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UCML - CADASTRAL EXCHANGE FILES MURKUP LANGUAGE

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Formulation of the problem

Land cadastre has cpecial plase within other cadastres systems. Land cadastre is basis for other cadastres thus it is the main source of spatioal data. In particular, the land cadastre is the basis for conducting [4]

- inventory of water resources;;
- inventory of natural plant resources;
- inventory of animal resourcesy;
- inventory of animal resources;
- cadastre of mineral resources, minerals of deposits, manifestations, and minerals of man-made deposits;
- inventory of forest resources[2];
- inventory of natural areas of resorts [6];
- inventory of territories and objects of the natural reserve fund [7];
- urban cadastre [8];
- inventory of anthropogenic emissions and removals of greenhouse gases [5].

However, the land cadastre is only a platform for implementing a variety of tools for solving land management issues. By itself, the instrument is not able to solve all the diversity of functions assigned to it without the existence and functioning of an ecosystem of technological, normative and methodological levels. In particular, cadastral exchange file can be considered as one of such levels.

Problem analysis

Cadastral exchange file — is an electronic document of the unified form for the exchange of information used in conducting the Land Book and the books of the records of state acts of ownership of land and the right to permanent use of land, land lease agreements and the implementation of topographical and geodetic works [3].

Despite changing the IN4 technology to XML, cadastral exchange file does not undergone any significant changes due to the qualitative component of the file.

At the beginning of the study, the author was expected to propose and introduce a number of rules relating to the partial improvement of the cadastral file structure, however, at the same time, did not significantly change it. However, the analysis of the existing state of the cadastral exchange file has revealed a number of structural and model problems. When all correction has been done to the existing file structure, the new file format has been developed. The low level of data quality stored by existing cadastral file is partially confirmed by other sources[1].

Given this, it was decided to upgrade the cadastral file at several levels, which enabled the new generation of cadastral exchange file which could be interpreted as a complete and seperate markup language.

Setting objectives

At the beginning of the work, a number of requirements were set for which the new cadastral file file should satisfy. To such purposes was assigned:

- cadastral file is systemic because it's positive and negative manifestations influence the Cadastre systems of Ukrain;
- all data structures must be rebuilt and clearly structured;
- cadastral file should correspond to a clear mechanism for making changes to its structure.

Main part

The new cadastral files markup language has built based on several basic elements:

- all attributes are objects;
- cadastral files of all cadastres built on the basis of the markup language.

All attributes are objects.

This mechanism determines that, regardless of the complexity of the attribute, it is still treated as an attribute.

```
<attrinute_name>attribute value</attribute_name>
```

That is, in this case the attribute will be considered:

Simple attribute

```
<attrinute_name>
 <sub_attrinute_name>attribute value</sub_attribute_name>
 <sub_attrinute_name>attribute value</sub_attribute_name>
 </attribute_name>
```

the next type also considered as an attribute:

Attribute with subattributes

According to different complexity of attributes, they should be considered as objects. That is, an object is a group of attributes that describe a set of information at a certain scale level. However, becouse composite nature of the data, that is, some complex data may components of other data, attributes themselves should also be considered as objects.

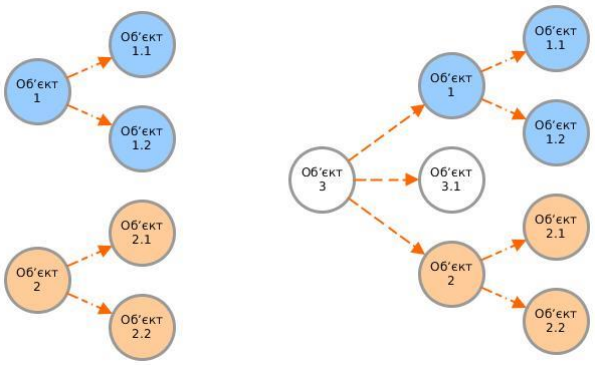


Fig. 1: Complex hierarchy of object-attributes

This approach allows better describe data and opens up the flexibility complex data describing.

