Serbian Profile of the Land Administration Domain Model

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Key words: Cadastre, Serbian Profile, LADM

SUMMARY

Since the data of cadastral records are of great importance for the economic development of the country, they must be well structured and organized. Cadastral records in Serbia met numerous problems in past several years. In order to avoid problems and to achieve efficient access, sharing and exchange of cadastral data on the principles of interoperability, it is necessary to create a model of the domain according to current standards and recommendations in the field of spatial data. This paper describes a domain model for cadastral records in Serbia based on the international standard ISO 19152. Existing model of cadastral records, national legislation and the possibility of applying ISO 19152 have been analyzed. This study resulted in an extended domain model for Serbia based on the Land Administration Domain Model (LADM). A profile for the Serbian cadastre has also been proposed. Based on the resulting profile, it is shown that ISO 19152 is applicable in the Serbian cadastre. The paper also describes the method for translation from the existing data model for Serbian cadastre into a new standard based data model, and also describes its benefits. For efficient exchange of cadastral data and executing processes in the cadastre, on top of defined standardized data model, it is necessary to develop a model of services that must be provided by the institutions interested in the exchange. This can be achieved by introducing a service-oriented architecture in the real estate cadastre information system, which is the next step in improving the cadastre in Serbia.

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1. INTRODUCTION

Real estates are always accounted for the greatest product of human creative activity, as well as the most obvious forms of material and other values. Given that the cadastral data are of great importance for the economic development of the country, they must be well structured and organized. Cadastral records in the territory of Serbia met many problems in previous years. This paper describes the analysis of cadastral information system in Serbia with regard to the existing problems and the ways in which they could be overcome. The data model is the core of the system. Modeling is the basic form to facilitate the development of the system and provides the basis for important communication between (parts of) the system. In order to avoid problems and to achieve efficient access, sharing and exchange of cadastral data on the principles of interoperability, it is necessary to create a domain model according to current standards in the field of spatial data. The paper describes the process of forming a conceptual data model for the cadastre in Serbia and testing the applicability of ISO 19152 (ISO/TC211, 2012) standard in creating a profile of the domain model for cadastre in Serbia.

2. REAL ESTATE INFORMATION SYSTEM IN SERBIA

The information system for real estate in Serbia is implemented in DOS application based on FoxDbf tables for significant part of Serbian territory, while a small part of data is stored in Microsoft Access database. Data models in these two applications differ from each other with evident absence of relations in FoxDbf database. Data cover only alphanumeric part, while the graphics data are partially digitized (Đurović, 2009). Data model is based on real estate folio concept, a legacy paper document which consists of 4 sheets. "A" sheet contains data about several parcels. "B" sheet contains data about parties which have some right or responsibility over parcels from "A" sheet. "V" sheet contains data about buildings and part of buildings (like flats, business premises…) which are built on top of parcels in "A" sheet together with data about their parties. "G" sheet contains data about restrictions on real estates defined in "A" and "V" sheet (Figure 1). This is how Law on State Survay and Cadastre (1988) defined real estate folio. However, the current Law on State Survay and Cadastre (2009) defines real estate folio as data about one real estate together with its rights, restrictions and responsibilities.

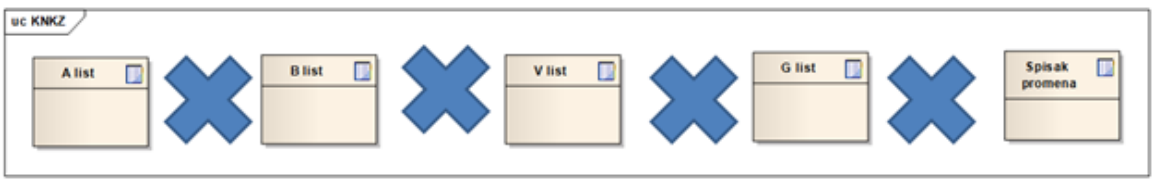

Figure 1 Existing data model

Based on the above, as well as for development of information technology, there is a need for innovation and integration of existing subsystems (alphanumeric and graphical) into one, unifying

data model that will be completely based on current legislation and standards in the field of spatial data and real estate.
According to the strategy of establishing a spatial data in the Republic of Serbia, the national data infrastructure should be established in accordance with the principles set out in the INSPIRE directive (INSPIRE, 2007). The INSPIRE Directive states that all the rules for its implementation should take into account the standards that have been developed by the European standardization bodies. Since the cadastral data are part of spatial data infrastructure, domain model for the cadastre should be based on the domain model for land administration (Land Administration Domain Model - LADM) defined within the ISO 19152 standard and national legislation.

