

Developing Vietnam's Cadastral Data Standards based on ISO 19100

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SUMMARY

For consistency in creating, managing, using and sharing cadastral data for land administration purpose, it is critical that cadastral data standards be available. They will serve as the basis for standardizing cadastral data and for a land information system in Vietnam in the future.

The purpose of this paper is to present the approaches taken to developing cadastral data standards for Vietnam and the key contents of the standards.

The cadastral data standards of Vietnam are developed based on international geodata standards ISO 19100, Vietnam's basic national geodata standards and reference made to developed cadastral data standards from several other countries. The contents of Vietnam's cadastral data standards include standards for cadastral data structures, standards for contents of cadastral data, standards for cadastral data coordinate reference systems, standards for cadastral data quality, standards for cadastral data presentation, standards for cadastral metadata, and standards for cadastral data exchanging – distributing.

Cadastral data structures are designed based on object oriented modeling, described with UML, with temporal data models used for storing historical data.

GML application diagrams are derived from UML diagrams, used for updating, exchanging and distributing cadastral data.

The purpose of having a unique set of cadastral data standards is for standardising cadastral data required for consistent land procedures, for a national land database and a land information system to be built, and for convenience in distributing and exchanging cadastral data for multi-users ranging from the Government, ministries, to various layers of governance and local authorities and the community.

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1. INTRODUCTION

The main purpose of this paper is to provide an overview of Vietnam's cadastral data standards, which are developed based on geo-data standards ISO 19100 (Vietnam's basic geo-data), particularly the draft versions of ISO 1952 – Land Administration Domain Model.

According to the existing technical regulations on cadastral mapping data and cadastral attribute data Vietnam, data of these two types must be in close relation. But in reality, it is not always that such relation is ensured. A common case is that attribute data is updated more often than mapping data, and as such the relation between mapping data and attribute data after some time becomes loose.

To modernize the land administration system of Vietnam, in addition to other jobs about finalizing the legal framework, procedures for land administration and land registration, an important thing to do is to finalise developing cadastral databases in the provinces.

The Land Information System (LIS) is expected to contribute to improving the land administration capacity in Vietnam. With LIS, land information will be updated and provided to support decision making in land administration, land administration public services, and to meet the land information need by other government agencies and by the whole economy. However, it has been difficult for land information systems to be developed due to the fact that Vietnam's technical regulations are still lagging behind the development of GIS technology in general and LIS technology in particular. As such, Ministry of Natural Resources and Environment of Vietnam (MoNRE) has decided to carry out a project to develop cadastral data standards, which are expected to be used as a unique tool for developing cadastral databases as well for promoting faster and in a sustainable way the development of land information systems in the provinces of Vietnam.

For such critical purpose, cadastral data standards have been developed based on conceptual models and ISO 19100 (Vietnam's geodata standards), particularly the conceptual models in ISO 19152 as well the existing legal framework of Vietnam on land administration.

2. BACKGROUND

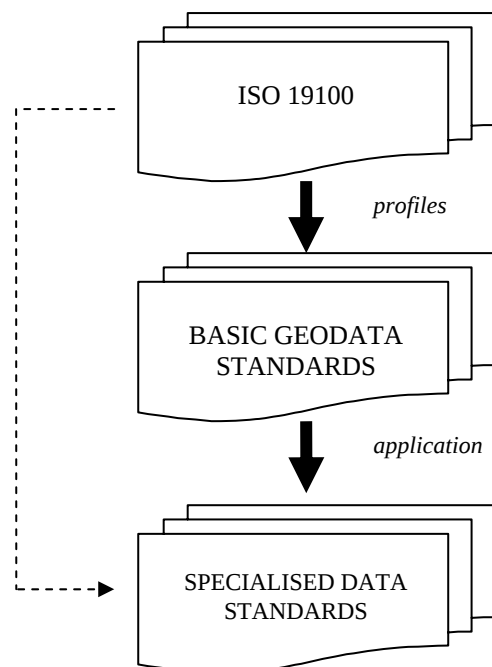
2.1 Vietnam's basic geodata standards

These basic geodata standards began to be developed in 2005 and were completed and issued in February 2008. These standards include 09 modules based on ISO 19100 of ISO/TC211 following ISO 19106-Profiles and therefore are compatible with ISO 19100. These modules include:

- Geodata structure model
- Conceptual spatial model
- Conceptual temporal model
- Geographic feature classification
- Coordinate reference system
- Geo-metadata
- Geodata quality
- Geodata presentation
- Encryption in geodata exchange

The national basic geodata standards are the legal and technical framework that governs the development of specialized data standards. At present, the cadastral data standards set is one of the two specialized data standards sets developed by MONRE.