Also it should be metioned that, in view of the above, geometry is also considered an attribute (object).

Murckup languige in core of all cadastral exchange files

This mechanism makes it possible to avoid the independent definition of data structures in the formation of cadastral exchange files different from the land cadastre. Since in most cases in one and the other cadastral file there will be data structures that duplicate each other. With this in mind, the model (Fig. 3) and the Ukrainian Cadastre Markup Language (UCML), as an implementation, forms an intermediate zone that allows the distribution of common data structures defined in one instance between different cadastral files of different cadastres. Also, this method automatically leads to the unification of all forms within the limits of all inventories as a whole.

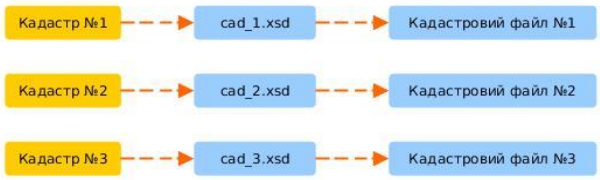


Fig. 2: Current exchange file model

In Fig. 3 it is possible to see a new structure of the system proposed in this study, in contrast to the current one (Fig. 2).

The new system identifies several additional levels of abstraction, which should improve the structure and systematize the data of all inventories and land cadastre. In particular, UCML defines two abstract groups of objects (data structures) that are markup language files and executed using XSD technology

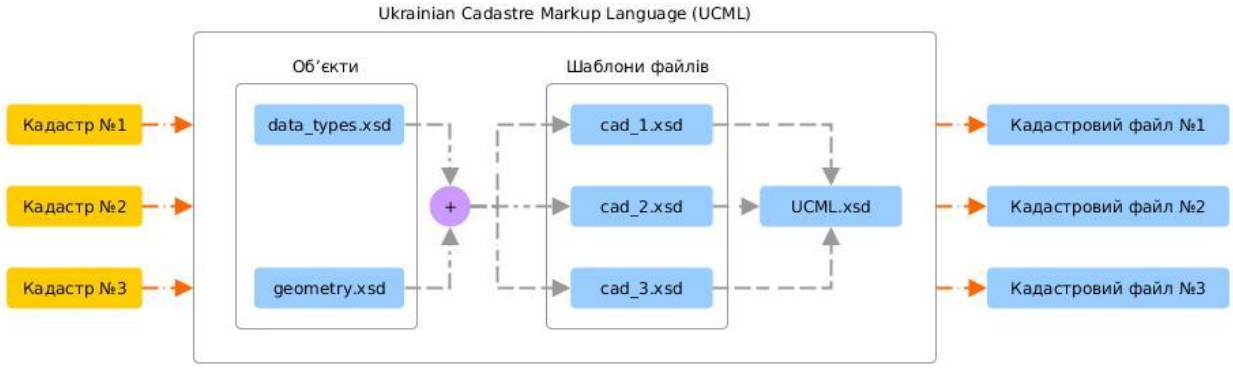


Fig. 3: UCML model

An important feature of the new approach is the use of XMLSchema 1.1 unlike the XMLSchema 1.0 which currently used.

The groups which mentioned above are:

- objects;
- file templates.

Given the scope of the description, this article offers an overview of only a few UCML objects, ignoring the overview of file templates.

The object group consists of two files "data_types.xsd" and "geometry.xsd". The first file is responsible for defining all objects of the markup language that can be distributed among eight cadastres of the Ukrainian cadastre system, and the second one is responsible for defining the types of geometry that support the cadastral file markup language.

The file template group is responsible for collecting all common objects and geometry in a new composite object. Given the variety of possible tracks, the variety of inventories and their exchange files, thes type of objects are isolated by a separate group of XSD files. The number of these files are determined by the number of required cadastral files. For the period of writing, only one template file is defined that is responsible for the form and content of the land cadastre exchange file.

Also in Fig. 3 it can be seen that regardless of the number of files from which the UCML is composed, a single access point for all objects of the language is the "UCML.xsd" file. This makes it possible to specify language only in one file, which implements all the capabilities of murckup language.

