National Vector Data
Change Management

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Natural Resources Canada
Geomatics Canada
Centre for Topographic Information
2144, King Street West, Suite 010
Sherbrooke (Quebec) Canada
J1J 2E8

GeoGratis Client Services
Telephone: +01-819-564-4857
1-800-661-2638 (Canada and USA)
Fax: +01-819-564-5698
E-mail: geoginfo@NRCan.gc.ca
URL : www.GeoGratis.gc.ca

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REVISION HISTORY

Date	Edition	Description
March – 2006	1.0	Original version
April – 2007	2.0	NRNv2 updates
January – 2009	3.0	Updates to accommodate a broader range of themes

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ABBREVIATIONS

AL	Aboriginal Land
ID	Identifier
NID	National Identifier
NHN	National Hydrographic Network
NRCan	Natural Resources Canada
NRN	National Road Network
NVD	National Vector Data
UUID	Universal Unique Identifiers

TERMS AND DEFINITIONS

National Vector Data

Several layers of vector data, referred to as National Vector Data (NVD), will share the same specification. The National Road Network (NRN) and National Hydrographic Network (NHN) are examples of NVD.

1 Overview

The objective is to update the NVD data on a regular basis as soon as mechanisms have been established between NVD's partners. One of the mechanisms is establishing change management principles. Two basic concepts are needed: identification rules and definition / classification of change.

National Vector Data – Identification Rules [1] defines the identification mechanism used as precisely as possible. Objects are information technology models of real world phenomena. If the real world phenomenon of interest is considered to be a geographic entity, then the term feature is typically used to describe the model of the entity. In other words, a feature is a type of object.

Many projects (or the literature) deal with update management and time modelling [1, 2, 3]. The model herein was developed in cooperation with the Centre for Research in Geomatics (CRG) at Laval University [4] and has been defined to be consistent with the terminology used by the Open Geospatial Consortium.

It characterizes the evolution of features in order to identify any changes that may have occurred between two versions of a feature, whether successive or not. The discrepancies observed between two versions are referred to as the differential[2]. In the context of the NVD, the purpose of update management is to

1 This document can be found at: http://www.geobase.ca

2 The differential corresponds to the set of differences observed between two landmarks of the territory [4].

facilitate synchronization of databases from producing partners and customers based on current national views (see Figure 1 : Evolution of the database in time).

The update management process must also make it possible to reconstitute the dataset as it was on a previous date. Depending upon the particular change management strategy used (as discussed below), the process may allow for time travel through the dataset, such that the state of individual features in the dataset can be ascertained at arbitrary times.

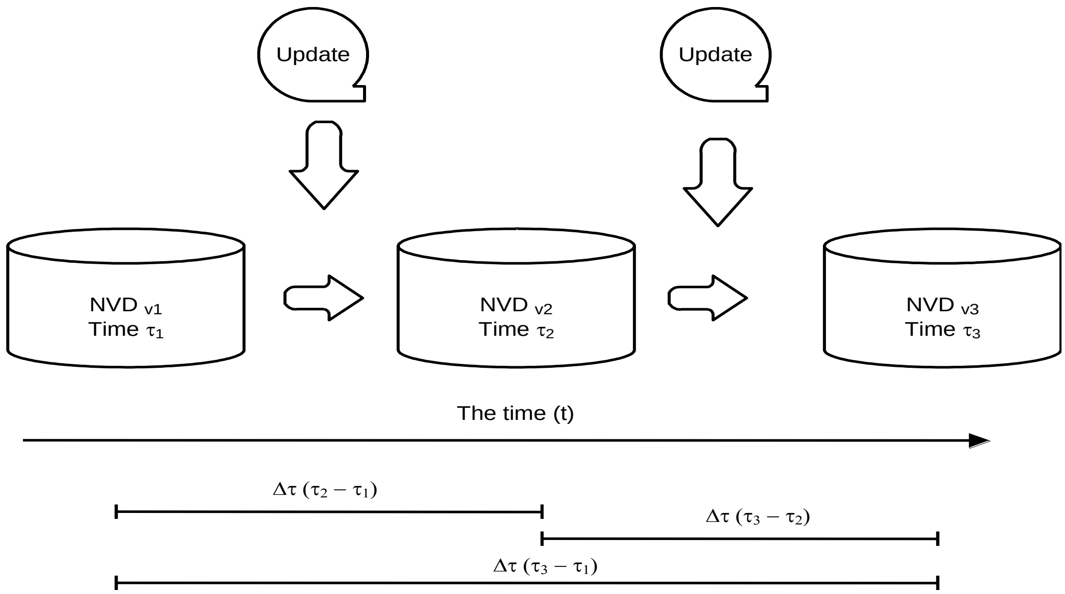


Figure 1 : Evolution of the database in time

2 Object Life Cycle

The NVD is intended to be the best representation of the data in question that is broadly available across Canada. Changes occur when a more up-to-date or accurate representation becomes available.