3. NATIONAL PROFILE OF THE DOMAIN MODEL

The first step in realization of new domain model is formation of conceptual model of real estate cadastre for Serbia. In current database schema, real estates, rights and restrictions are grouped according by sheets of real estate folio document defined by the Law of 1988. The second step is to analyze the possibilities of fitting the resulting conceptual model in LADM (Radulović, 2015).

3.1 Forming of conceptual model

Figure 2. shows a conceptual model that represents the contents of "A" sheet. As mentioned before, "A" sheet contains data about parcels and part of parcels which are actually different forms of land use. Basic attributes for parcel are number of parcel, cadastral municipality, number of real estate folio and transaction data. According to this, a conceptual model is derived which includes classes KatastarskaOpstina (cadastral municipality), Parcela (parcel), DeoParcele (part of parcel) and ListNepkretnosti (real estate folio). Cadastral municipality is formed as a collection a certain number of parcels within which the numbers of parcel go from 1 to n. Parts of parcels are recorded in the real estate folio so that a folio can contain several parcels, and therefore more parts of parcels.

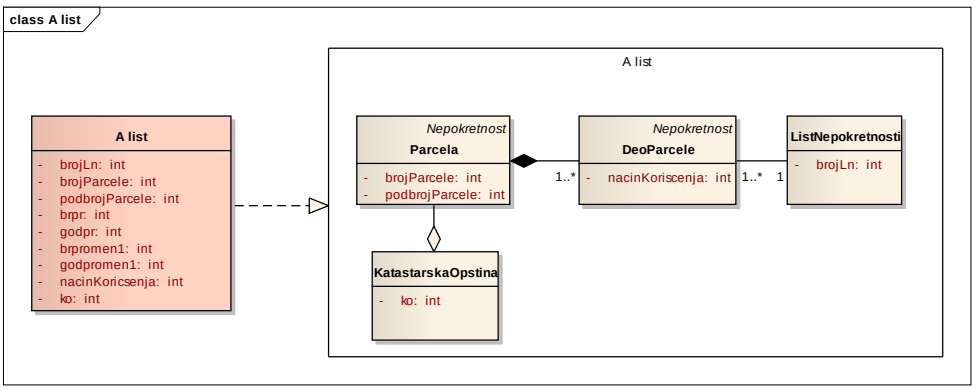

Figure 2 Transformation of "A" sheet class

In a similar manner, other classes from Figure 1. are transformed into conceptual model. By transforming "B" sheet, classes NosiociPrava and PravaNaParceli occurred. Class NosiociPrava refers to records of natural and legal parties who have some rights or responsibilities on real estates. Class PravaNaParceli refers to a specific right or responsibility bringing together a party, type of right and share of right, as well as the number of real estate folio.

"V"sheet contains data on buildings and parts of buildings together with information about rights to them. Building is identified by number and the corresponding parcel. This leads to the following classes: Objekat (building), PosebanDeoObjekta (part of building like flat etc.) and PravaNaObjektuIPosDelu (rights and responsibilities on buildings and its parts).
"G" sheet contains data about restrictions on real estates. In addition to the real estate indication, this class contains data about type of restriction (mortgages, right of passage, usufruct, etc.) and a textual description of constraints. In conceptual model class Ogranicenje (restriction) is formed.
Afterwards, a generalization of conceptual model is performed by introducing two abstract classes Nepokretnost (real estate – represents all three types of real estates) and PravaNaNepokretnostima (rights on any type of real estate).

Finally, the domain model of real estate cadastre in Serbia can be represented as shown in Figure 3. Real estate folio (ListNepokretnosti) contains one or more real estate (from the "A" and "V" sheet – class Nepokretnost), one or more rights to real estate (from the "B" and "V" sheet – class PravaNaNepokretnostima) and none or more restrictions on real estate (from the "G" sheet – class Ogranicenja). One party (class NosiociPrava) may have none or more property rights.