UCML objects

As mentioned, the object in this sense, the entity which is responsible for a particular data structure and acts as an attribute.

The data structures that occur more than once are presented in separate objects

UCML defines the next object types:

- static objects (objects have a clearly defined structure but may contain other types of objects including variables):
  - Address
  - CadastralNumber
  - CertificatedPerson
  - CheckingAction
  - Comment
  - Contacts
  - Country
  - Duration
  - Image
  - LandParcel
  - ProjectExecutor
  - Registration
  - RegulatoryAct
- Variable objects (objects that change their structure and completeness depending on the criteria for describing an object defined by multiple XML attributes)
  - Document
  - LandProject
  - LandUnit
  - Name
  - Payment
  - Subject
- objects lists (objects that organize multiple objects of the same type):
  - ApprovalList
  - CertificatedPersonsList
  - ChackingActionsList
  - ImagesList
  - DocumentsList
  - LandParcelsList
  - LandUnitsList
  - PrivilegesList
  - SubjectsList
- objects list references (objects that define lists of links to other objects of the document):
  - DLinksList
  - GLinksList

Address

The address object did not undergo significant changes in the structure compared with the previous version, however, better structured data and defined additional levels of detail. In particular, the division of the name of the settlement into two different attribute views was added: the type of settlement and the name of the settlement. The same approach was applied to the street field, where the street type and its name were highlighted in separate attributes. Also, for the attributes of the type of settlement and type of street or travel, an exhaustive list of possible values was added. This approach allows clearly define a list of valid values and to remove the load from an operator when filling out a cadastral file, as it is no longer possible to interpret differently the same name.

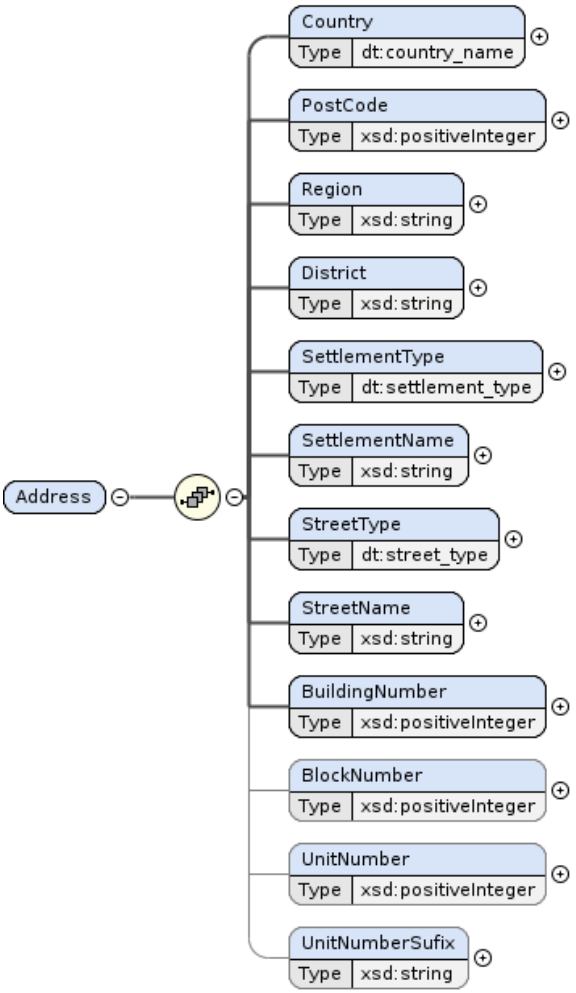


Fig. 4: Address object

Also, as shown in Fig. 4, the “UnitNumber” apartment number was changed and the “UnitNumberSufix” details were added, which is responsible for storing the information for the additional description of type "a" with the full displayed number "1a".

It is worth noting that the changes also occurred in the Country field, which is a separate object of the UCML language. Now it contains the name of the country unlike the code representation in the previous version.

CadastralNumber

The newly created object, which is absent in previous versions where different parts of the cadastral number were placed in different places of the cadastral file, is formed in a single field.

