

**Technical Paper
April 2000**

**IMPLEMENTING
the
SPATIAL DATA STANDARDS FOR FACILITIES,
INFRASTRUCTURE, AND ENVIRONMENT (SDS)
and
FACILITY MANAGEMENT STANDARDS FOR FACILITIES,
INFRASTRUCTURE, AND ENVIRONMENT (FMS)
Using
INTERGRAPH'S GEOMEDIA**

Final Draft

**Published by: The CADD/GIS Technology Center for Facilities, Infrastructure, and
Environment
Army Engineer Research and Development Center (at Vicksburg)
3909 Halls Ferry Road
Vicksburg, MS 39180-6199**

Intergraph's GeoMedia

GeoMedia is a GIS software package developed and sold by Intergraph Corporation of Huntsville, Alabama. It is based on Jupiter technology from Intergraph and will run on the Windows 95, 98, and NT operating systems.

GeoMedia in its viewing mode (read only) allows the user to combine geographic data from different sources, in different formats, and with different map projections (ArcInfo, ArcView, MGE, Framme, etc.). The user can then perform complex queries on spatial and attribute information across these varied sources.

GeoMedia stores data by placing information about the geographic area in a file called a GeoWorkspace (GWS). This file contains information about the configuration of the data on the screen (scale, projection, legend entries, etc.). This file is linked to a warehouse that holds non-graphic or attribute data. When GeoMedia is viewing other formats of data (ArcInfo, MGE, etc.), this warehouse would be the data set for that format. When GeoMedia is being used in a read/write mode, this warehouse will be an Access database. The Access database will contain the graphic description of the feature and also the attribute tables linked to the feature if required.

The Spatial Data Standards/Facilities Management Standards (SDS/FMS) has built a geographic data model that allows spatial (graphic) and tabular (attribute) data to be related. As the SDS/FMS has been designed for applicability to existing GIS products, the

SDS/FMS structure accommodates the GeoMedia data model. As described later in this document, the SDS/FMS hierarchy and terminology seamlessly maps into the GeoMedia structure. In order to create the GeoMedia data structure for graphic and attribute data, the following module has been created by Upper 90 System, Inc.

GeoMedia GeoDatabase Builder

The GeoMedia GeoDatabase Builder is intended to build or populate the structures of the GeoMedia GeoDatabase in accordance with the SDS/FMS. It enables users to pick and choose features according to a variety of methods and construct the necessary GeoMedia structures to store and display data compliant with the SDS/FMS.

GeoMedia Versions

For the purpose of this implementation guide, GeoMedia 3.0, SDS/FMS 1.9, Access97, and GeoMedia GeoDatabase Builder 1.01.0032 was used. Users should be familiar with these software applications for a successful implementation.

Implementing the SDS/FMS using Intergraph GeoMedia

Project Setup Overview

The following steps should be followed to establish the appropriate GeoMedia working environment. Many of these steps will need to be performed only once when the project is set up, not for each individual session. The following chart shows the relationship

between GeoMedia Project Setup and SDS/FMS Implementation steps (see Figure 1).

GeoMedia does not provide a tool for the creation of a specific project. GeoMedia will place all files in a default directory