This model describes the current data structure that is formed under the Law of 1988. According to the Law of 2009. real estate folio contains one real estate with its rights and restrictions. This reflects on previous model by changing cardinality on class Nepokretnost from 1 .. * to 1. This is how it is accomplished that real estate folio contains single real estate.

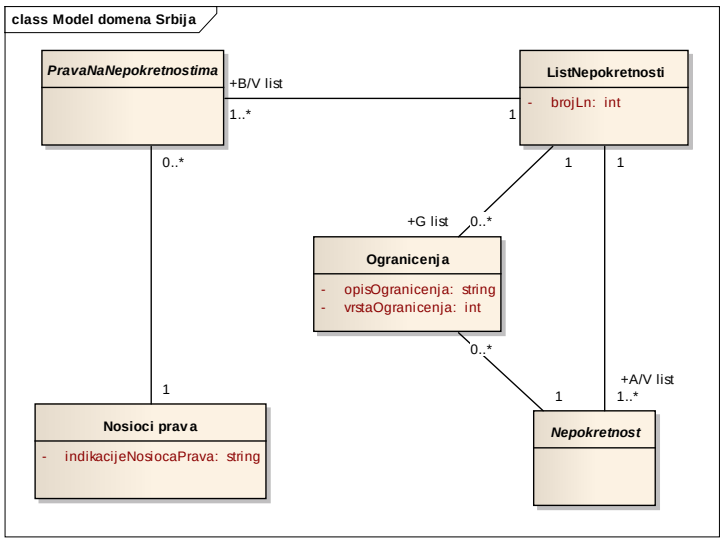

Figure 3 Conceptual Model for Serbia - the basic scheme

3.2 Verification of LADM applicability

The second step in the establishment of the standardized domain model profile for real estate cadastre in Serbia is related to comparison of the basic LADM model and the previously formed conceptual model for Serbia. Basis of the LADM model are classes that represent spatial structures (LA_SpatialUnit), rights, restrictions and responsibilities (LA_RRR), and parties (LA_Party), as well as links between them (Figure 4. at the top). Class LA_BAUnit gathers rights (restrictions,

responsibilities) that parties have over some spatial units so that the total amount of shares in rights, restrictions or responsibilities equal to 1. Figure 4. shows the mapping of basic LADM class to classes from a conceptual model for Serbia (Sladić, 2013).

Since LA_Party class describes the rights holders, so the appropriate class of the conceptual model is class NosiociPrava. Class SpatialUnit describes spatial units (real estates) and can be mapped to an abstract class Nepokretnost. Class LA_RRR describes the rights, restrictions and responsibilities on some real estate. In the conceptual model there are two classes for a description of the rights and restrictions (PravaNaNepokretnostima and Ogranicenja), and both derive from the class LA_RRR. LA_BAUnit class represents a set of rights, restrictions and responsibilities of one or more real estate so that the sum of shares equal to 1. In conceptual model for Serbia, it is equivalent to real estate folio so the corresponding class is ListNepokretnosti.

