ATTRIBUTE DATA MODELS

A separate data model is used to store and maintain attribute data for GIS software. These data models may exist internally within the GIS software, or may be reflected in external commercial Database Management Software (DBMS). A variety of different data models exist for the storage and management of attribute data. The most common are:

- Tabular
- Hierarchical
- Network
- Relational
- Object Oriented

The tabular model is the manner in which most early GIS software packages stored their attribute data. The simple tabular model stores attribute data as sequential data files with fixed formats (or comma delimited for ASCII data), for the location of attribute values in a predefined record structure.

The hierarchical database organizes data in a tree structure. Data is structured downward in a hierarchy of tables. Any level in the hierarchy can have unlimited children, but any child can have only one parent. Hierarchical DBMS have not gained any noticeable acceptance for use within GIS. They are oriented for data sets that are very stable, where primary relationships among the data change infrequently or never at all. Also, the limitation on the number of parents that an element may have is not always conducive to actual geographic phenomenon.

The network database organizes data in a network or plex structure. Any column in a plex structure can be linked to any other. Like a tree structure, a plex structure can be described in terms of parents and children. This model allows for children to have more than one parent.

Network DBMS have not found much more acceptance in GIS than the hierarchical DBMS. They have the same flexibility limitations as hierarchical databases; however, the more powerful structure for representing data relationships allows a more realistic modelling of geographic phenomenon. However, network

databases tend to become overly complex too easily. In this regard it is easy to lose control and understanding of the relationships between elements.

Relational Model

- The relational database organizes data in tables.
- Each table, is identified by a unique table name, and is organized by rows and columns.
- Each column within a table also has a unique name.
- Columns store the values for a specific attribute, e.g. cover group, tree height.
- Rows represent one record in the table. In a GIS each row is usually linked to a separate spatial feature, e.g. a forestry stand.
- Accordingly, each row would be comprised of several columns, each column containing a specific value for that geographic feature.
- Data is often stored in several tables.
- Tables can be joined or referenced to each other by common columns (relational fields).
- Usually the common column is an identification number for a selected geographic feature, e.g. a forestry stand polygon number. This identification number acts as the primary key for the table.
- The ability to join tables through use of a common column is the essence of the relational model. Such relational joins are usually ad hoc in nature and form the basis of for querying in a relational GIS product.

RDBMS ADVANTAGES

- Simplicity in organization and data modeling.
- Flexibility - data can be manipulated in an ad hoc manner by joining tables.
- Efficiency of storage - by the proper design of data tables redundant data can be minimized; and
- The non-procedural nature - queries on a relational database do not need to take into account the internal organization of the data.

OBJECT-ORIENTED DATA MODEL

- The object-oriented database model manages data through objects. An object is a collection of data elements and operations that together are considered a single entity.
- The object-oriented database is a relatively new model. This approach has the attraction that querying is very natural, as features can be bundled together with attributes at the database administrator's discretion.
- To date, only a few GIS packages are promoting the use of this attribute data model. However, initial impressions indicate that this approach may hold many operational benefits with respect to geographic data processing.
- Fulfillment of this promise with a commercial GIS product remains to be seen.