The general model about applying ISO 19100 and Vietnam's basic geodata standards for developing specialized data standards is depicted below:



While developing the cadastral data standards, ISO 19103, ISO 19107, ISO 19108, ISO 19109, ISO 19110, ISO 19111, ISO 19113, ISO 19114, ISO 19118, ISO 19136 have been indirectly applied by using Vietnam's basic geodata standards (profiles of the above mentioned ISO). As ISO 19131, ISO 19138, ISO 19139, ISO 19152 are not currently applied in Vietnam's geodata standards, they have therefore been directly referred to during the development of the cadastral data standards.

2.2 Existing technical regulations on cadastral data in Vietnam

According to the existing technical regulations on cadastral mapping data and cadastral attribute data Vietnam, data of these two types must be in close relation. But in reality, it is not always that such relation is ensured. A common case is that attribute data is updated more often than mapping data, and as such the relation between mapping data and attribute data after some time becomes loose.

2.2.1 Cadastral mapping

Existing technical regulations on cadastral mapping in Vietnam include:

- Cadastral mapping regulation that governs contents of cadastral maps, thematic basis, accuracy requirement, classification layers of DGN format CAD features, and practical requirements and methods to be used for cadastral surveying and mapping;
- Set of mapping symbols: governing presentation of cadastral map contents.

Cadastral map contents include such features as parcel boundary, house outline, socio-economic points, hydrological features, transport features, topographic features.

At present, both analogue cadastral maps and digital cadastral maps are stored in CAD MicroStation DGN format for the purpose of land administration.

2.2.2 Cadastral attribute data

Cadastral attribute data include the following categories:

- Land parcel
- Land user
- Land administrator
- Shared and own land use
- Land use purpose
- Land use history
- Land use temporal term
- Financial obligation
- Land use restriction
- Land price

- Properties associated with land
- Land use certificate
- Land change

Regulations for such information are currently guidelines as to how entries are made in cadastral records such as land index book, cadastral book, LUC issuance book, land change and LUC book, therefore the regulations are more about the content of the information, not data structure model.

2.3 Necessity of cadastral data standards

By the time the cadastral data standards were developed, the regulations on cadastral data in Vietnam had only been about mapping contents and presentation; the regulations on cadastral data did touch upon data categorization but more about providing guidelines for recording and describing the data for cadastral records; they are not real technical regulations on cadastral databases. Therefore, the provinces have met with difficulties in developing cadastral databases. As those regulations focus on the contents of data and presentation of the data but not on a cadastral data structure model, there have been inconsistencies among databases of the provinces; designing of cadastral databases has mainly been to ensure storing sufficient data for presentation on maps or in various cadastral records.

The purpose of developing cadastral data standards is:

- To have a unique model for cadastral data structure and contents
- To have a unique format for data exchange for the purpose of updating and distributing cadastral data
- To improve the quality of cadastral data

It is very important to have a unique model for cadastral data structure and contents because the existing cadastral data regulations only govern traditional data contents: layers of mapping objects, cadastral attribute data, analog record forms, etc., therefore inconsistencies have been caused when such regulations are used to develop cadastral databases by the provinces.

The existing regulations on data exchange for updating and distributing cadastral data are currently about distributing cadastral maps in MicroStation DGN format, or extracting parcel maps from cadastral maps, or analog forms for data distribution.

The existing regulations have made it difficult for developing cadastral databases using spatial database technology as well as exchanging cadastral data; they have also restricted LIS applications.

3. CADASTRAL DATA STANDARDS

3.1 Cadastral Feature Catalogue

Cadastral feature catalogue is developed following the standards for geographical feature catalogue – Vietnam’s basic geodata standards (based on ISO 19110). The features defined in the catalogue include:

- Spatial features
- Attribute features

The main characteristics of features defined in cadastral feature catalogue include:

- Each feature has a unique identifier developed in conformity to uuid (Universally Unique Identifiers)
- Each feature has temporal attributes: beginTime and endTime

Using uuid helps maintain the relation between features in the cadastral database and facilitate updating/synchronising cadastral databases.

The beginTime and endTime attributes are used for features that have different temporal versions, facilitating their organization in the cadastral database and allowing for retrieving historical data at any point of the past.

Uuid is used not only for all cadastral features (spatial and attribute) but also other features, such as:

- Parcel identifier
- Real estate identifier

The parcel identifier consists of administration code, cadastral sheet map code, and parcel number in sheet.

