiles



Global tile grids at the two lowest-resolution Bing Maps zoom levels. Bing Maps uses a Spherical Web Mercator projection representing the globe as a square shape. Tiles at each zoom level are indexed by tile row and tile column number (beginning with 0) from the upper left corner of the global map. The number pairs on each tile grid show the tile column and tile row (X,Y) for each tile.

Table of possible pre-rendered, fixed zoom levels in a Bing Maps Custom Tile Layer

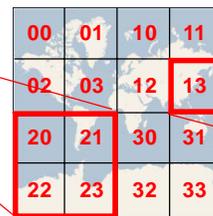
## Zoom Levels

Bing Maps uses a numbered sequence of zoom levels as shown in the illustration and table to the right. The least-detailed zoom level in Bing Maps is level 1, which represents the entire globe with a 2 by 2 grid of tiles. The common corner of these four tiles is located at 0 degrees longitude and 0 degrees latitude. Each integer increase in zoom level doubles the number of tiles in both the north-south and east-west directions. Zoom level 2 covers the globe with a 4 by 4 grid of tiles, level 3 with an 8 by 8 grid, and so on. Because the tile size is fixed, each increase in zoom level also reduces the size of the area on the ground represented by one pixel in a tile by a factor of 2, providing increasing visual detail in the tileset at higher zoom levels (see table to the right and the Technical Guide entitled *Tilesets: Setting Zoom Levels*).

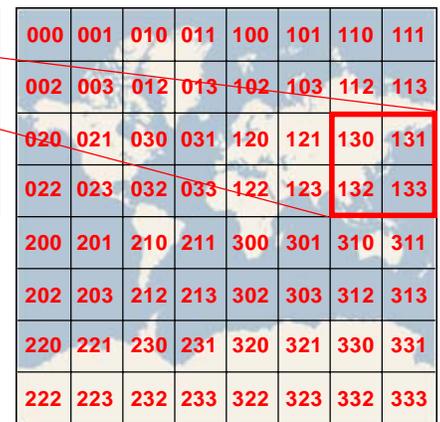
Zoom Level 1 Quadkeys



Zoom Level 2 Quadkeys



Zoom Level 3 Quadkeys



Bing Maps tiles are also indexed using quadtree keys, or “quadkeys”. Each quadkey number identifies a single tile at a single zoom level.

## Tile Coordinates and Quadkeys

Tile positions within each zoom level are indexed in Bing Maps by tile column and tile row numbers. Tile columns are numbered from left to right and tile rows from top to bottom of the global map, each beginning with 0 as shown in the illustration above. Any tile position in the tileset can thus be

identified by its zoom level, tile row, and tile column. This indexing system allows tile files in a custom tile layer to be stored in a hierarchy of nested subdirectories organized by zoom level and tile row, as discussed on the reverse.

(over)

Bing Maps tiles are also indexed using quadtree key numbers, or “quadkeys”. Each quadkey number uniquely identifies a single tile position and zoom level. At the lowest zoom level, each of the four tiles is assigned a value from 0 to 3 as shown in the illustration on the previous page. At the next zoom level each of these original tile areas is subdivided into four higher-resolution tiles. The quadkey for each of these tiles begins with the value inherited from the corresponding lower-resolution tile followed by the value 0, 1, 2, or 3 according to its position within the lower-resolution tile. The length of the quadkey is thus equal to the zoom level of the tile.

### Flat Bing Maps Structure with Quadkey Filenames

The native structure for Bing Maps tile layers uses the quadkey identifier for each tile as its file name root, followed by the file extension appropriate for the file format of the tile. (A Bing Maps tile layer can contain JPEG and/or PNG tile files; see the TechGuide entitled *Tilesets: Tile Image Formats*). The tile filename alone contains all of the

information needed for Bing Maps to place each custom tile in the correct geographic position and zoom level. All of the custom tile layer’s tile files of either format can thus be placed in a single tile directory (a “flat” structure). Custom tile layers with this native flat structure can be viewed in both 2D and 3D in Bing Maps. Custom tile layers that cover large areas at high resolution can include millions of tile files. A very large Bing Maps custom tile layer using the native flat structure could thus exceed your computer operating system’s limit on the number of files permitted in a single directory.