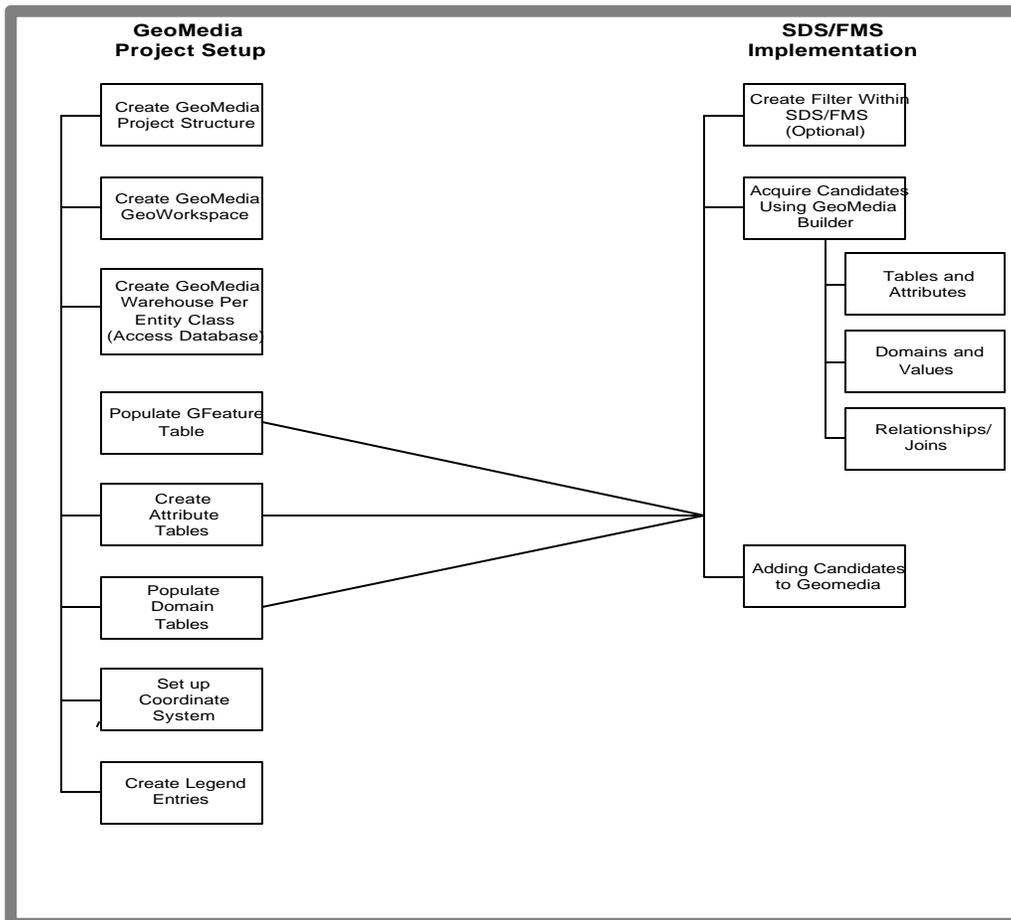


Figure 1. GeoMedia/SDS/FMS Implementation Diagram

unless the user specifies a different directory structure. The Tri-Service CADD/GIS Technology Center suggests the directory structure found in Figure 2.