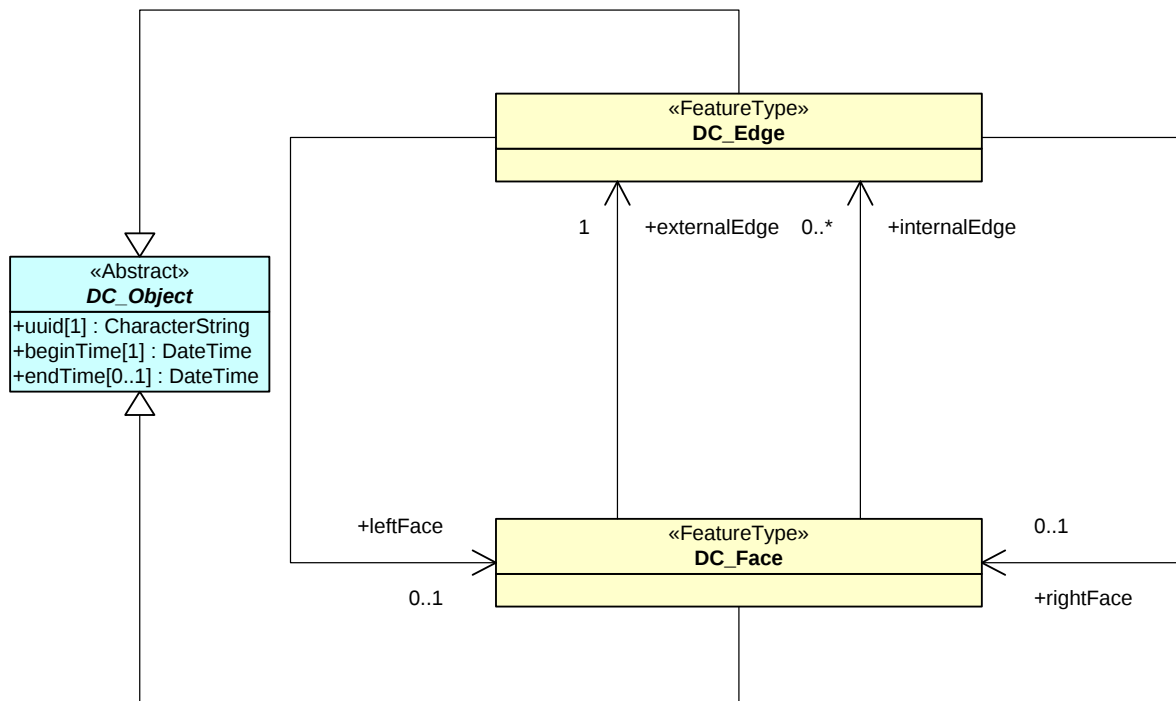
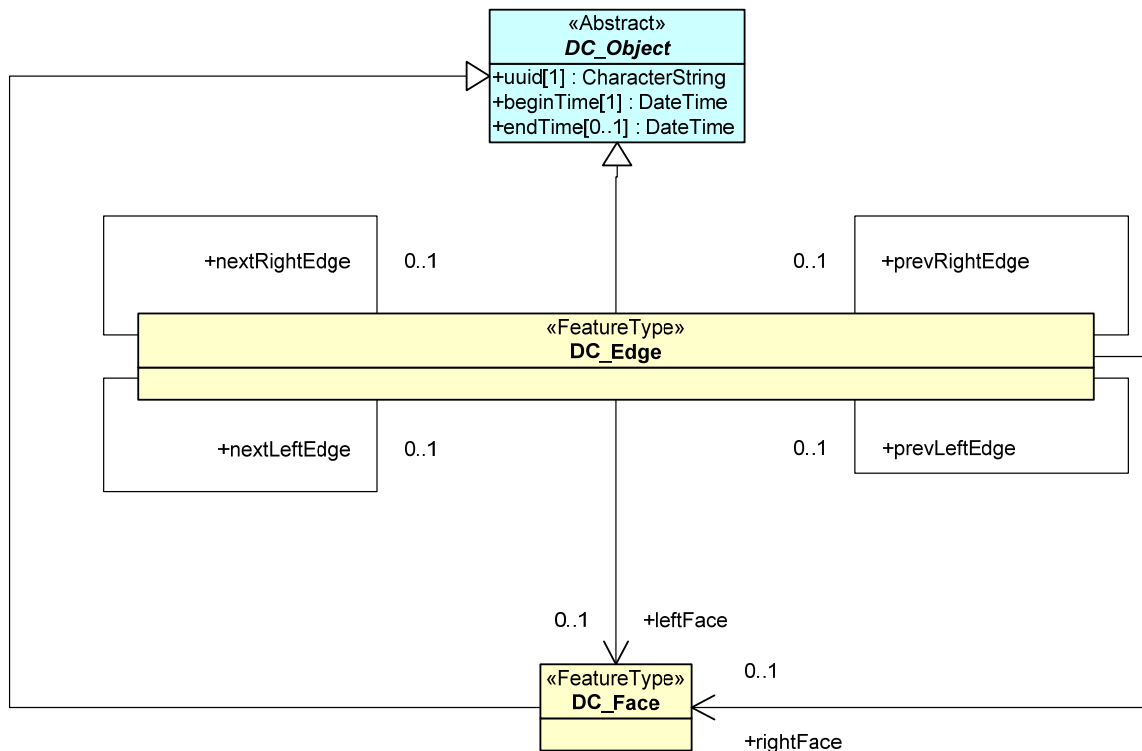
3.2 Cadastral Application Schema