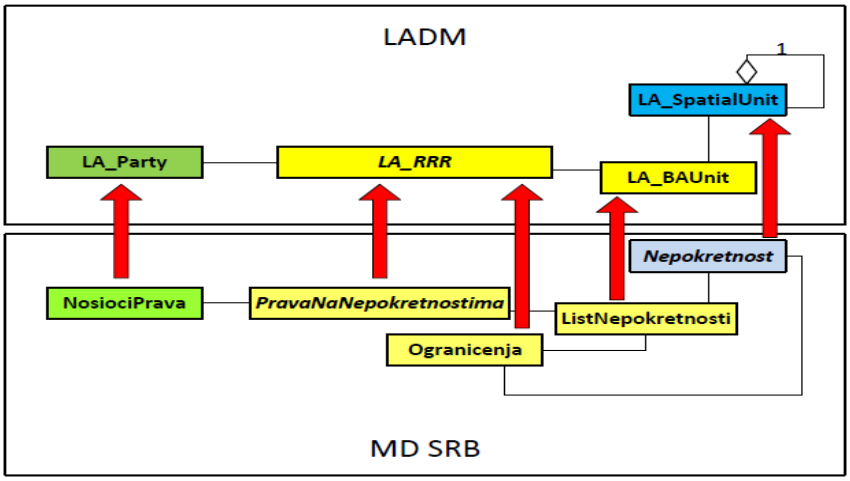

Figure 4 Mapping of basic classes in model for Serbia and LADM classes

3.3 Serbian LADM profile

Next step is formation of the corresponding classes of the Serbian profile for domain model derived from LADM (Radulović, 2011). Classes will be described according to packages recommended by LADM. Profile classes are identified by the prefix RS, while the code lists are marked with prefix CL.

Spatial Unit Package

Spatial Unit Package predicts two classes: LA_SpatialUnitGroup and LA_SpatialUnit. Class LA_SpatialUnitGroup is related to set of spatial objects and can be used to specify the administrative units within the cadastral system. By inheritance of this class, classes for domain model profile for Serbia are created: RS_Country, RS_AdministrativeMunicipality, RS_City, RS_CadastralMunicipality and RS_CadastralDistrict.

Class LA_SpatialUnit describes spatial objects in the cadastre including parcel, part of parcel, building and part of building (Figure 5). Profile classes are RS_Parcel, RS_PartOfParcel,

RS_Building and RS_PartOfBuilding. Class RS_Parcel has two additional attributes for parcel indication, number and sub number of parcel. Part of parcel has additional attributes for describing of land use (wayUseID), type of land (purposeParcelID)… The values of these attributes are retrieved from the respective code lists. Type of land use can be field, garden, orchard, meadow, pasture, and the land under the building, the city's green areas, embankment, a pond, an artificial lake and so on. Type of land refers to whether it is urban construction land, agricultural land, forest land or public building land.

For buildings and parts of buildings LADM foresees additional class LA_LegalSpaceBuildingUnit. Class that represent building in Serbia (RS_Building) requires additional attributes to describe a number of the building (sequence), the date of construction (builddate), the number of entrances (entnum), number of floors underground, on the ground floor, above the ground and in the attic (etaza1, etaza2, etaza3, etaza4), legal status (legalStatusID), the way of use of building (wayUseID) according to the values of code list (residential buildings, commercial buildings, auxiliary buildings, power plants, Hotels and Restaurants).

Class RS_PartOfBuilding is related to part of the building such as an apartment or office space. Additional attributes are a number of part of the building (unitnum), date of registration (regdate), number of kitchens, bathrooms, office rooms, WC's and other rooms. Also, there are information about floor where a part of the building is (basement, ground floor, first floor, second floor) and way of use of part of building (flat, office space, garage).

Party Package

Basic class in party package is class LA_Party used to describe holders of rights in the cadastral system. Corresponding class in Serbian profile is RS_Owner (Figure 6). Code list LA_PartyType must be expanded with following values: natural persons and legal persons like state authorities, local authorities, institutions, shops, religious, sports and political organizations and other legal entities. Additional attributes in class RS_Owner are surname, middlename, address, personal identification (personalID), ID card number (personalNumber), passport number if the person is foreign national.

Administrative Package

Rights, restrictions, real estate folios and changes on real estates are defined within the administrative package (Figure 7). LADM class LA_RRR defines an abstract class that represents the rights, restrictions and responsibilities and subclasses LA_Restriction and LA_Right as a specialization of this class. For the presentation of rights in Serbian profile, a class RS_Ownership is created. All attributes from class LA_Right are inherited with additional data like type of ownership (private, public, social, cooperative, mixed) and type of share in right (whole right, ideal part of right, real part of right and joint right). Code list LA_RightType should be extended with values: ownership, right to use, holder, lease, user. Restrictions are described by class RS_Restriction. This class inherits class LA_Restriction. Type of restrictions are mortgages, right of passage, usufruct, right of use. Other attributes are date of restriction registration (regdate) and description of restriction (comment).

LA_BAUnit class represents a set of rights, restrictions and responsibilities on real estate so that the total sum of shares equal to 1. Corresponding class in Serbian profile is RS_RealestateFolio (Figure 8). In addition to uID attribute that represents the identifier of real estate folio, number, sub number, link to cadastral municipality are added.

