Database Linkages Unleashed

Using MicroStation, it is possible to establish a connection between design file elements and database records. The following is a description on how this connection is stored internally.
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For every database linkage a few pieces of information are added to an element. Contained within a database linkage are two important entries; an entity number and an mslink number stored in hexadecimal format. The entity number refers to a database table. It is the number assigned to a specific table in the mscatalog. Every table that is linked to elements in a design file must have and entry in the mscatalog. The mslink number refers to the record or row in a table. It is a unique number assigned to every row in a table that is linked to graphics. You can use the (Windows) scientific calculator to convert the hexadecimal mslink and entity number into decimal format and then use this information in a SQL statement.

 An example of a database linkage is shown in Figure 1. Two linkages are shown for records with mslink 1 and mslink 2 in the lot table.
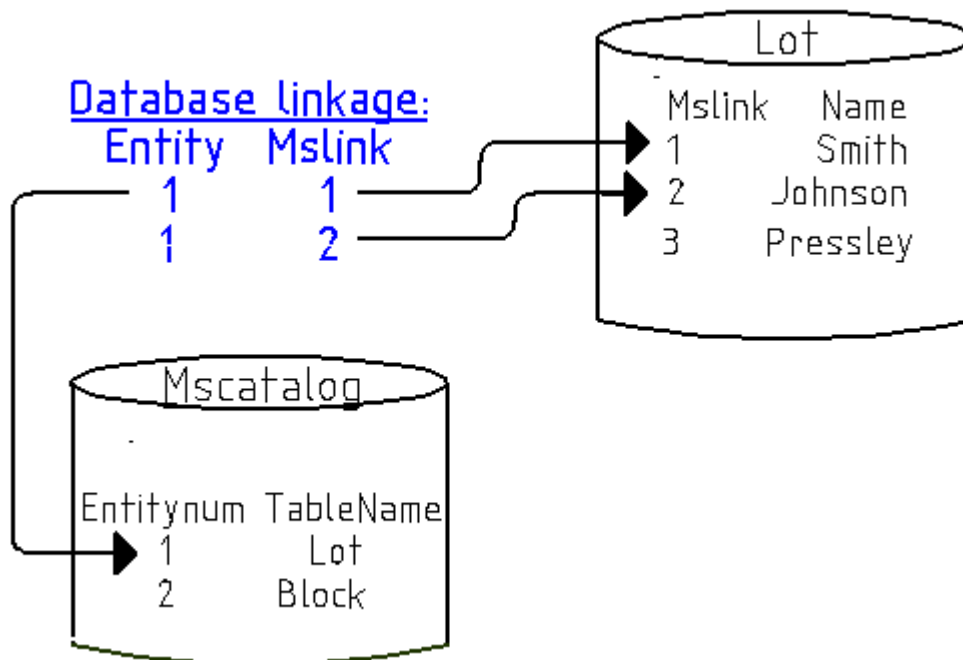

Figure 1 Entity and Mslink number

Beside an entity and mslink number, a linkage contains more information. Key-in **Analyze** or select the **Information** icon from the Primary toolbox and then select the graphic element. Go to the attributes tab (MicroStation V8) or scroll the vertical bar until you see the database linkages in the dialog box (MicroStation/J).
The linkages can be represented in an 8 *word* format (ODBC, Oracle, Informix, ...). The 8 word (of two bytes) format contains the entity number in the 4th word and the mslink in the 5th and 6th words (see Figure 2.

Using design files created in older versions of MicroStation or with some specific applications, linkages of a 4 *word* format (DMRS) may be found. The 4 word format contains the entity number in the 2nd word and the mslink in the 3rd word and high order byte of the 4th word. See Figure 3.