3.2.1 Spatial schema

The cadastral application schema includes definitions of data structure of geographical features such as parcels, houses... and non-geographical features such as persons, rights, land titles...

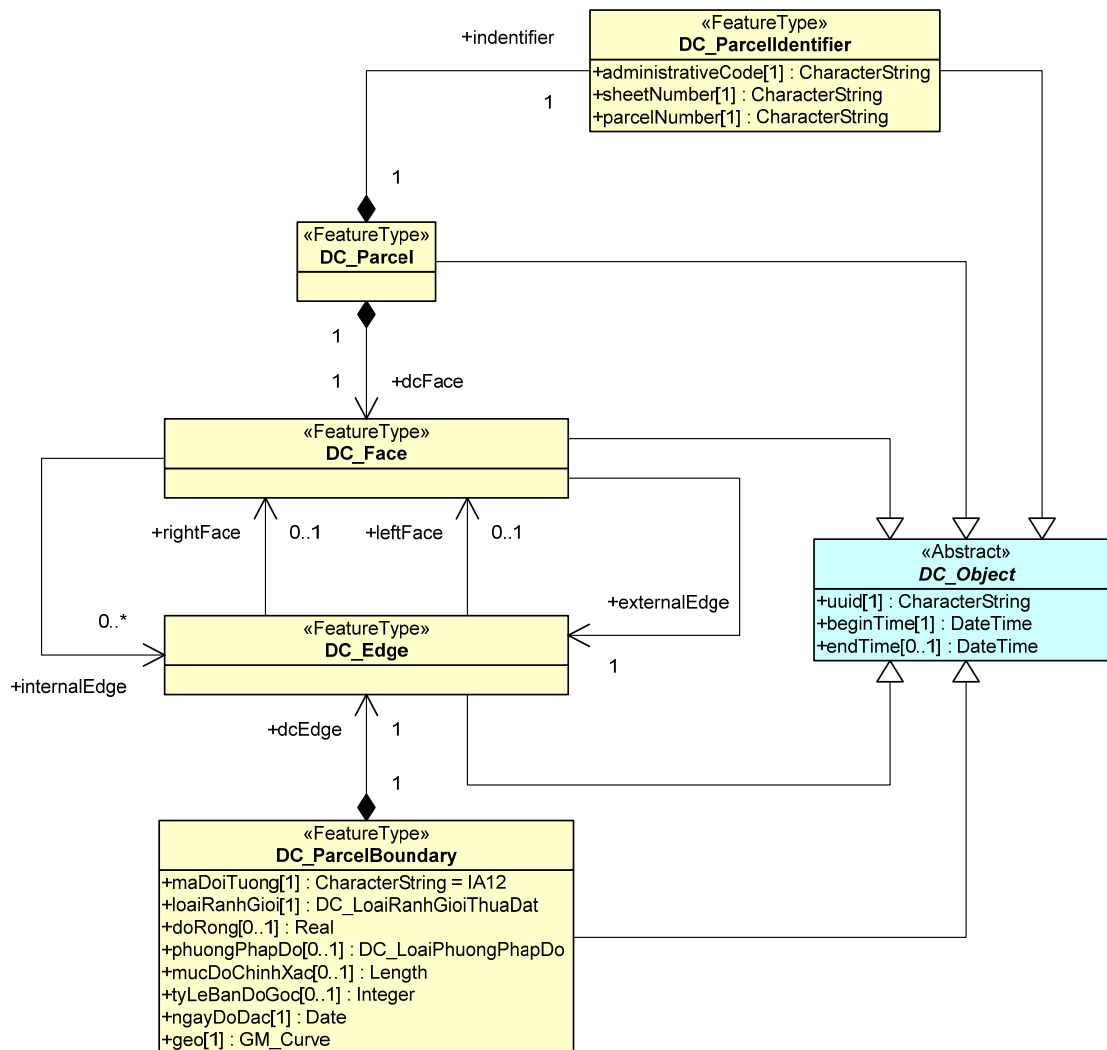
Spatial attributes of geographical features are presented using geometric primitives or topological primitives.