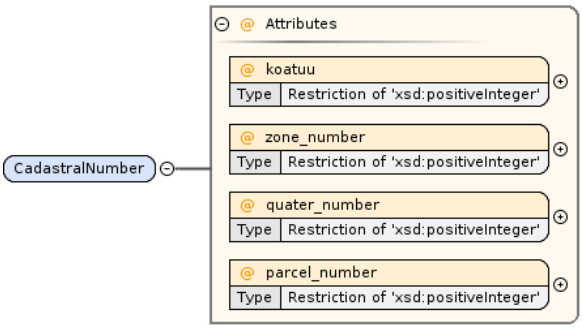


Fig. 5: Cadastral number object

It should be noted that this object implements its components through XML. This is done for convenience because it allows you to reduce the amount of text markup language to one line. It is also worth noting that for each of the fields restrictions are imposed according to the cadastral number pattern.

CertificatedPerson

An object is an analogue of an object in an existing version of a cadastral file of exchange and is responsible for storing data relating to a certified person in a particular direction of work. However, due to the composite nature, it consists of several attributes: subject, contacts and references to documents.

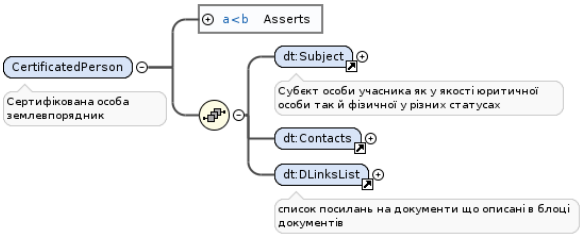


Fig. 6: Certificated person object

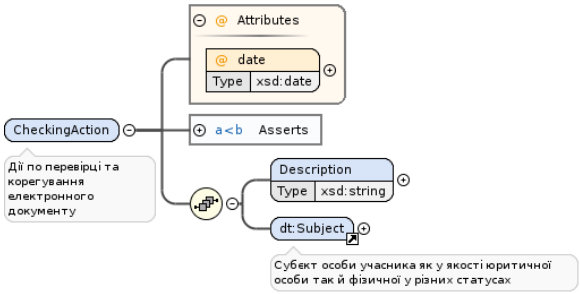
It should be noted that the use of the object concept radically changes the structure of the cadastral file of exchange. In particular, the component "DlinksList" contains links to document objects, which is why in this object there is no direct indication of the details of the certificate.

Subject "Subject" is a special type of object in the language of UCML, however, it should be noted that a compulsory condition is imposed on it: type "employee" and "performer" class.

CheckingAction

An object is an analogue of an existing object, but the same as the previous one uses the Subject object for which mandatory options are put: the type of "employee" and the class "auditor".

As can be seen in Fig. 7, the object stores some of the data as an attribute, including the date field. In the



Description field, as well as in the previous version, there is a description of adjustments and verifications.

Fig. 7: Cheched action object

Comment

Representative of the simplest UCML language objects, which retains a purely textual description. Given the number of references given in a separate object representation to reduce the amount of duplication and facilitate future possible modifications. The purpose of this object, as well as in the previous version of the cadastral file of exchange, is the additional information described by the operator when forming the cadastral file of exchange.

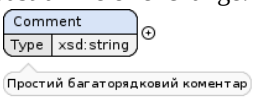


Fig. 8: Comment object

Contacts

The analogue of an object contained in the in-house version of the cadastral file of exchange and is responsible for the storage of contact information. However, UCML defines it more flexibly.

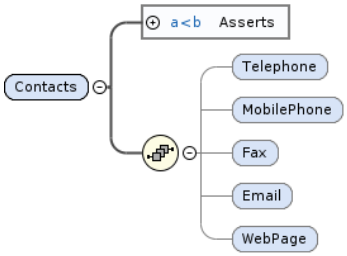


Fig. 9: Contacts object

In particular, as shown in Fig. 9, all attributes are at first glance that may be missing (thin link line), that is, the "Contacts" attribute may be completely blank. However, the UCML determines that at least one of "Telephone", "MobilePhone", "Fax" or "Email" must be present.