Changes over cadastral data are recorded with class RS_Changelist. The change is described by number and the year, date, description of the change and type of change. Class RS_Changelist has two links to real estates, one with which an instance of real estate is created and one with which an instance of real estate is deactivated.

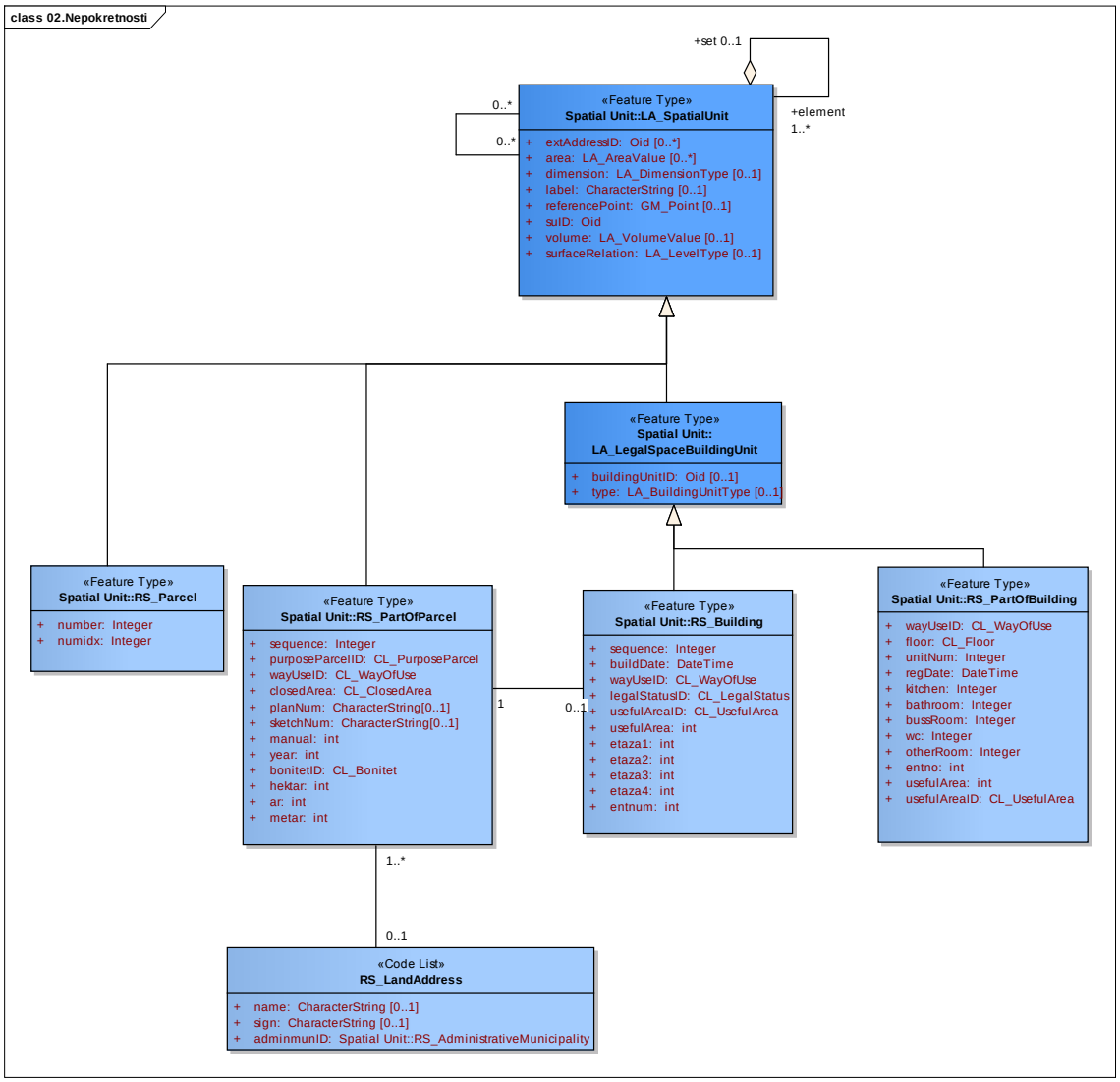

Figure 5 Spatial unit package of Serbian profile

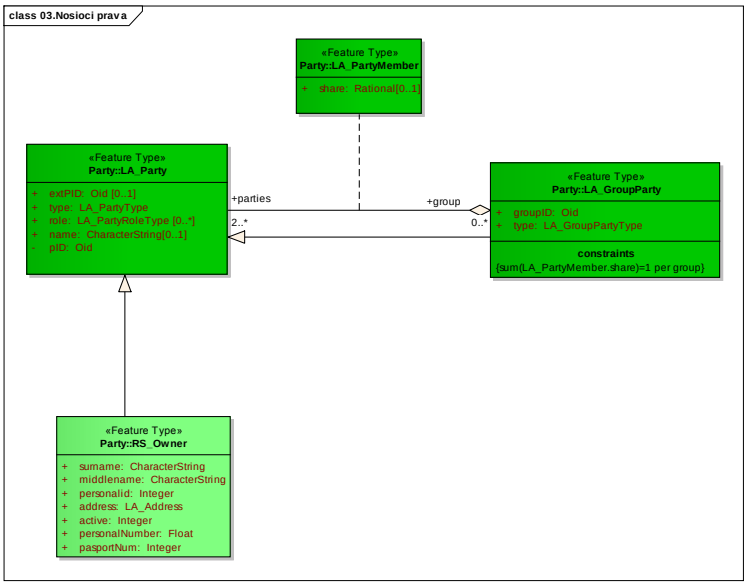

Figure 6 Party package of Serbian profile

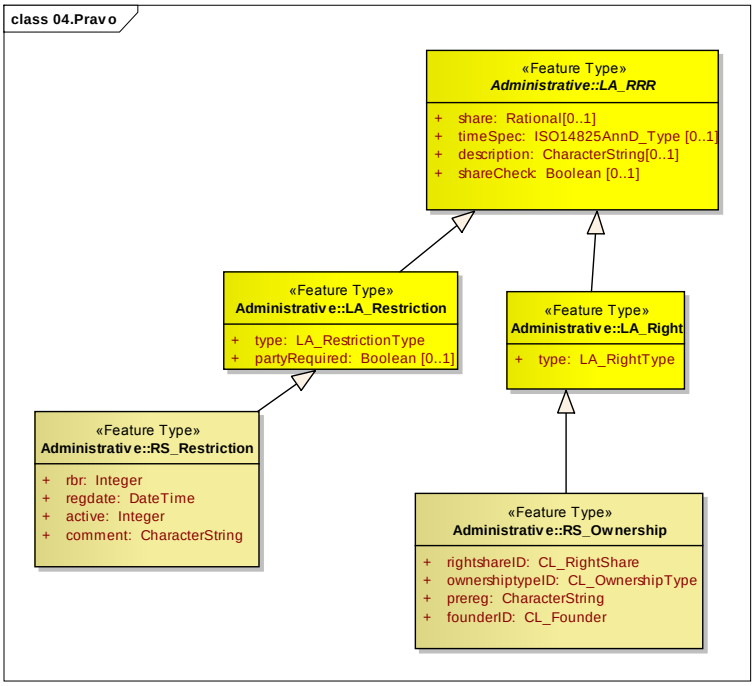

Figure Administrative package of Serbian profile (1)