For land parcels, winged-edge topology is used; therefore it is necessary to expand the spatial schema of ISO 19107 to make it suitable for the topology.



The leftFace and rightFace of DC_Edge correspond to the coboundary of ISO 19107. The externalEdge and internalEdge of DC_Face correspond to the boundary of ISO 19107. And the nextRightEdge, preRightEdge, nextLeftEdge, preLeftEdge are the expansions required to support the winged-topology applied in Vietnam's cadastral data standards.

The DC_Edge, DC_Face are defined as inherited from DC_Object; therefore, when there is a change to a land parcel (dividing or merging), the boundaries or parcels that have a relation to the changed boundary or parcel will only have their topology changed.



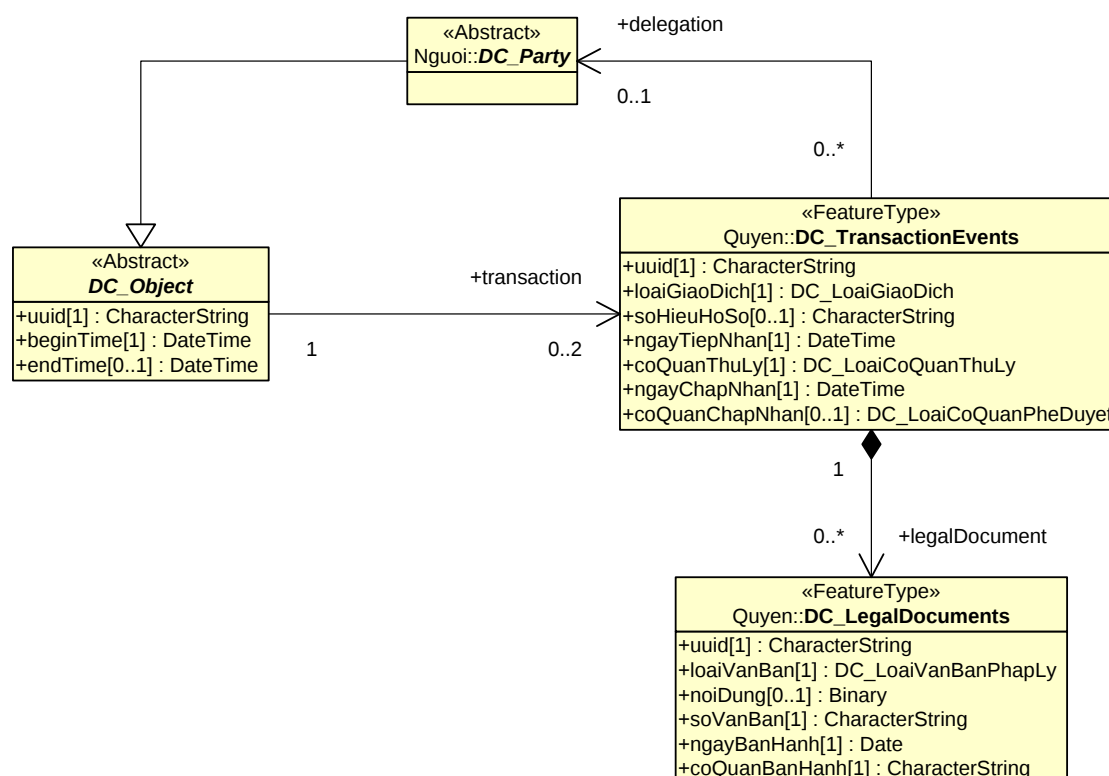
3.2.2 UML application schema

The DC_Object is developed based on the VersionedObject in ISO 19152 to facilitate management of historical data in the database. To manage different versions of one feature

instant, the DC_Object uses one uuid for each feature instant. Therefore, the features of DC_Object include:

- Uuid for each feature instant
- beginTime for each version of the feature instant
- endTime for each version of the feature instant

Each cadastral feature when changed (from one version to another or replaced to present another feature) will refer to a feature that describes transactions that changed the feature such as transactionType, transactionDate, the authorities that process the transactions,....

