

Geographic information — Processing — Query and update: spatial aspects

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National foreword

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Foreword

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1 Scope

This CEN Report describes the characteristics of query and update of geographic information. It identifies the spatial operators that a standard data manipulation language uses to process geographic information, and identifies the minimum characteristics of the server and client.

2 References

This CEN Report incorporates by dated or undated reference, provisions from other publications. Where appropriate, these references are cited in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this CEN Report only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ENV 12009:1997, *Geographic Information - Reference Model*.

ENV 12160:1997, *Geographic Information - Data Description – Geometry*.

3 Definitions

For the purposes of this CEN Report the following definitions apply :

NOTE Definitions for other terms used in this document can be found in the appropriate standards, referenced in clause 2.

3.1

archive, noun

Collection of data, holding superseded or rarely accessed data

3.2

archive, verb

Transfer data to an archive

3.3

client database

Database that requires information from another database

3.4

Geographic dataset

Identifiable collection of geographic data

[ENV 12656]

3.5

function

Process that performs a single operation and can return values

3.6

geometric primitive

Description, partial or total, of the spatial aspects of an object by means of coordinates and mathematical functions

[ENV 12160]

3.7

metadata

Data about a geographic dataset or geographic datasets

[ENV 12657]

3.8

predicate

Function that returns only true or false as values

3.9

query

Operation to select and retrieve data from a database without changing its contents

3.10

server database

Database that provides information to another database

3.11

spatial data manipulation language

Data manipulation language with additional operators suitable spatial data

3.12

topological primitive

Description, partial or total, of the topological aspects of an object

[ENV 12160]

3.13

transformation

Mathematical conversion from one coordinate system to another

3.14

data transfer

Movement of data between systems, which may comprise file transfer or message handling

[ENV 12658]

3.15

update

Operation to amend or replace data in a dataset

3.16

update set

Dataset that contains updated data to update data in the database

3.17

update set number

Sequential number and date of a transfer of a updated dataset

4 Abbreviations

ADT	Abstract Data Type
DML	Data Manipulation Language
GIS	Geographical Information System(s)
MER	Minimum Enclosing Rectangle

5 Characteristics of a spatial data manipulation language

5.1 General

This clause describes the characteristics of a spatial data manipulation language (5.2-5.4) and the characteristics that the server and the client can agree to, in order to ensure that the integrity of the client's database is maintained (5.5).

Both query and update involve the retrieval of selected information from a dataset. The fundamental difference between a query and an update is that the update changes the state of a dataset, whereas a query makes no changes.

5.2 Predicates for query

5.2.1 General

A query is an operation to select and retrieve information from a dataset without changing its contents. The operation requires data to be processed before the query is satisfied. A query includes the creation of temporary data (such as a buffer or a minimum enclosing rectangle) but the only permissible change to the dataset during the operation is to 'lock' data affected by the query until the operation is complete.

A query consists of up to five stages :

- identifying the structure and definitions of the data on the server database ;
- forming the query in terms of that data structure and definitions ;
- identifying the subset(s) of data and metadata that will provide an answer to the query ;
- processing the data to answer the query ;
- reporting the response.

The query requires information about :

- a specific primitive ;
- primitives that satisfy specific attribute values and explicit or implicit relationships ;
- any aspect of the data definition, such as structure, relationships, attributes.

Queries comprises predicates, functions or both.

Annex A gives detailed descriptions and annex B gives examples of application.

5.2.2 Predicates

A predicate tests a condition and returns a value of true or false. Table 1 defines predicates that can be used to query a dataset. For spatial data, predicates apply to geometric primitives, topological primitives or both. Clause A.1 presents each predicate in a common template. A matrix specifies how the predicate applies to each type of primitive where appropriate.