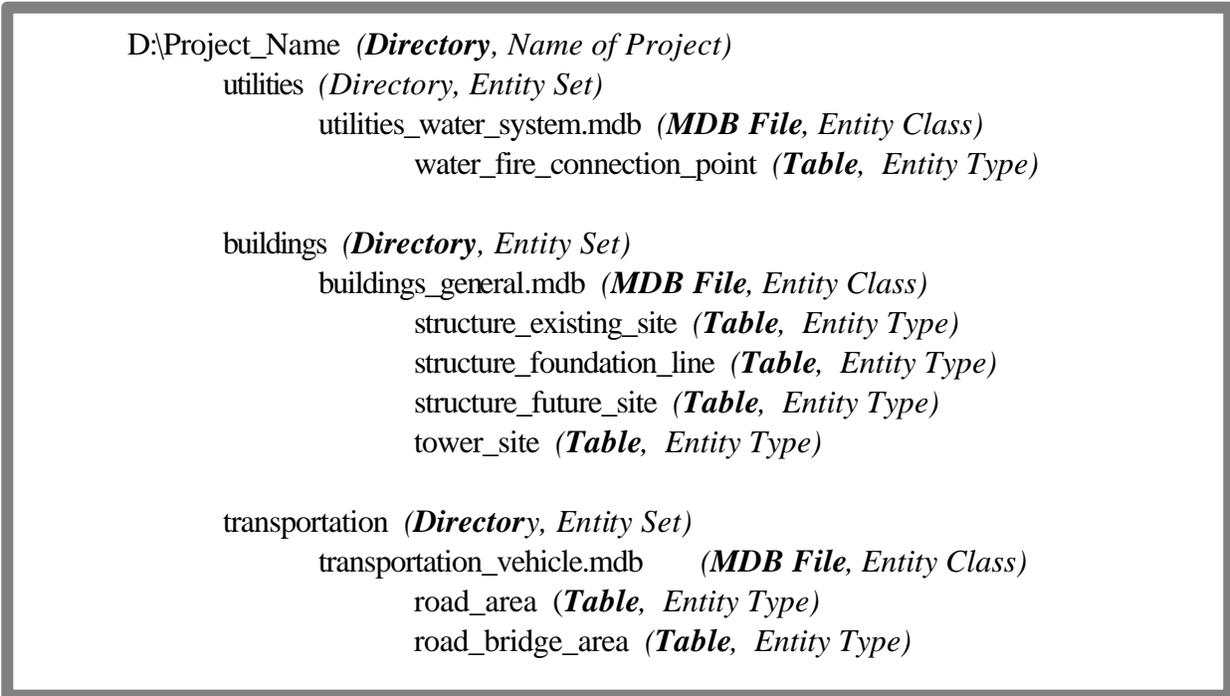


Figure 2 Tri-Services Suggested GeoMedia Project and Directory Structure

Creating the GeoMedia GeoWorkspace

In order to store data within GeoMedia, the user must create a GeoWorkspace. This is done by opening GeoMedia and creating an empty GeoWorkspace. The workspace is given a default name of GeoWorkspace1. The user can then modify the workspace by changing the projection, adding a warehouse connection, etc. Once any modifications are made, the GeoWorkspace can then be saved using a name that best describes the project. The GeoWorkspace is created in the default geoworkspace directory unless specified as above.

Creating the GeoMedia Access Warehouse

Once the GeoWorkspace has been created, the user can connect any number of read only warehouses to it. Once the features in these read only warehouses are added to the legend, they are available for viewing using GeoMedia. However, if the user wishes to create new graphic data and manipulate the attribute data that goes along with it, a read/write Access warehouse must be created.

The warehouse is created by selecting the Warehouse item at the top of the GeoMedia

window and then selecting New Warehouse.

The user will be asked to select a template to be used to create the new warehouse.

GeoMedia provides an Access 97 and 2000 template for this purpose. Once the template is selected, the user is asked to provide a name for the new warehouse. The name of the new warehouse should be the same as the entity class within the SDS/FMS that is to be implemented. If the user is implementing an electrical exterior light data source, the directory would be utilities; the warehouse would be utilities_electrical_ext_light.mdb.

Once the GeoWorkspace and the Warehouse have been created, it is now time to use the GeoMedia GeoDatabase Builder.

Connecting the GeoMedia GeoDatabase Builder to the SDS/FMS and the GeoMedia Warehouse

The GeoMedia GeoDatabase Builder is a third part software application developed by Upper 90 Systems, Inc. It should be loaded on a computer with a current version of MicroSoft Access, the SDS/FMS, and GeoMedia. Once the application is loaded, the user simply runs the program Geobuild.exe. This program will open Geomedia Builder Menu. See Figure 3. It should also be noted that GeoMedia GeoDatabase Builder provides a very extensive set of help files that support to the user.

The GeoMedia Builder Menu must first be connected to the SDS/FMS database and the GeoMedia Warehouse. To connect to the

SDS/FMS, the user should select the “Open” item along the top of the Builder Menu and then select “SDS/FMS Connection”. This will open a window allowing the user to point the menu to the