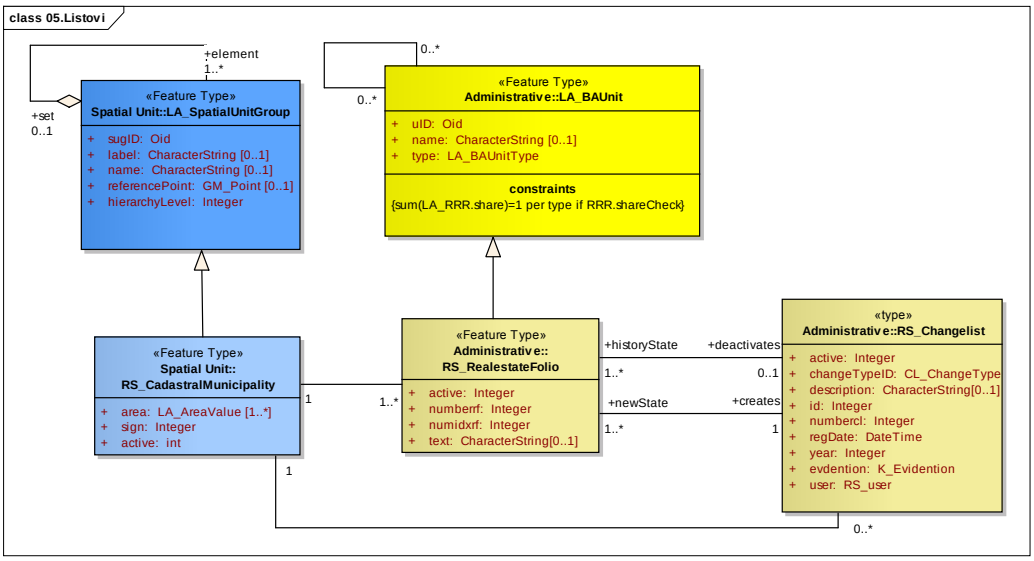

Figure 8 Administrative package of Serbian profile (2)

The Law on State Survey and Cadastre from 2009 defines real estate folio as data on one real estate together with its rights and restrictions. By analyzing the association between LA_SpatialUnit and LA_BAUnit, on can come to a conclusion that in the case of current legislation cardinality of connection should be 0..1 to 1. With this change it is accomplished that a maximum of one real estate may be in defined in one real estate folio (Figure 9).

Surveying and Representations Subpackage

For the modeling of spatial objects basic 2D geometric elements were used: point (RS_Point), line (RS_Polyline) and polygon (RS_Polygon). Collection of geometries which together describe the parcel is called geocomplex and described with class RS_Geocomplex. It follows that one geocomplex represents a graphical presentation of one parcel. Class RS_Polyline is derived from LA_BoundaryFaceString class. Class RS_Point is derived from class LA_Point. In addition to basic geometric and topological data, thematic characteristics of elements and their visualization is also managed. Through thematic properties of geometric primitives is determined whether a point on the ground is well, pillar or traffic light.

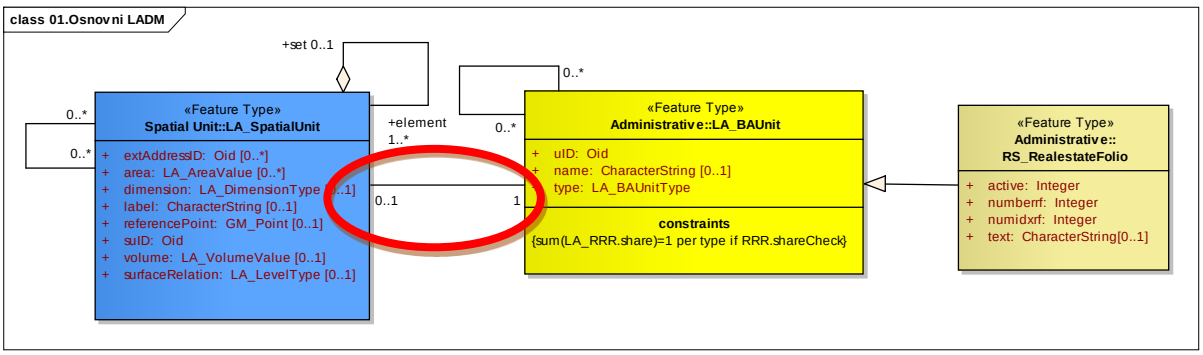

Figure 9 Adjusting links cardinality

Previous shows that LADM is applicable with the addition of appropriate attributes and classes and specialization of links cardinality to meet the valid legal regulations. As a result of the analysis the profile of the domain model for real estate cadastre in Serbia is proposed.

Table 1. shows the summarized review of the mapping of conceptual model classes obtained on the basis of existing data structures, basic LADM classes and LADM Serbian profile classes.