Table 1 - Predicates for query

Name	Definition
Adjacent to	Identifies whether a face has one or more edges in common with another primitive
At	Identifies whether an object is at a specified location
At end of	Identifies whether a node is at the end of a specified edge
At start of	Identifies whether a node is at the start of a specified edge
Connected to	Identifies whether an edge shares a common node with another edge
Contains (see Belongs)	Identifies whether one primitive includes another primitive
Crosses	Identifies whether a curve passes through another geometric primitive without sharing a coordinate
Encloses (see Within)	Identifies whether the extent of one primitive wholly include the extent of another primitive
Belongs (see Contains)	Identifies whether one primitive is included in another primitive
Left of (see Left of)	Identifies whether a topological primitive of type face is to the left of a topological primitive of type edge
Meets	Identifies whether a geometric primitive has a single coordinate in common with another geometric primitive
Overlaps	Identifies whether one primitive partially includes another primitive
Right of (see Left of)	Identifies whether a topological primitive of type face is to the right of a topological primitive of type edge
Within (see Encloses)	Identifies whether the extent of one primitive wholly include the extent of another primitive

5.3 Functions for query

5.3.1 General

Table 2 defines functions that can be used to query a dataset. These apply to geometric primitives, topological primitives or both. Clause A.2 presents each function in a common template. A matrix specifies how the function applies to each type of primitive where appropriate.

The functions 'buffer', 'minimum enclosing rectangle' and 'overlap' introduce temporary geometry but are classified as query since the geometry does not alter the state of the dataset.

5.3.2 Functions

Table 2 lists the functions for query.

Table 2 - Functions for query

Name	Definitions
Area	Returns the value of the surface of a given geometric primitive
Bearing	Returns the value of the clockwise angle of point 2 from point 1 with respect to the zero azimuth of the coordinate system
Buffer	Creates an expanded surface with a specified width around a given primitive
Distance	Returns the measure of shortest path between two given geometric primitives
Length	Returns the measure of the path along a given primitive of type curve
Minimum Enclosing Rectangle	Returns the minimum rectangle enclosing a primitive or set of primitives with the sides of the rectangle parallel to the coordinate axes
Intersect	Returns a primitive that forms the intersection of two primitives
Perimeter	Returns the measure of the length of the outer boundary
Granularity	Returns the smallest distance between any two coordinates of a given geometric primitive or set of geometric primitives

5.4 Functions for update

5.4.1 General

Table 3 defines functions that can be used to update a dataset. These apply to geometric primitives, topological primitives or both. Clause A.3 presents each function in a common template. A matrix specifies how the function applies to each type of primitive where appropriate.

Update functions cause the state of the dataset to be changed. Insert and delete functions are handled by existing DML functions. The insertion or deletion of topologic or geometric primitives can require changes to other primitives to ensure that the topology and geometry of the dataset is maintained.

5.4.2 Functions

Table 3 lists the functions for update.

Table 3 - Functions for update

Name	Definition
Centroid	Creates a unique point within an surface
Filter	Removes intermediate points from a given geometric primitive
Merge	Merges any number of contiguous primitives of the same type to form a single primitive of the same type
Split	Splits a primitive at its intersection with other primitives to form two or more different primitives of the same type
Transform	Transforms a set of geometric primitive or set of geometric primitives between coordinate systems through a given transformation

5.5 Management of update

5.5.1 General

There are many different ways in which a client database can be supplied with update. At one extreme, the information can be supplied in response to an ad hoc enquiry to an unrelated, remote database with a different application schema. At the other extreme the server and client databases may have identical application schemas and update of the client database is automatically triggered by any change in the server database. The different transaction types are analysed in annex C.

This clause classifies the different types of update and identifies the minimum characteristics that the server and client can agree to.

5.5.2 Update set

NOTE An update set can correspond to a version of the database, a replacement subset for part of the database, or one or more primitives each with a change history.

The specification for the content and structure of this information can be agreed by the server and client. The server ensures that the update set conforms to the agreed specification. The client ensures that the integration of the update set with the client database does not compromise its integrity. Objects within the update set can be selected from the server database by attribute values defined in the server's application schema.

A change-only update set contains only those objects that have been modified or superseded by the server since an event or time agreed by the client and server and new objects that have been created.

A full update set contains all current objects. It can contain other objects.

5.5.3 Types of update

If the client's and the server's application schema are compatible then the transfer can be either a change-only update set or a full update set. If they are not compatible then the transfer is a full update set. The main types of update are :

- one-way transfer - initiated by an event (e.g. quantity of change) or date. The server transfers an update set to the client ;
- two-way transfer - initiated by a client request for an update of a subset by the server. The client transfers a subset to the server. The server modifies the subset and transfers an update set to the client ;
- two-way transfer - initiated by a client request for an update set owned by the server when the server's application schema is known to the client. The client transfers a query statement to the server. The server transfers an update set to the client ;
- four-way transfer - initiated by a client request for an update set owned by the server when the server's application schema is not known to the client. The client transfers a query statement requesting information on the application schema and metadata of the server. The server transfers metadata, elements of the data dictionary and the application schema, but no geographic data. The client interprets the metadata and transfers a query statement requesting data. The server transfers an update set to the client.

5.5.4 Minimum requirements for update

The client and server agree :

- the event or time at which update set will be transferred ;
- the definition of and values for object attributes that identify the types and time of change ;
- the definition of and values for metadata attributes that identify the relationship of the update set to other update sets ;
- the relationship between new and superseded objects;
- the existence of a unique identifier for each object if change-only update of the geographic data is wanted in the future.

In addition, for change-only update the client and server agree the rules for changing the identifiers of objects when they are merged or split.

5.5.5 Update set numbering

Update set numbering provides a record of the transfer of a series of update sets. It serves two main purposes : confirmation of the sequential number and date of the latest transfer of a replacement dataset, and an audit trail of previous transfers.

NOTE The latter can be essential if the latest update set contains change information for primitives supplied in the preceding update set.

Update set numbering is applied to a superseded dataset when it is removed from the client/server database and either deleted or archived.

During the archive process the date of archiving, an attribute to indicate that the dataset has been superseded, and the update set number is recorded for the replaced dataset. The replacement date and update set number is recorded for the replacement dataset.

5.5.6 Managing the update of primitives

Upon each update , the updated primitive is coded with two values, an update status and an update date. Where all update sets are maintained, primitives can have many sets of these attributes if they have undergone many changes.

The update status reflects the events that affect the state of a primitive. The value of this attribute are set in accordance with a pre-defined state transition or entity life analysis.

The update date is the date at which the update status changed to its current value.

Tables 4 to 6 define the effect of events on different primitives. Each event causes a change to the values of the update status and update date of a primitive according to the rules set out in the state transition or entity life analysis for the application.

Table 4 - Events that alter Point or Node primitives

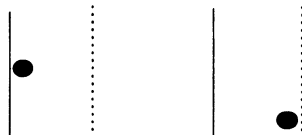
Event		Result
Description changes		Attribute updated Same primitive
Position changes		Primitive deleted New primitive created

Table 5 - Events that alter Curve or Edge primitives

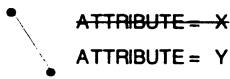
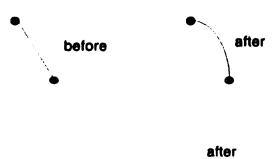
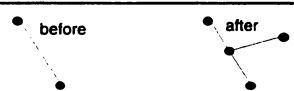
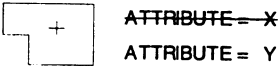
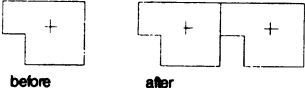
Event		Result
Description changes		Attribute updated Same primitive
Position changes		Primitive deleted New primitive created
Relationship changes curve's morphology changed		Primitive deleted New primitives created (in the diagram, three primitives are created)
Relationship changes curve's morphology unchanged		Original primitive retained New primitive created

Table 6 - Events that alter Area or Face primitives

Event		Result
Description changes		Attribute updated Same primitive
Position changes		Primitive deleted New primitive created
Relationship changes : primitive's morphology changed, primitive deleted or changed		Primitive deleted or superseded New primitives created (in the diagram, two primitives are created)
Relationship changes : primitive's morphology unchanged		Original primitive retained New primitive created