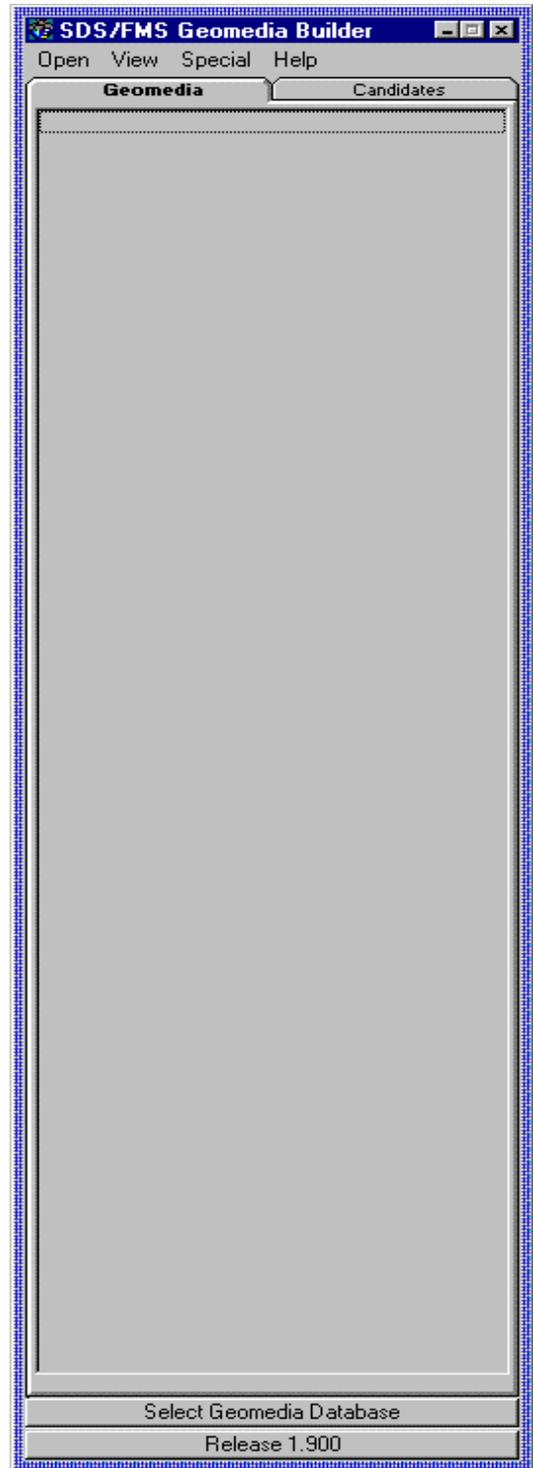


Figure 3 GeoMedia Builder Menu

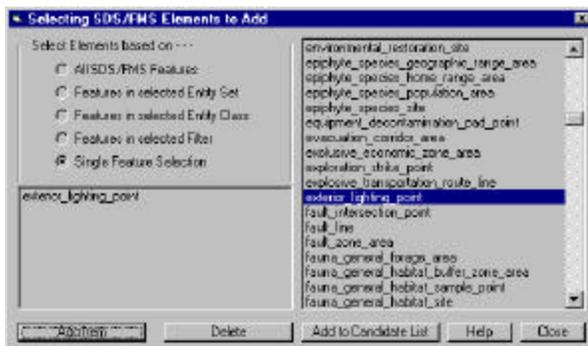
location of the SDS/FMS database. This is a one time operation and the connection will be saved for future use.

The user must now connect to the GeoMedia Warehouse (Access database) that is going to be populated by the GeoMedia GeoDatabase Builder. This is accomplished by again selecting the “Open” item at the top of the Builder Menu and then “GeoMedia Databases” or by selecting the “Select GeoMedia Database” button found at the bottom of the Builder Menu.. A dialog box will appear giving the user the opportunity to select the appropriate GeoMedia Database. This procedure will have to be accomplished each time a GeoMedia Warehouse is to be populated by the GeoMedia GeoDatabase Builder.

Populating the GeoMedia Warehouse

Once the GeoMedia GeoDatabase Builder is connected to the SDS/FMS database and the GeoMedia Warehouse, the user must prepare a candidate list for inclusion into the GeoMedia Warehouse. This is done by selecting “Open” and then “Select Features to Add”.

This will open a dialog box that will contain a list of features found in the SDS/FMS



database. See Figure 4.

Figure 4 Select SDS/FMS Features to ADD
The “Select Features to Add” gives the user several options to choose from when it comes to selecting candidates. The user can select all features within the SDS/FMS, those features within a particulate Entity Set, Entity Class, or a previously created filter. The user can also select one feature at a time.

After the features have been selected, the user should click on the “Add to Candidate List” button. This will place the select features onto the Candidates Tab of the GeoMedia Builder Menu. See Figure 5.

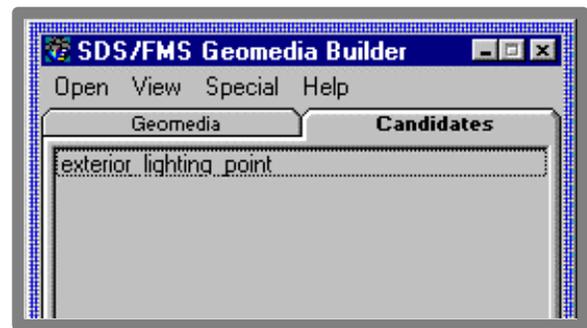


Figure 5 Features in Candidates List

The feature is still not a part of the GeoMedia Warehouse. One final step must be performed before the feature becomes part of the Warehouse. After all the required features have been place onto the Candidates Tab, the user must run the command “Add Candidates to GeoMedia”. This command can be found under the ”Open” item at the top of the GeoMedia Builder Menu.

Selecting the “Add Candidates to GeoMedia” from the pull down menu will open the dialog box “Adding Candidates to a Geomedia Database”. This dialog box opens

with the default options selected. The user clicks on the “Build/Generate” button to begin the process of adding the candidate or candidates to the GeoMedia Warehouse. See Figure 6. Depending on the number of candidates, this process could take several minutes

It should be noted that GeoMedia GeoDatabase Builder will not allow duplicate features within the GeoMedia Warehouse.