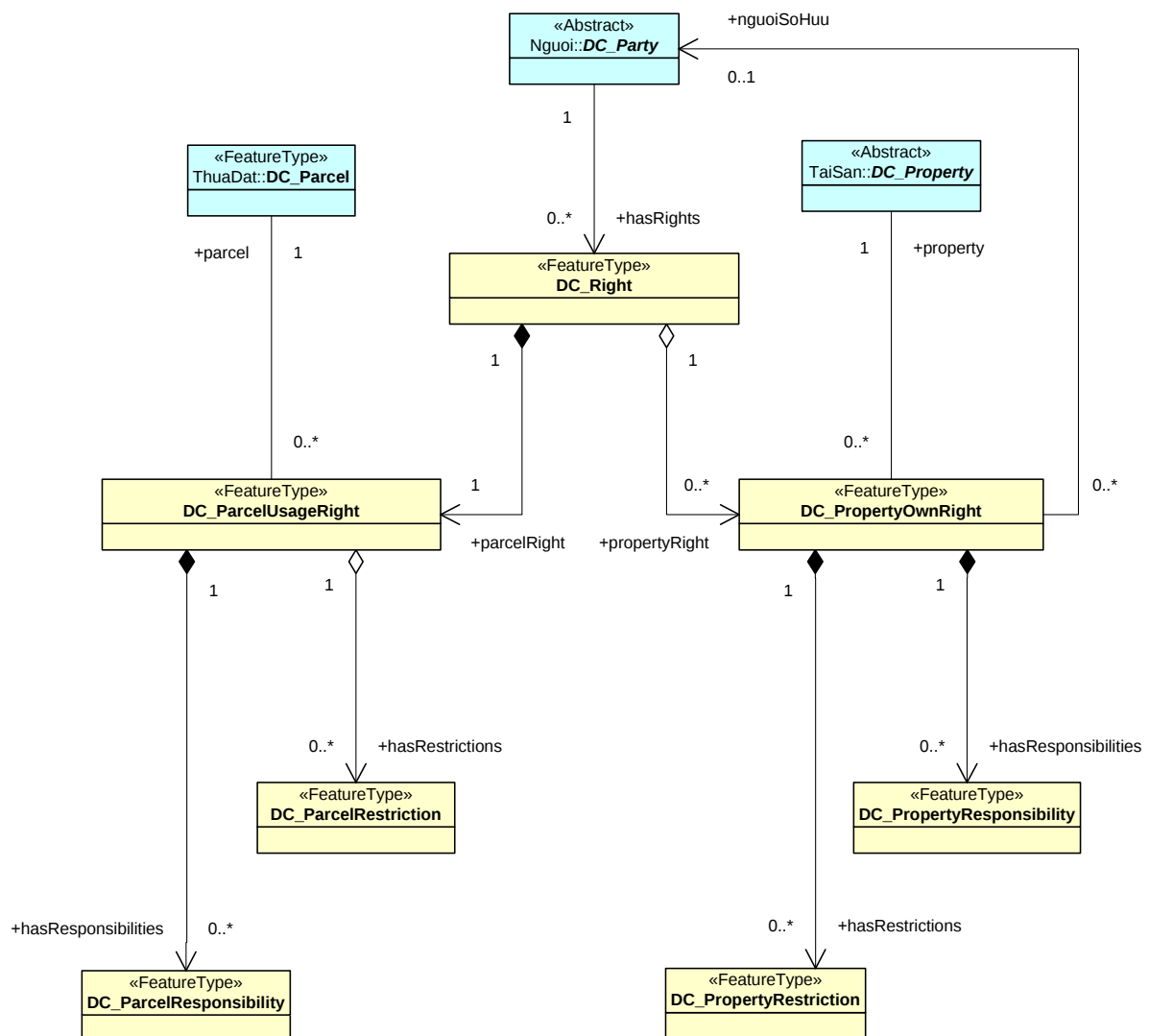


The features in the cadastral application schema are grouped into two: spatial and attribute; there is a relation between these two groups. Each feature will have sub-features to describe changes of the feature in its life cycle. The figure below depicts a feature about individuals with name that can be changed.