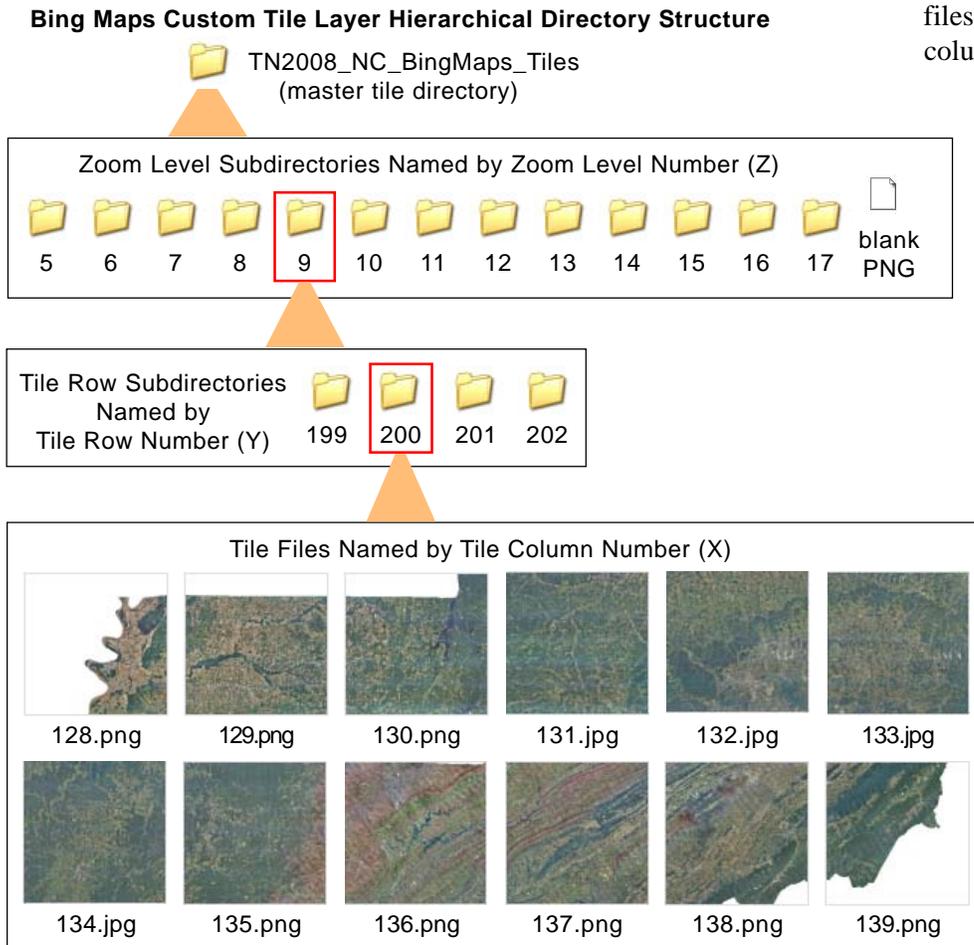
### Hierarchical Structure

Bing Maps also supports custom tile layers that use a hierarchical directory structure and custom file names rather than the native quadkey file naming structure. In the hierarchical Bing Maps structure, all of the tile files for each zoom level are stored in a correspondingly-named directory (see illustration below left). Within each zoom level directory, the tile files for each tile row are stored in a separate subdirectory named by row number. The individual tile files are named by their corresponding tile column number. This hierarchical structure ensures that a tileset will not exceed the limit on number of files or directories set by your computer’s operating system. Bing Maps custom tile layers with this hierarchical structure can be viewed in 2D in Bing Maps, but not in 3D.

### How the Custom Tile Layer is Loaded in Bing Maps

A sample HTML file created with each Bing Maps custom tile layer includes JavaScript code that loads the tileset in Bing Maps for display in your web browser. The script in this file references classes and methods provided by Microsoft in the Bing Maps AJAX Control application programming interface (API). This JavaScript code specifies the geographic extents of your custom tile layer, the minimum and maximum zoom levels, and the tile layer’s opacity. As Bing Maps renders your custom tile layer, it calls a function for each tile position to identify the path to the corresponding tile file. The form of this function depends upon the tileset structure.

For both flat and hierarchical structures, the entire Bing Maps custom



Directory structure for a Bing Maps Custom Tile Layer created in TNTmips using the Automatic option for Tile Format, which creates JPEG files for interior tiles and PNG files for edge tiles to provide transparency for non-image areas. This tile layer includes zoom levels 5 through 17. Tiles are stored in nested subdirectories, first by zoom level number and then by tile row number. Individual tile files are named by tile column number.



33767.jpg

Illustrated to the left is a single 256 by 256-pixel tile from zoom level 17 of the orthoimage tileset with hierarchical structure that is illustrated on the previous page. The ground extent of a single pixel at level 17 at this latitude is 0.996 meter. The Bing Maps tile coordinates for this tile are: tile row or Y = 51,209, tile column or X = 33,767. The Javascript code in the sample HTML file created with this tileset constructs the URL to this tile file (shown below) using the numeric zoom level directory name, tile column directory name, and tile file name.

[path to tileset] \ TN2008\_NC\_BingMaps\_Tiles \ 17 \ 51209 \ 33767.jpg

tile layer is stored in a subdirectory whose name consists of the name of your tileset followed by “\_Tiles”. If your custom tile layer has the flat structure, this single subdirectory contains all of the tile files. The JavaScript code to get the tile files constructs a simple file path consisting of the tile directory name followed by a placeholder string defined by Microsoft to indicate that tile files are named using the quadkey system. Bing Maps therefore loads the file with the filename corresponding to the quadkey for the current tile position. Since the your tile directory can contain files in either PNG or JPEG format, these tiles are loaded as separate layers by the JavaScript code.

If your custom tile layer has the hierarchical structure, the directory/file path to any tile file in the structure consists of: tiles directory/zoom level number/tile row number/tile column number (see the illustration on the previous page. In this case the JavaScript function uses the tile row and column for the current tile position to construct the required directory/file path for Bing Maps to locate and load each required tile file. As in the flat structure, PNG and JPEG tiles are loaded as separate layers.

#### Bing Maps Key

Microsoft requires that a web page (“application”) that uses the Bing Maps AJAX Control API to load a custom tile layer in Bing Maps must be registered and assigned a Bing Maps Key. The registration procedure requires that you provide a name for your web application and the URL of the web site hosting the application. The JavaScript in the sample HTML file must set the credentials for your web application using the Bing Maps Key. Instructions for registering your web application and obtaining one or more Bing Maps Keys is at: <http://msdn.microsoft.com/en-us/library/ee692181.aspx>.

#### Size of Google Maps Tile Overlay Structures

The table above the number of tiles and stored size by zoom level for a Bing Maps hierarchical tileset created in TNTmips from statewide, 1-meter color orthoimage coverage of the state of Tennessee. As each higher zoom level requires up to 4 times the number of fixed-size tiles than the previous level, high-resolution Google Maps tilesets can include millions of tile files and require tens of gigabytes of drive space (see the TechGuide entitled *Tilesets: Understanding Sizes*). You should take these factors into account as you plan your processing activities.

#### Folders, Tiles, and File Size by Zoom Level for a Sample Bing Maps Custom Tile Layer (1-m Orthoimage Mosaic of a US State)

(see Technical Guide entitled *Tilesets: Understanding Sizes*)

**Source image size:** 352 GB (uncompressed)

**Image area:** 109,185 square kilometers

**Tile Size:** 256 x 256 Pixels (required)

**Tile Formats:** JPEG + PNG for edge tiles

#### Coordinate Reference System:

WGS84 / Spherical Web Mercator (required)

Zoom Level	Number of Folders	Number of Tiles	Size on Disk
5*	1	2	32 KB
6	2	5	92 KB
7	2	7	308 KB
8	3	18	0.98 MB
9	4	43	2.86 MB
10	7	143	6.96 MB
11	13	516	17.1 MB
12	25	1,871	58.8 MB
13	49	7,236	201 MB
14	96	28,388	750 MB
15	192	112,485	2.88 GB
16	382	447,836	10.6 GB
17†	762	1,786,429	40.5 GB

\* minimum zoom level: lowest level requiring more than one tile to cover the image area

† maximum zoom level: pixel size equal to or less than the spatial resolution of the input image

**Total Number of Folders:** 1,551

**Total Number of Tiles:** 2,384,979

**Total Size on Disk:** 55.1 GB