The user should also be aware that the GeoMedia GeoDatabase Builder will allow the user to place within the target Warehouse more than one Entity Class, i.e. Electrical and Water features in the same warehouse.

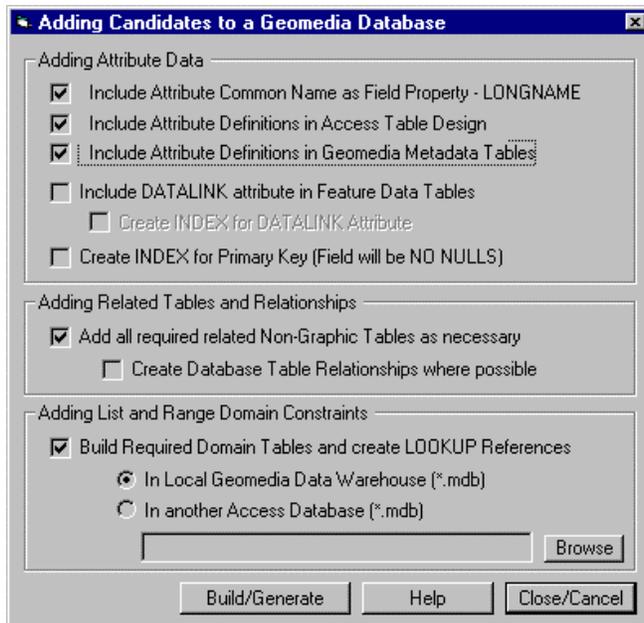


Figure 6 Adding Candidates to a Geomedia Database

Once the “Build/Generate” command has been completed, the GeoMedia Warehouse can be considered SDS/FMS compliant. That is it now contains the correct structure to allow

for the inclusion and creation of SDS/FMS compliant data.

GeoMedia GeoDatabase Builder Help Files

The GeoMedia GeoDatabase Builder comes with a set of help files that will provide the user with an overview of the Builder. These help files provide a glossary of terms, steps to construction, etc. This help file is generic, but it does provide the user with a good idea of what the Builder is meant to accomplish and how it works with the SDS/FMS. Figure 7 is an example of the GeoMedia GeoDatabase Builder Help files.

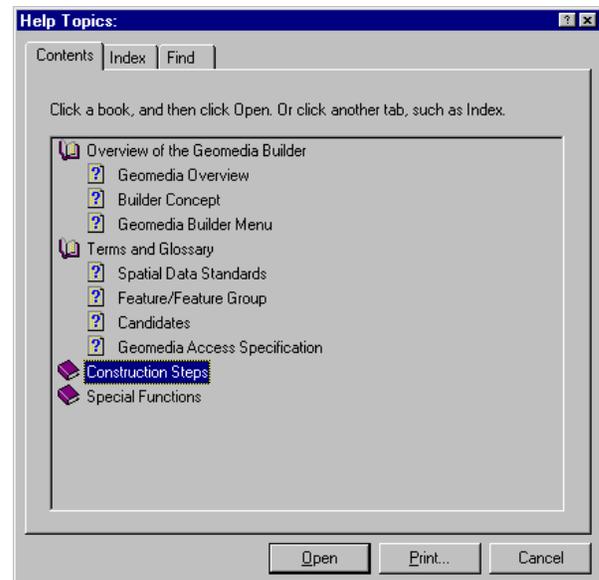


Figure 7 GeoMedia GeoDatabase Builder Help File

Now that we have looked at how to add SDS/FMS entities to a GeoMedia Warehouse, let us look at how the structure of the SDS/FMS and GeoMedia relate to one another.

Table Relationships between SDS/FMS and GeoMedia

Structure Relationships between SDS/FMS and GeoMedia

While the SDS/FMS is a data standard and GeoMedia is a GIS software application, a correlation can be found between the two in the way the GeoMedia project is set up when the suggested Tri-Service CADD/GIS Center structure is used. Figure 8 depicts this relationship.