The land legislation of Vietnam recognizes the right to use a land parcel and the right to own the building and other properties associated to the parcel; therefore, in the cadastral data standards, the core model of ISO 19115 has been expanded. Details are as follows:

- The features that describe rights include: the feature for land use rights, and the feature for ownership of properties associated with the parcel
- Features about restrictions and obligations in relation to the features about land use rights and ownership of properties associated with the parcel
- Two features with registered rights: the land parcel (DC_Parcel) and the properties associated with land (DC_Property)
- Features inherited from DC_Property, including residential house (DC_House), forests (DC_Forest), orchards (DC_Orchard), apartments (DC_Apartment), non-residential buildings (DC_BuildngsInstallations)

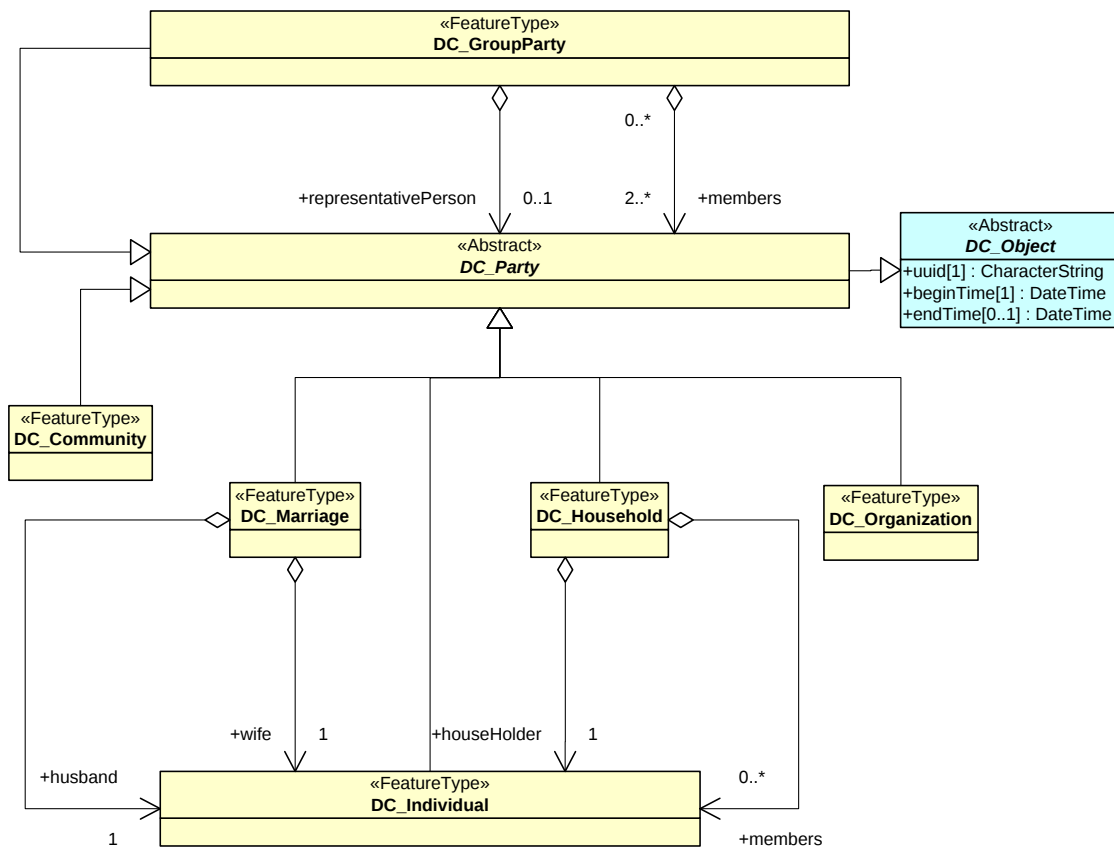
As such, one party (individual, organization, household...) may have rights to use one or more than one land parcels and have ownership of one or more than one pieces of properties attached to the land. In special cases, the right to use the land parcel may belong to one person while the ownership of the properties associated to the land may belong to another.



Relational diagram between party, land use right, right to own buildings and other properties associated with land

The conceptual schema about parties is an expanded development from the LA_Party in ISO 19152 to make it suitable for Vietnam's legislation on land users, owners of residential buildings and other properties associated with land and parties related to land transactions, including:

- Abstract feature DC_Party that describes general features of DC_Party;
- Other features inherited from DC_Party including: DC_Individual, (DC_Household, DC_Organization, DC_Community, DC_Mariage, DC_GroupParty



Parties

3.2.3 Integrating basic geodata application schema into cadastral application schema

For land administration, there is a need for both detailed cadastral data and basic geographical data. At present, Vietnam is finalising basic geodata standards. To avoid duplication and to ensure compatibility for exchanging and integrating cadastral data and basic geodata, we do not redefine the features that have been defined in the basic geodata standards but only refer to them.