Eight-Word Format for Database Linkage
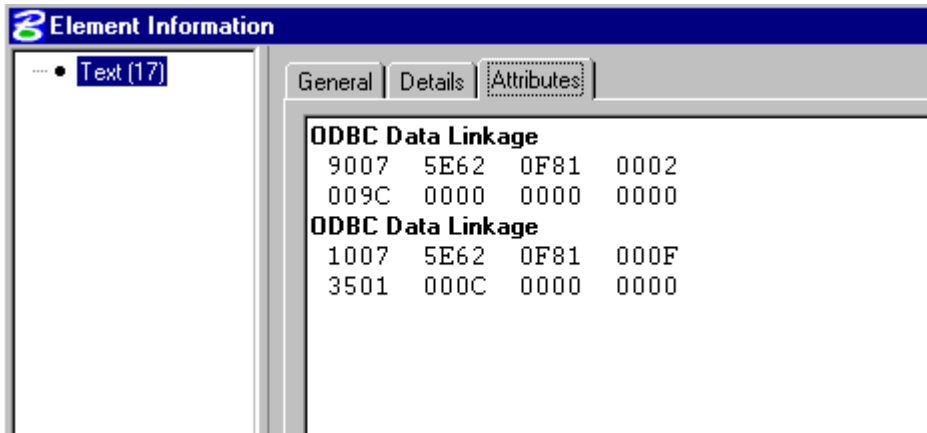
Figure 2 ODBC Data Linkage Example (using the Analyze tool of MicroStation V8)

The first word of the eight-word data linkage contains the following information:
4 bits with:

I	The linkage is informational ("read-only") or non-informational ("read/write")
R	Remote linkage ID
M	Indicates linkage has been modified
U	Linkage is a user data linkage

and the Linkage Class (4 bits) and the Type (8 bits).

In practice only the I-bit is used to determine whether the linkage is informational or not. Possible values are:

9007 - Indicates that the linkage is informational (read-only).
1007 - Indicates that the linkage is non-informational (read-write).

The second word indicates the type of database linkage (ODBC, RIS, Oracle, Informix, etc.). Predefined types are:
6091 - Oracle
1971 - dBASE (or Xbase)
3948 - Informix
3A77 - Ingres
4F58 - Sybase
5E62 - ODBC
71FB – RIS
5800 – OLEDB

The third word is a secondary id that is not used and will always be **0F81** (decimal 3969).

The fourth word is the entity number value in the mscatalog table. For example:

0002 (decimal 2) and **00012** (decimal 18) - The values of the entitynum column in the mscatalog table for the user tables.

> *select * from mscatalog where entitynum = 2*
> *select * from mscatalog where entitynum = 18*

The fifth and sixth words are used for the mslink value of the user attribute table. Swap the order of the

2

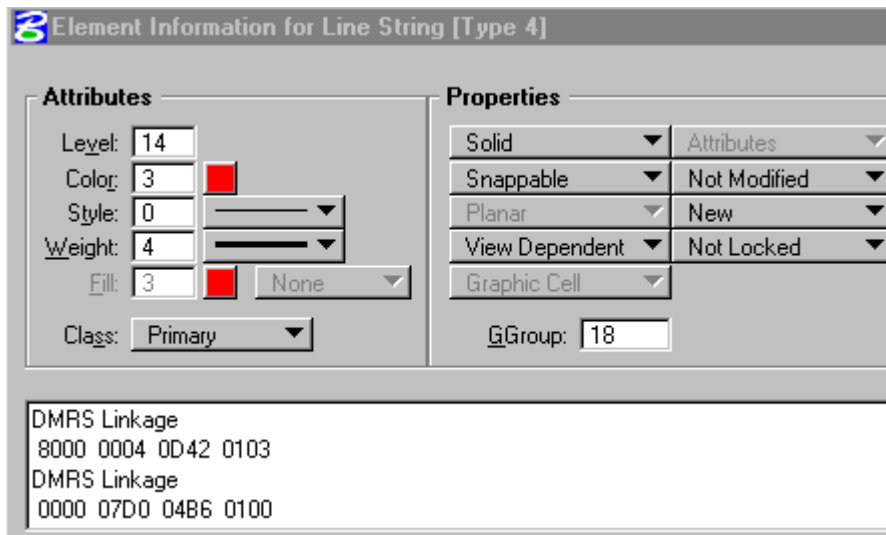fifth and sixth columns to get the hexadecimal number.
E.g.