The creation of the Access Warehouse within GeoMedia produces a set of standard tables required by GeoMedia. These tables are AttributeProperties, FieldLookup, GAliasTable, GCoordSystem, GeometryProperties, Gfeatures, GSQLOperatorTable, ModificationLog, and ModifiedTables. Figure 9 is an example of tables found within

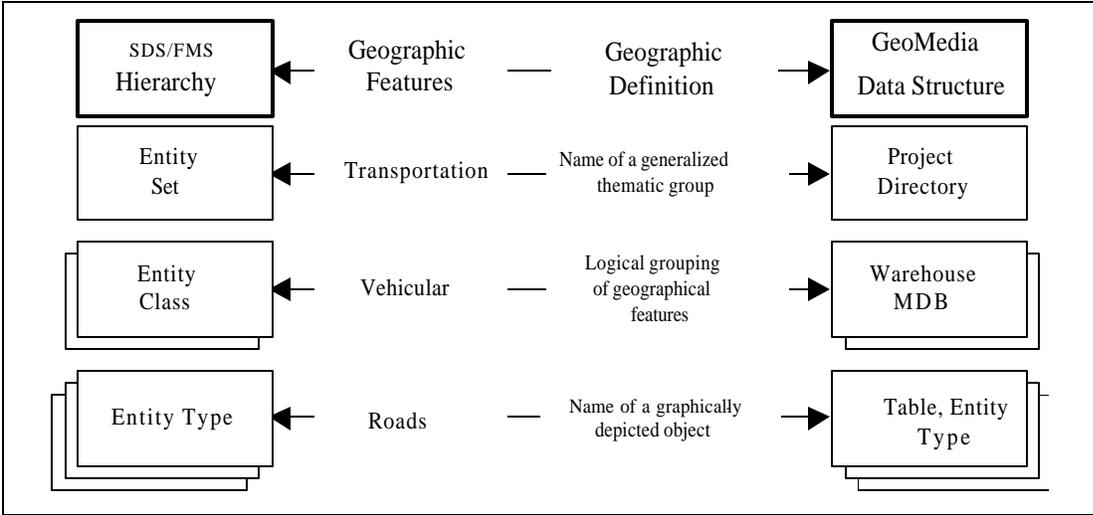
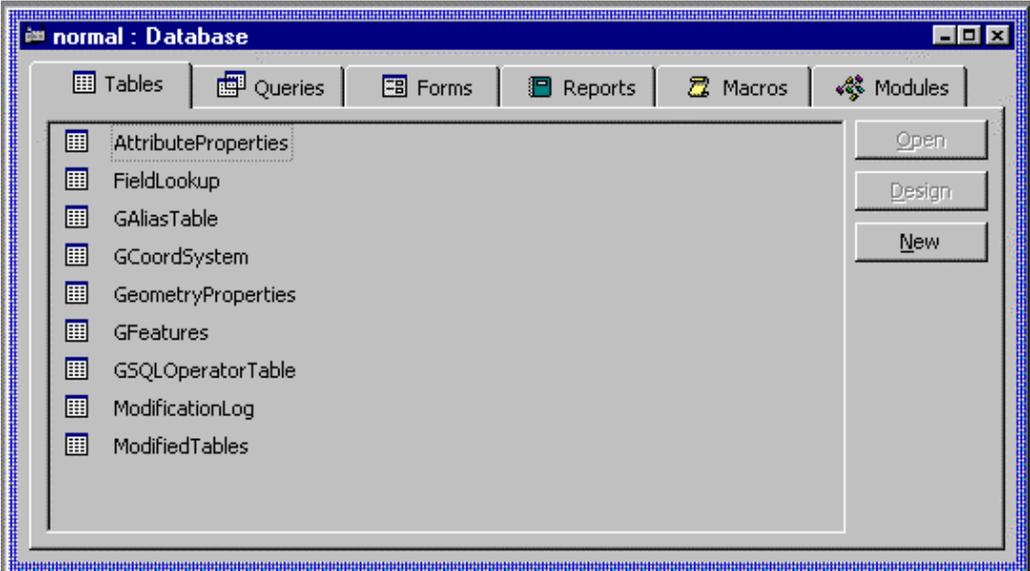


Figure 8 Structure Relationships between SDS/FMS and GeoMedia



Intergraph GeoMedia

Figure 9 GeoMedia Database Required Tables

a GeoMedia Database after GeoMedia creates it.

The tables depicted in Figure 9 are mostly metadata tables and are used to describe the content of the GeoMedia GoeWorkspace and Warehouse.

The “Build/Generate” command updates the tables listed in Figure 9 and creates additional tables as required within the attached GeoMedia Warehouse. Figure 10 is an example of tables found within a GeoMedia Database after the ”Build/Generate” command has included tables associated with the exterior_lighting_point entity type.

The “Build/Generate” command has added several metadata tables to GeoMedia Warehouse. These tables begin with the letters ‘CM’ and are from the Common Entity Set of the SDS/FMS.

The command has also created several domain tables. These tables begin with ‘D_’. A domain table is a table that holds a list of valid values for an associated attribute within an attribute table.

Finally the “Build/Generate” creates the feature class or entity type table, ‘exterior_lighting_point’. This table contains the attribute description and the geometric

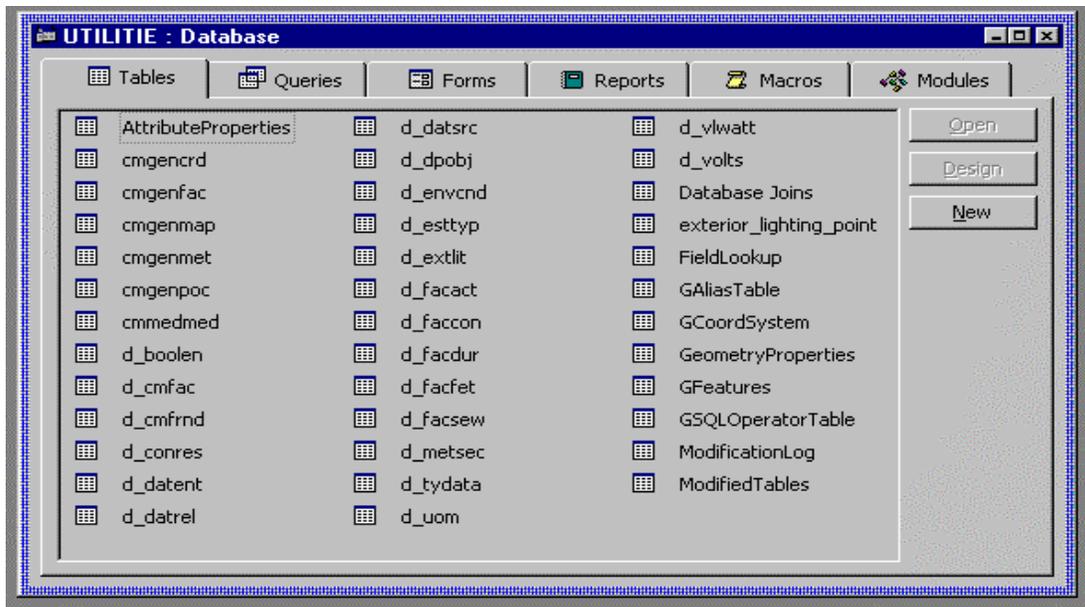


Figure 10 GeoMedia Warehouse after “Build/Generate”

description of the feature.

Exterior lighting geometry imported or added directly into the GeoMedia Warehouse will be stored in this table.

Following is a list terms and definitions taken from GeoMedia help files. These terms are used by GeoMedia to group and organize spatial and non-spatial data relevant to a task:

GeoWorkspace

A GeoWorkspace is the container for all your work. Within its confines are the warehouse connections to your data, map and data windows, toolbars, coordinate-system information, and queries you have built. The first thing you do is open an existing GeoWorkspace or create a new one.

Once you are in a GeoWorkspace, you can change its coordinate system, establish warehouse connections, run queries, display data, and perform spatial analyses. The settings and connections you define in a GeoWorkspace are saved in a .gws file, although the actual data remains stored in warehouses.

Warehouse

You display feature geometry's and attribute data in a GeoWorkspace through connections to warehouses where the data are stored. Each warehouse connection uses a data server to convert the data into a format that the software can display. This version of the software lets you connect to data created in the following formats: Access, ARC/INFO, ArcView, AutoCAD, MicroStation, FRAMME, MapInfo, Modular GIS Environment, and Oracle.

All warehouse types are read-only, except for Access. This protects the integrity of your source data. So, if you want only to display data in the software from one or more warehouses, you simply create one or more

warehouse connections and then use map windows and data windows to display the data.

Map and Data Windows

Map windows display graphic data (geographic and other map objects), while data windows display the attribute (nongraphic) data associated with the geographic objects (geometry's) in the map window. Map and data windows are linked so that changes made in one window are reflected in the other.

Each map window contains a legend as well as a north arrow and a scale bar. You select or deselect each of them on the View menu to turn them on or off.

For the most part you define the content and design of each map window through its legend. While a traditional legend simply reflects what is displayed on a map, you use the GeoMedia legend to control what is displayed in the map window and how it looks.