Country

This is one of the representatives of the simplest objects, which is responsible for preserving the name of the country and contains an exhaustive list of values, as indicated by its type country_name. It's worth noting that, despite its simplicity, rendering this type of data in separate flyovers allows you to better describe the structure of an arbitrary file.

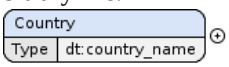


Fig. 10: Country object

Duration

The object is an analogue of the existing object of the cadastral file of exchange and determines the

fixation of the time period. Just like the object in Fig. 5, to simplify the structure, uses XML attributes unlike XML elements. It is worth noting that given the situation where the deadline is not specified or not at all, the given object identifies the XML attribute "end_date" as an optional one. That is, it may be missing, which in turn will indicate the uncertainty of the deadline.

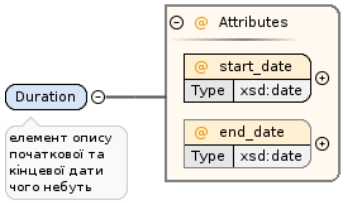


Fig. 11: Duration object

Image

UCML is positioned as a markup language that can identify a markup file with a complete electronic document and surpass it. With this in mind, UCML offers a mechanism for storing images. In particular, the object in Fig. 12 is able to store information about the location of the image, which should participate in the final document. Just like other similar simple objects, recording a location in an image is saved by means of an XML attribute.

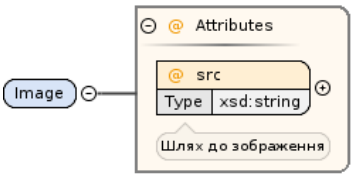


Fig. 12: Image object

LandParcel

Despite the presence of a similar object in an existing version of the cadastral file of exchange, this object represents a radical reorganization of the land plot at lower levels. This object is composite from a number of other objects and stores information about the whole plot of land, including restrictions and encumbrances, neighborhood, ownership and location (Fig. 13).

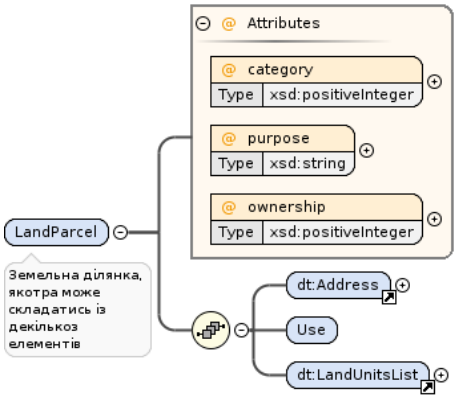


Fig. 13: Land parcel object

It is worth noting that this object has a mandatory description made using XML attributes and includes: the category of land, the type of property, and the intended use. Also, as an analogue from an existing version of an exchange file, this object contains the "Use" attribute, which stores information about the intended use according to the document, which is the basis for the occurrence of the right. And also the ability to store several land plots contained in the "LandParcelsList".

ProjectExecutor

The object is an analogue of the object of the display of the subject of the executor of works, but at this level the distinction and advantages of the proposed method can be clearly seen. As can be seen in Fig. 14, the object consists of two "Subject" objects and one "CertificatedPersonsList".

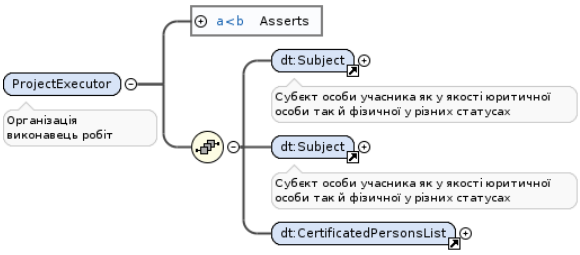


Fig. 14: Executor object

The peculiarity is manifested in the restrictions imposed on objects of type "Subject". In particular, the first to be remembered object should be defined by XML attributes that have the meaning: "class" executor and "type" employee. The second one to be remembered is to be defined by XML attributes that have the meaning: "class" director and "type" employee. The specified attributes define the content and structure of the subject "Subject".