Serbian conceptual data model	LADM class	Serbian profile class
Spatial Unit Package		
Parcela	LA_SpatialUnit	RS_Parcel
DeoParcele	LA_SpatialUnit	RS_PartOfParcel
Objekat	LA_LegalSpaceBuildingUnit	RS_Building
PosebanDeoObjekta	LA_LegalSpaceBuildingUnit	RS_PartOfBuilding
KatastarskaOpstina	LA_SpatialUnitGroup	RS_CadastralMunicipality
-	LA_SpatialUnitGroup	RS_AdministrativeMunicipality
-	LA_SpatialUnitGroup	RS_City
-	LA_SpatialUnitGroup	RS_Country
Party package		
NosiociPrava	LA_Party	RS_Owner
Administrative Package		
ListNepokretnosti	LA_BAUnit	RS_RealestateFolio
PravaNaParceli	LA_Right	RS_Ownership
PravaNaObjektuIPosDelu	LA_Right	RS_Ownership
Ograničenja	LA_Restriction	RS_Restriction
Promene	-	RS_Changelist
Surveying And Representations Subpackage		
-	LA_Point	RS_Point
-	LA_Point	RS_BasePoint
-	LA_Point	RS_DetailPoint
-	LA_BoundaryFaceString	RS_PolyLine
-	LA_BoundaryFaceString	RS_LineSegment
-	LA_BoundaryFaceString	RS_Polygon

Table 1 Mapping of conceptual model classes, LADM and Serbian profile classes

4. CONCLUSION

In this paper, existing problems in the real estate cadastre information system of Serbia were analyzed in order to find a way to overcome them. Since the data model is the core of the system, restructuring of the existing data model according to standards in the field of spatial data is proposed. Especially, attention has been paid to the ISO 19152 standard, which describes the domain model for land administration. Applicability of this standard on the cadastre in Serbia was tested. It is shown that it is applicable with the addition of appropriate classes and attributes according to current legislation. As a result a profile of the domain model for cadastre in Serbia is obtained. The benefit of this data model is reflected in the need for the development of national spatial data infrastructure. Cadastral data are an important part of the national data infrastructure, and it is necessary to ensure interoperability and the possibility of exchange of such data.

Next step in the improvement of the information system of cadastre would be directed towards solving the problem of data redundancy, problems in finding data, lack of harmonization between data, poor accessibility... In order to overcome these problems in the field of land administration it is necessary to develop a services model that must be provided by the institution and users

interested in the exchange of cadastral data. Model of service is defined according to a pattern known as a service-oriented architecture (SOA). Such service architecture would reduce time and costs, increase the degree of automation and facilitate the realization of the services of real estate cadastre. Cadastral data are particularly important for the implementation of e-government services. In Serbia, there is still no two-way communication with the state authorities, so that the existence of e-government is reduced to obtain information about the services of the state administration, which are the competent authorities, which documents are necessary, to download necessary forms, although not to complete all the paperwork electronically. Identification and implementation of e-government services relating to data from real estate cadastre would greatly facilitate execution of the services to citizens and to the institutions of the state and the private sector (commission for conflict of interest, notaries, banks, insurance companies, institute for urban development).

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BIOGRAPHICAL NOTES

Ph.D Aleksandra Radulović is an Assistant Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. She has published several papers in international and national journals and conferences, including 5 paper in international journals, more than 20 papers on international conferences and more than 10 papers on Serbian national journals and conferences. She has also participated in several research projects including GIS(geoportal) for the Ministry of Environmental Protection and Ecology of Serbia, Information system of the real estate cadastre for Republic Geodetic Authority of Republic of Srpska, Information system of the real estate cadastre in

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Ph.D Dubravka Sladić is an Assistant Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. She has published 5 paper in ISI journals and more than 20 papers in international and national journals and conferences. She has also participated in several research projects and projects including design and implementation of cadastral information systems in Republic of Srpska in Bosnia and Hertzegovina, Montenegro and Serbia. Her domain of interest are Geographic Information Systems, Spatial Data Infrastructures, Service Oriented Architecture, Cadastral Systems, etc.

Ph.D Miro Govedarica is a Full Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. His involvement in university teaching and research is entirely dedicated to the field of geodesy, geomatics and GIS, especially in the field of geoinformation technologies and systems. His practical and theoretical results belong to disciplines, such as object-oriented software engineering, databases, spatial databases, database management, development of service-oriented information and geoinformation systems, photogrammetry, laser scanning, remote sensing, global navigation satellite systems. He was lead member of several projects in the development of software components for real estate cadastre and implementation of GIS systems.

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