009C   0000 - In this example 9C form the hexadecimal number for the mslink number 156 in decimal.
   *select * from <table> where mslink = 156*

3501   000C - Precede 3501 with a C to form the hexadecimal number C3501 which converts to a decimal number of 800001.
   *select * from <table> where mslink = 800001*

After converting hexadecimal numbers to decimal using a scientific calculator and combining the fifth and sixth word, the mslink number can be used to perform SQL queries on the database.

The seventh and eighth words are used for the dastype or displayable attribute number from the corresponding displayable attribute table (DAS table). The dastype is a number assigned to a specific SQL statement contained in a DAS table. Swap the order of the seventh and eighth columns to get the hexadecimal number.

Four-Word Format for Database Linkage

Figure 3 DMRS Linkage Example (using the Analyze tool of MicroStation v7 or the key-in Analyze Old in MicroStation v8)

As with the 8 word format, the first word indicates whether the linkage is *read/write* or *read* only.

8000 (32768 decimal)- Indicates that the linkage is informational.
0000 (0 decimal) - Indicates that the linkage is non- informational.

The second word represents the **entity number** value in the **mscatalog** table.

0004 (4 decimal) and **07D0** (2000 decimal) -The entitynum column has a value of 4 and 2000 in the mscatalog table.
   *select * from mscatalog where entitynum = 4*
   *select * from mscatalog where entitynum = 2000*

The third word and high order byte of the fourth word are used for mslink values in the table specified in the second word. For example:

high order byte of the fourth word

OD42   01**03** - In this example, precede OD42 with a 03 to form the hexadecimal number 30D42 which converts to a decimal number of 200002
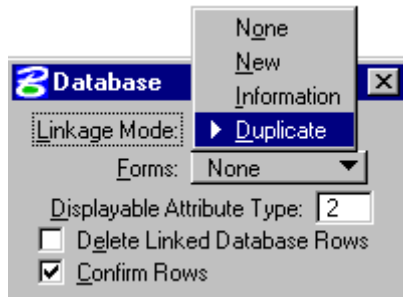   *select * from* <table> *where mslink =200002*

Range of valid mslink values

With the 8 word format 4 bytes are available for storing the mslink number: 2^{32} = 0 - 4,294,967,295
With the 4 word format 3 bytes are available for storing the mslink number: 2^{24} = 0 - 16,777,215

Creating Informational linkages

An informational linkage is created when in the Database dialog box the Linkage Mode is set to **Informational**. The dialog box is opened from MicroStation's pull-down menu by going to Settings > Database.

Figure 4 Database Setting

When an element with an informational linkage is copied, the new element will be linked to the same record in the database. A new record will be not created.
However, when an element with a non-informational linkage is copied, the Linkage Mode controls whether an existing record is used or a new record is created. When set to New, all columns from the record linked to the original element are copied and a new Mslink is generated for the new element.

When an element with an informational linkage is deleted, the referred database record will never be deleted.
When the database linkage is non-informational (read-write), the option "Delete Linked Database Rows" defines whether the referred database record is deleted.

Controlling the Database Linkage Type

The MicroStation and GeoGraphics database tools supports a number of database linkage types. The linkage type identifies what database server was used to generate the linkages. The linkage type for newly created linkages is controlled by the **MS_LINKTYPE** environment variable. This variable is set in the <database>.*cfg* . The files are located in the *Program Files/Bentley\Program\MicroStation\config\database* directory. An example of this variable setting is:

      MS_LINKTYPE = ORACLE
      MS_LINKTYPE > ODBC
      MS_LINKTYPE > OLEDB
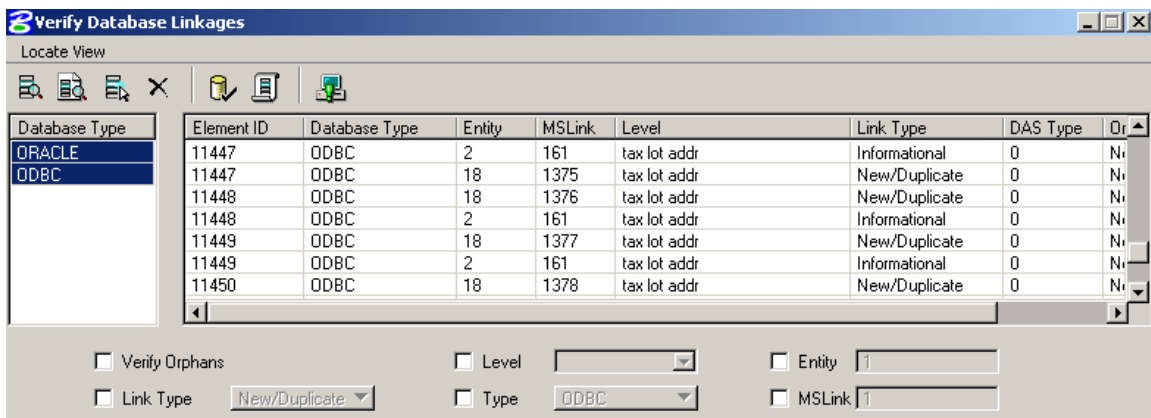   MS_LINKTYPE > DMRS
      MS_LINKTYPE > XBASE

MS_LINKTYPE > IX
MS_LINKTYPE > RIS

When copying elements with 4 word DMRS linkages a eight words linkage will be created (assuming the current linkage type is not DMRS).

Verifying Linkages

With the Verify Database Linkages tool (**Settings > Datebase > Very Linkages** or **Mdl Load DbCheck)** a review can be made of the database linkages of elements. It includes the possibility to verify orphan linkages, detach or modify the linkages and the level of the selected elements. Selected elements can also be located. More details can be found in the MicroStation Users Guide.
This tool is available since MicroStation v8.5.

Tools on DeveloperWare

In the DeveloperWare section of Select Services Online (http://selectservices.bentley.com/index.htm) several (MDL and Basic) examples are available to reformat a database linkage.

Chgent.bas   Changes the entity number of a database linkage of an element.
CgDbLn.ma and Chgelnk.bas   Changes the type of database linkage of existing graphic elements.
Infolink.bas   Sets the database linkage type to non-informational.
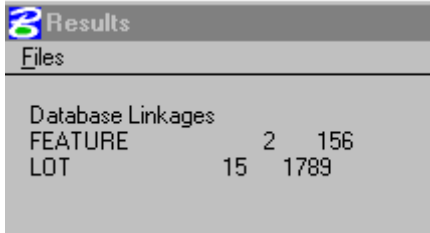
For GeoGraphics users

For those who are using GeoGraphics, some additional tools are available for working with attached database linkages. They are:

[Fence] Lock Attributes and **[Fence] Unlock Attributes** Key-ins that are available when a project has been opened in the GeoGraphics Project Setup. Linkages are changed from informational and non-informational.
[Fence] Convert LinkType Key-in that changes the linkage type of all linkages of an element. A linkage that refers to non-existing records is not changed. Note: Fixed in GG v8.1.1. The new linkage type is defined by the environment variable MS_LINKTYPE (check the category Database in the User Configuration). It can also be used to convert a 4 word DMRS linkage to an 8 word Oracle linkage.

List Attributes A key-in that shows the linkage information entity and mslink number (Figure 5).
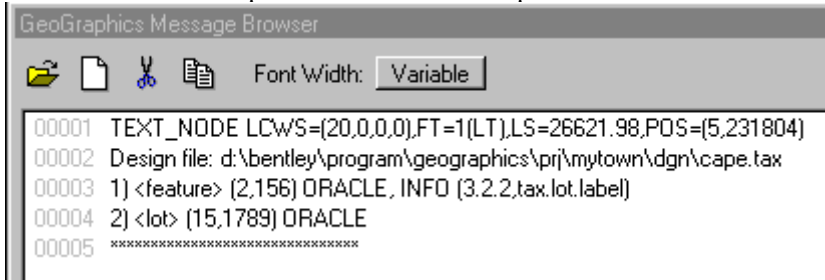
Figure 5 Results of the command List Attribute

GeoScripts CheckDB Verify whether a record still refers to an existing element. For using this tool, the used map should have been registered in the Map Manager with a valid extension and Mapid and the records that are linked with elements in a maps should have a populated Mapid column..