The "CertificatedPersonsList" object contains information about certified entities, which in turn also consists of an object "Subject"

.

Registration

This is one of the representatives of the simplest objects, which is responsible for maintaining the registration information. The data object, as well as a number of others, stores data using XML attributes and waits for the date of registration "date" and the number "registration" number. Note that "number" is defined as a string attribute because the number may contain non-numeric characters (Fig. 15).

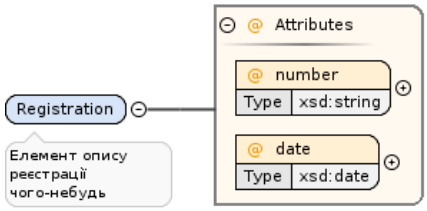


Fig. 15: Registration object

RegulatoryAct

This object is an innovation in view of the presentation of a regulatory document as a full-fledged

element of the cadastral file sharing structure. The object is responsible for preserving information about the type of document its name and reference to the article. Also, the object has the mandatory XML attribute of the date of the normative document.

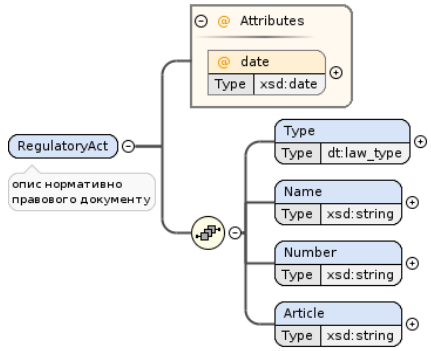


Fig. 16: Regulatory act object

In Fig. 16 it can be seen that “Type” has an additional defined data type that limits the range of valid values.

Conclusions

Despite the use of XML technology in the land management system as the basis for the formation of cadastral file sharing, the quality of the latter, as well as the possibility of their improvement, system upgrade, the mechanism of making changes to the structure and, ultimately, the integration of the land cadastre into the Ukrainian cadastre system remain unfulfilled.

Part of the material covered in this article offers an entirely new format for cadastral file sharing that addresses the above issues.

Using fully functional XML, it was possible to develop a language for marking cadastral UCML exchange files that allows solving the data transfer problem at the cadastral file exchange level between different inventories that potentially can operate on the territory of Ukraine and enables the use of previously defined data structures within the cadastre. Thus, disseminating the experience gained from one inventory to others, as well as, consequently, systematizing the document flow as a whole, bringing it into a single basis throughout the country's cadastral system. UCML also expands the capabilities of the cadastral file, allowing it to contain information about an attached set of images that to some extent improve the convenient use of the electronic document and equates it to a paper analogue for the fullness of data, and, as a result, makes the exchange file a complete repository of exhaustive data that may be required for an automated land cadastre system, excluding additional work related to data scanning and an additional survey of paper materials.

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EXCHANGE FILES MARKUP LANGUAGE UCML

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Purpose. Given the importance of the land cadastre, the quality of the cadastral exchange file plays an extremely important role, both for the land cadastre and for all other cadastres in the whole. Despite the widespread use of cadastral XML exchange file formats in the field of land management, the lack of a sufficient understanding of the conceptual peculiarities of this thesaurus does not allow us to fully disclose its potential and, as a result, functionally improve the cadastral exchange file and cadastral system of Ukraine. The material of this article outlines some of the components of the newly created UCML cadastral file markup language and gives a general overview of the conceptual difference between the UCML and the mechanism used today in the land management field. **Result.** At the beginning of the study, the author proposed to propose and make a number of edits that would be related to the partial improvement of the structure of the cadastral file of exchange however, at the same time, did not significantly change it. However, the analysis of the existing state of the cadastral file of exchange has revealed a number of structural and model problems that were corrected in a substantially different format cadastral file sharing. **Scientific innovation.** The results obtained allow to propose a series of changes to improve the quality of the cadastral exchange file or to replace it completely. Also, a mechanism is proposed that partially eliminates the boundaries between the various cadastres and allows for the full exchange of information.