The topics referred to include:

- Frontiers, administrative boundaries;
- Reference;
- Transport;
- Hydrology;
- Topography

Reference between the conceptual model of cadastral data and the conceptual model of basic geodata is an important pre-condition for developing a universal spatial data infrastructure where cadastral data is one component.

3.3 GML application schema for cadastral data

This part of the paper describes the key elements of the GML application schema for cadastral data. The GML application schema is developed primarily for two purposes:

- To provide a method, format for change update only;
- To provide a format distributing cadastral data for other applications.

3.3.1 For updating

The land administration of Vietnam is divided into 4 levels: central (General Department of Land Administration-GDLA), provincial (Department of Land Administration - DONRE), district (Section of Natural Resources and Environment - SONRE), communal (communal land administration). Basically, cadastral data is maintained and updated on three levels, i.e. provincial, district, and communal. Therefore, maintaining and updating data across these three levels is urgently necessary to make sure cadastral data is up to date and accurate. When there is a change in one database/at one level, updating is required for the other two.

GML application schema for updating cadastral data is developed based on a universal unique identifier for each feature instant.

For cadastral data, it is required that historical data is stored. Therefore, when a feature changes, new version of it will be created to update.

The type of features that update a cadastral feature to turn it into a historical feature in the database:

```
<complexType name="HistoricalFeatureType">
  <complexContent>
    <extension base="gml:AbstractFeatureType">
      <sequence>
        <element name="endTime" type="date" minOccurs="1" />
        <element name="uuid" type="string" minOccurs="1" />
        <element name="featureTypeName" type="string" minOccurs="1" />
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

Adding a feature of a changeType to define the feature as an update in case the update is required after an error has been made (changeType = Update) or adding a new instant of the feature or a new feature (changeType = New).

```

<complexType name="DC_Object">
  <complexContent>
    <extension base="gml:AbstractFeatureType">
      <sequence>
        <element name="uuid" type="string" minOccurs="1" />
        <element name="beginTime" type="date" minOccurs="1" />
        <element name="endTime" type="date" minOccurs="1" />
        <element name="changeType" minOccurs="1">
          <simpleType>
            <restriction base="string">
              <enumeration value="New" />
              <enumeration value="Update"/>
            </restriction>
          </simpleType>
        </element>
      </sequence>
    </extension>
  </complexContent>
</complexType>

```

3.3.2 GML application schema for distributing cadastral data

One feature instant has different versions; the versions have the same uuid and only differ in beginTime; therefore, the actual id of a version of the feature instant should be uuid and beginTime. On the other hand, GML only supports relation between elements via XLink and requires that each element have one unique id throughout the GML records. Therefore, it is impossible to use the GML relation mechanism for coding the relation between features in the cadastral application schema (as the actual id is uuid and beginTime).

The solution to this matter is that the GML application schema is only used to support distributing cadastral data at a specific point of time or distributing various GML records for various points of time.

4. CONCLUSION

Based on the draft standards ISO 19152 and others of ISO 19100, the draft cadastral data standards of Vietnam have been developed and are being piloted in some provinces and finalised. They are scheduled to be issued for national use in June 2010.

Using ISO 19100 and Vietnam's basic geodata standards, the development has been easier by taking on the conceptual models and standardization methods recommended by ISO 19100.

Basically, the conceptual model of cadastral data of Vietnam has been developed following the object-oriented model, which is possible for storing historical data by applying temporal data model, standardizing spatial topology data model for land parcels, suggesting a GML application schema for updating and distributing cadastral data.

The developed cadastral data standards are also possible for integrating cadastral data and basic geodata by offering a model for referencing to basic geodata features. This is the basis for developing a universal spatial data infrastructure.

The cadastral data structure model is developed following the object oriented model, described in UML and using temporal data model for storing historical data.

GML application schema is derived from the UML application schema and is used for updating, distributing cadastral data.

A unique set of cadastral data standards offers the possibility for standardising cadastral data required for consistent land procedures, for a national land database and land information system to be built, for convenience in distributing and exchanging cadastral data for multi-users ranging from the Government, ministries, to various layers of governance and local authorities and the community.

By using modern approaches and following the international trends in this regard, the cadastral data standards of Vietnam are being highly ranked in both theoretical and practical terms as compared with regional countries.

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