The effects on NVD data will therefore be established based on the preceding representation. Data life cycle is therefore limited by two events. The cycle always begins with an "addition" (assignment of a new NID) and ends with "retirement." Between these two events, geometric or descriptive modification or confirmation of the preceding state can occur, while maintaining the same NID. Data with the effects "addition," "geometric or descriptive modification," and "confirmation" are *active* (or current) features. Features with the effect "retirement" are *nonactive* (historical) data.

3 Effect Types

Various kinds of updates are recognized, based on the *effect* of the update on the dataset. (These are analogous to transaction types in the database world.) Effects can be classified as follows:

Addition (Existence)

When a new object has no geometric counterpart in the NVD, a new feature is *added*, which has a new NID.

Retirement (Existence)

When a feature no longer represents an entity, the feature is *retired*. The feature is removed from the current data while maintaining its NID.

Modification (Evolution)

A feature is said to be *modified* if one or more of its descriptive attributes or its geometric representation is changed. In this case the initial NID is preserved, as the new version will have the same NID value as the version it replaces. Two types of modification are possible.

Descriptive Modification

A descriptive modification occurs if one version of a feature is replaced by a second version with the same NID and geometry but with one or more differences in attribute values. For example, the surface of a specific road may have changed from «unpaved» to «paved».

Geometric Modification

A geometric modification occurs if one version of a feature is replaced by a second version with the same NID but with a change in the object's geometric representation.

Four types of geometric modification are currently defined within the NVD. Each has a certain level of complexity. In comparing two representations (old and new), the following change management methods are recognized:

First Method

- While comparing an old and new version of an object, if any vertex is different positionally, or if any vertex has been added or removed, the old representation of the object is retired and a new representation added. The new version has a new NID and no explicit reference to the original version is retained. This method means that ***geometric modifications are not followed,*** making time travel through the data difficult or impossible.

Second Method

- The second method of managing representation change is based on comparing the old and the new Junction locations. Two Junctions always bound a Network Linear Element. Any modification along a linear element (geometric representation) may occur between its Junctions. These are treated as a geometric modification while conserving its NID. If, for whatever reason, one of the old Junctions located at one end of the Network Linear Element has changed, then this Network Linear Element is retired and a new one added with a new NID.

Third Method

- The third method is based on topological links. If the representation of the Linear Element Junctions have maintained the same topological links (even if the Junctions have moved and the Network Linear Element geometry has been modified), then these changes are treated as a geometric modifications and the Network Linear Element and Junctions maintain their NIDs.

Fourth Method

- The fourth method is the most lenient. The geometric representation of a feature may be redefined in any way, but the feature itself is considered to continue and will retain the same NID. For example, the boundaries of an Aboriginal Land may be modified or extended. In this case the old version is replaced by the new version with the same NID.

For any given dataset, the method(s) that apply to geometric modification must be specified.

Confirmation (Evolution)

Addition, retirement and modification all pertain to change. However, an entity may have been observed again, with no changes required to the description of its geometric or attribute properties. In such a case, *confirmation* of the existing description has occurred.

4 Examples

4.1 NRN data

The following example is designed to illustrate update management for better comprehension. Figure 2 : Example of an update demonstrates the comparison between the original data and new data. In terms of geometry, a single Road Element (object 6) was added with respect to the original data. In terms of description, the type of surface of the Road Element (object 2) has changed from unpaved to paved.

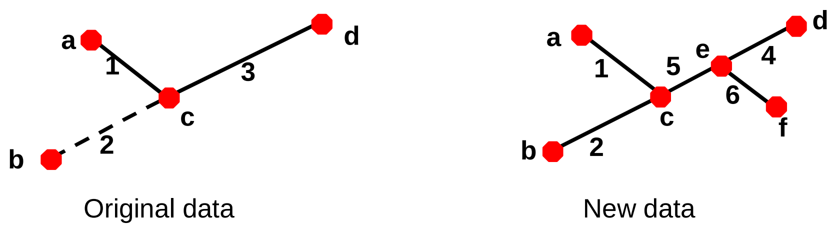


Figure 2 : Example of an update

Table 1: Updating effects shows the geometric effects observed after the update.

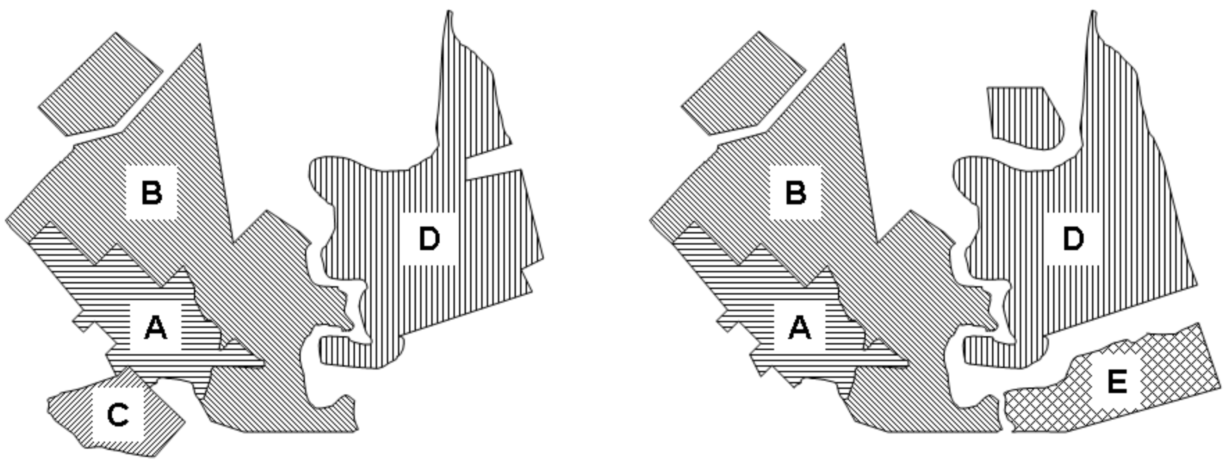
Objects	Explanation	Effects
3	No correspondence with a new object.	Retirement
4	No correspondence with an object in the original data; the arrival of object 6 changed the topological structure of the objects (and therefore the geometry).	Addition
5	No correspondence with an object in the original data; the arrival of object 6 changed the topological structure of the objects (and therefore the geometry).	Addition
6	No correspondence with an object in the original data; the feature was not represented.	Addition
e	No correspondence with an object in the original data.	Addition
f	No correspondence with an object in the original data.	Addition
2	Attribute value changed.	Description modification
1	Geometry and attributes did not change.	Confirmation
a	Geometry and attributes did not change.	Confirmation

b	Geometry and attributes did not change.	Confirmation
c	Geometry and attributes did not change.	Confirmation
d	Geometry and attributes did not change.	Confirmation

Table 1: Updating effects

4.2 Aboriginal Lands (AL) data

The following example describes change management for AL data. The AL data uses the Fourth Method to manage all changes. The example illustrates the changes that occurred between the original dataset and the new dataset. The geometry of Indian Reserve A was not altered, but its name was changed. Indian Reserve B was confirmed to exist with the same geometry and description. Indian reserve C was abandoned, lands were added to Indian Reserve D, and Indian Reserve E was created. The table below the figure explains the effects for each of the five AL objects.



Original data

New data

Figure 3: Example of AL Change Management

Table 2 shows the updating effects of descriptive and geometric modifications.

Object	Explanation	Effect
A	Attribute values changed.	Modification
B	Geometry and attributes did not change.	Confirmation
C	No correspondence with an object in the new dataset.	Retirement
D	Geometry was changed.	Modification
E	No correspondence with an object in the original	Addition

	dataset.	

Table 2: Updating effects

5 References

1 Langran, Gail. *Time in Geographic Information Systems*, Éd.Taylor & Francis, 1993, 187 p.

2 PEUQUET, Donna J. It´s About Time: A Conceptual Framework for the Representation of Temporal Dynamics in Geographic Information Systems, Annals of the Association of American Geographers, vol. 84, no 3, 1994, p. 441-461.

3 Worboys, Michael F. *A Unified Model for Spatial and Temporal Information*, The Computer Journal, Vol 37, No. 1, pp. 26-34

4 Pouliot, J, Larrivé, S., and Bédard, Y. *Typologie des mises à jour*, 2000, 11 p.