GeoScripts Show_dblinks A key-in shows information about the database linkages of an element, available with GeoGraphics. With GG v7.1 the product GeoSELECTools needs to be installed (Figure 6).

Figure 6 Results of the command GeoScripts Show_dblinks

Note that the MicroStation GeoGraphics features are always informational. When you copy a featurized element, the record in the feature table is not copied.

The macro **Infolink.bas** checks whether feature linkages are informational and sets them to informational if needed.
The macro **FeaRpt.bas** creates a report of all features in a DGN file and also reports whether the Feature linkage is Informational.

Converting hexadecimal numbers to decimal

A calculator can be opened from the Windows menu bar by going to Program > Accessories.
You can use one of the electronic calculators in scientific mode to convert hexadecimal to decimal. Select **Hex** and key in the hexadecimal number. Then select **Dec** to convert the hexadecimal number to decimal.
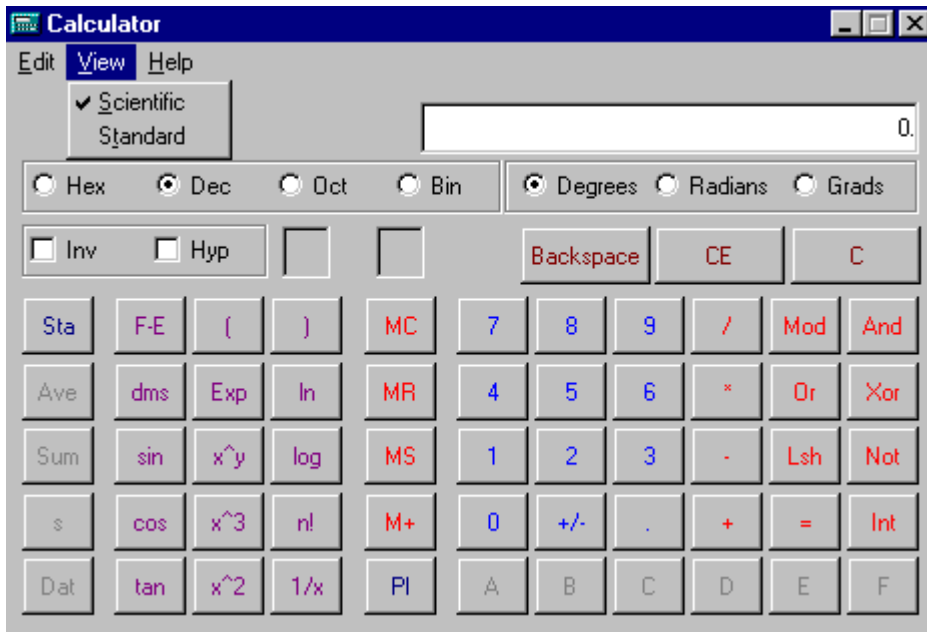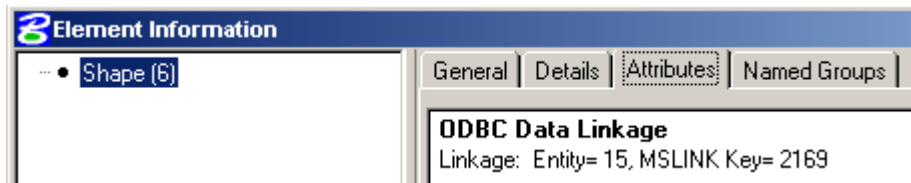
Figure 7 Scientific Calculator

Element Information dialog in MS v8.5

With the Analyze icon the Element Information dialog is opened. In the Attribute tab the database linkages (the entity and mslink number) are displayed:

When the environment variable MS_SESSION_DEBUG has been set, the hexadecimal words are displayed with the Analyze tool: