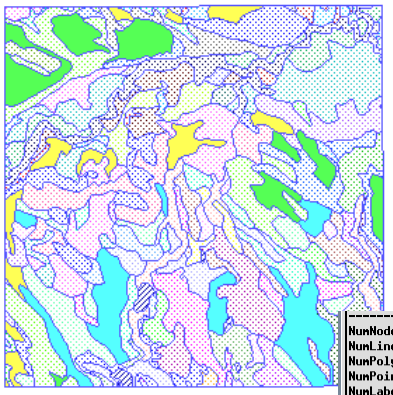
Vector Topology Types

Three levels of vector topology are supported in TNTmips: polygonal, planar, and network, which can be 2D XY, 3D XY or 3D XYZ. Toplogy for 3D XYZ objects is often referred to as 2.5D because topology is maintained in the XY plane only. The defining characteristics of these object types are provided below with an illustration of a typical object of each topology level. In general, a vector object should represent a particular theme, such as soil type or roads, and the theme will determine the necessary topology level. You can change the topology type of any vector object in the Spatial Data Editor. All three topology types are always maintained during editing operations.

Polygonal Topology

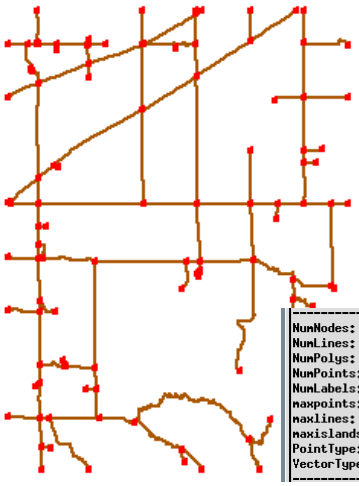


Project File Maintenance
Object Information

```
NumNodes: 420
NumLines: 629
NumPolys: 212
NumPoints: 0
NumLabels: 205
maxpoints: 32
maxlines: 43
maxislands: 1
PointType: 1 (2D X-Y)
VectorType: 0 (POLYGONAL)
```

Polygonal topology is the highest, or strictest, level of topology. It requires that no two nodes have the same X and Y coordinates, all lines start and end in nodes, lines do not intersect other lines or themselves (nodes are inserted where lines would otherwise cross), enclosed areas are defined as polygons, and any point element can be in at most one polygon. Polygonal topology is necessary if you want ground area measurements, but it takes time and rigor to maintain, which may be unnecessary depending on your application. A soil map or property ownership map is typical of a polygonal vector object. For some applications you may want to combine themes, such as ownership boundaries and roads, to make retrieval of certain information, such as property owners along a specified road, a matter for a simple query. Polygonal objects need not be rectangular. They can have an irregular boundary that conforms to the polygon edges.

Planar Topology

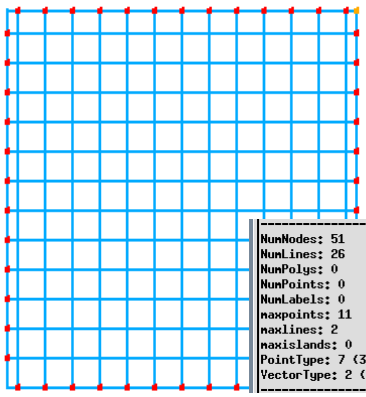


```
NumNodes: 116
NumLines: 134
NumPolys: 0
NumPoints: 0
NumLabels: 0
maxpoints: 131
maxlines: 6
maxislands: 0
PointType: 7 (3D X-Y-Z)
VectorType: 1 (PLANAR)
```

Planar topology requires that all lines start and end in nodes and no two lines cross, as with polygonal objects. However, polygon information is not maintained. With the exception of polygon filling, planar and polygonal objects appear the same. Planar topology may be appropriate for hydrology if no lakes are present. Planar topology may also be appropriate for road systems that lack underpasses and overpasses or other features that require network topology for correct representation. Note the presence of nodes (red) at every position where lines would otherwise cross, as well as at the dangling ends, in the roads at the left.

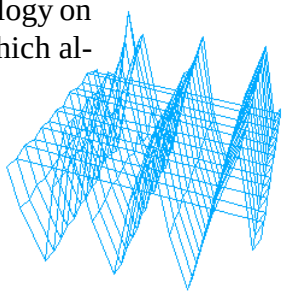
Polygonal and planar objects can be either 2D or 3D XYZ; topology is maintained in the X-Y plane for 3D objects of these topology types (polygon dimensions and the location of nodes separating lines that would otherwise cross are determined by projecting onto the X-Y plane).

Network Topology



```
NumNodes: 51
NumLines: 26
NumPolys: 0
NumPoints: 0
NumLabels: 0
maxpoints: 11
maxlines: 2
maxislands: 0
PointType: 7 (3D X-Y-Z)
VectorType: 2 (NETWORK)
```

Network topology places nodes at the start and end of all lines, but lines *may cross themselves* or other lines. *There are no polygons.* Note the absence of nodes where the lines cross in the grid at the left. Although nodes need not occur where lines cross, they can be present at any intersection and are necessary for use in network analysis (routing and allocation). The constraints imposed by 2D topology on 3D objects are eliminated by choosing **network** topology, which allows two nodes to have the same X and Y coordinates. Lines that appear to cross in a 2D view may be separated in 3D by their Z values, as shown in the 3D view of this grid at the right. This topology type is well suited for flight paths, sewer, water, and similar infrastructure representation.



NIMA Topology.

NIMA's (National Imagery and Mapping Agency's) GIS side is active in establishing the ground rules for the various levels of topology of vector geodata and in turn their potential applications. MicroImages' vector objects adhere to their definitions for Levels 1, 2, and 3 and the TNT products maintain and can convert between these topological levels during editing and analysis. Of particular note is that NIMA is now defining topology Levels 4 and 5 for full 3D and even multi-temporal geospatial data creation, storage, and analysis.

Level 0: (non-topological or spaghetti vector object)

Name: Boundary Representation (2D or 3D coordinates)
Primitives: Entity nodes & edges.
Relationships: None
Description: A set of entity nodes and edges

Level 1: (TNT network topology vector object)

Name: Non-planar Graph (2D or 3D coordinates)
Primitives: Entity nodes, connected nodes, and edges
Relationships: Start and end nodes, connected edges
Description: A set of entity nodes and edges that may meet at nodes

Level 2: (TNT planar topology vector object)

Name: Planar graph (2D or 3D coordinates)
Primitives: Entity nodes, connected nodes, and edges
Relationships: Start and end nodes, connected edges
Description: A set of edges and nodes where, when projected onto a planar surface, the edges meet only at nodes.

Level 3: (TNT polygonal topology vector object)

Name: Full planar topology (2D or 3D coordinates)
Primitives: Connected nodes, entity nodes, edges, and faces (including universe face)
Relationships: Start and end nodes, connected edges, containing face, contained entity nodes, left and right faces, outer and inner rings
Description: The surface is partitioned by a set of mutually exclusive and collectively exhaustive faces. Faces meet only at edges, and edges meet only at nodes.

Level 4: (not supported)

Name: 3D face topology (3D coordinates only)
Primitives: Connected nodes, space nodes, edges, and faces (no universe face)
Relationships: Start and end nodes, connected edges, containing face, contained entity nodes, bordered faces, outer and inner rings
Description: A set of faces, edges and nodes where the faces meet only at edges, and the edges meet only at nodes

Level 5: (not supported)

Name: Full spatial topology (3D coordinates)
Primitives: Start and end nodes, entity nodes, space nodes, edges, volumes
Relationships: Start and end nodes, connected edges, containing face, containing volume, contained entity and space nodes, contained entity edges, bordered faces, bordered volumes, outer and inner rings, outer and inner shells
Description: The space is partitioned by a set of mutually exclusive and collectively exhaustive volumes. Volumes meet only at faces, faces meet only at edges, and edges meet only at nodes

For diagrams and more descriptive information about these levels of topology please see www.geovista.psu.edu/sites/geocomp99/Gc99/037/gc_037.htm.