Features/Features Class

A feature is represented on a map by geometry and is further defined by nongraphic attributes in the database. The values of these nongraphic attributes can be viewed as cells in the data window.

In a read/write warehouse, you can create a new feature class, add features to a feature class, and edit a feature class table. You can edit a feature class table in the following ways:

- By adding attributes (columns)
- By removing attributes
- By changing attributes

In a read/write warehouse, you can also manage feature data in the following ways:

- By changing attribute values (cells)
- By adding or deleting features (rows)

Capability for read/write warehouses in the product exist as delivered for Access warehouses only.

IMPORTANT Changes to data in a read/write warehouse are automatically saved as soon as you make them.

Legend

The legend is the control center for the map window. Through the legend, you control map objects - such as feature classes, images, query results, and thematic displays - are displayed in the map window and how they look.

The legend contains a separate entry for each map object. When a feature class or query has multiple geometry or text attributes, a separate entry is added to the legend for each of these attributes.

Each entry contains a title and a style key. If statistics for a legend are turned on, the entry displays the count of map objects in parentheses next to the title. Style keys for feature classes and queries are dynamic and represent the geometry type of the feature class (point, line, area, or compound). Style keys for thematic displays, images, and text

are static and represent the object type.

Populating Metadata Tables

Providing metadata on the graphics and attribute tables is essential to documenting the validity of data sets. For instance, the SDS/FMS can be used to meet Federal Geographic Data Committee (FGDC) requirements for metadata in support of the National Spatial Data Infrastructure (NSDI). The GeoMedia GeoDatabase Builder generates and updates the tables with descriptive information on the underlying data structure and the methodology of describing/capturing the “real world” objects.

In the GeoMedia environment, there is no user-friendly tool to view metadata directly, as the main functions are built primarily to manipulate feature-attribute data. However, any table within the GeoMedia Warehouse can be queried and rows can be retrieved, including metadata. To populate the metadata tables, the user can use the functionality of Access or the data window.

SDS/FMS Implementation Scenario

The following scenario illustrates the process when planning a new project for the application of the SDS/FMS standards, starting with geographic features and attribute information. Both the GeoMedia structure and the SDS/FMS must be thoroughly understood for full compliance.

Implementation for Graphic and Attribute Data

As with any import or implementation procedure, the user should be thoroughly familiar with the software applications being used. The user should also be familiar with the data (graphic and non-graphic) that is going to be imported into the GeoMedia Warehouse

Figure 1 above describes how the SDS/FMS can be used to implement the Entity and Attribute table structure when setting up a GeoMedia project.

First, a project directory structure should be created as per the Tri-Service CADD/GIS Center (Figure 2).

Second, an empty GeoWorkspace and Access Warehouse should be created and saved within the project directory.

Third the user should now populate the newly created GeoMedia Warehouse using the GeoMedia GeoDatabase Builder. The builder will create and populate the necessary tables based on the candidate list created by the user within the Builder interface.

The SDS/FMS data structure is now established within the new GeoMedia Warehouse and can accept new feature and attribute data. This new information can be added using the GeoMedia Geometry commands. These commands add features and attribute data to GeoWorkspace and Warehouse.

Importing Features

If there are existing feature and attribute

data for the project, it has to be imported into the previously created GeoWorkspace and Warehouse using the tools provided by GeoMedia.

The data source containing the feature to be imported must be connected to the newly created SDS/FMS GeoWorkspace. This is done by using the “New Connection” command found under the “Warehouse” item at the top of the GeoMedia window or by using the “Display Design File: command under the “Tools” item.

Once the connection is made to an existing warehouse, the user can choose the “Import from Warehouse” or “Output to Feature Class” command to bring the existing features into the SDS/FMS GeoWorkspace and Warehouse.

It should be noted that any geometry imported from an outside source should be run through the GeoMedia line cleaning routines.

Importing Attribute Data

Attribute data can also be brought into the GeoMedia Warehouse by using the tools supplied by Access. Care should be taken however not to modify or affect those tables created and maintained by GeoMedia. See Figure 9.

Feature Cleanup

The user should be aware that GeoMedia does not contain line cleaner routines to clean up imported data. The user must be sure to provide clean features to the GeoMedia

GeoWorkspace and Warehouse.

GeoMedia does, however, maintain clean line work if it is placed anew within the GeoMedia Environment using the “Add Geometry” commands.

Once the features are clean, however, they are available for use in data queries, spatial queries, buffering, and topology analysis.