**Paper #3: Using Semantic Web Ontologies for better interoperability on social network sites**

The paper summarized in this section aims at introducing all existing ontologies for semantic web, along with their properties and use in a way to provide a basis for a framework to guarantee inter-operability among multiple social network sites and attain inter-linking of such sites.

Introduction:

The authors claim that currently, there are not any established framework that aggregate ontologies. For social networks, which are considered to be “online networks which indicate connections between actors in social activities” [2], some interoperability has been reached by the use of ontologies, but no efforts have been done in inter-linking different social network sites. Because of their current isolation, there is a need to expand the potential such networks offer and find new ways of using ontologies to build a better social network environment that could bring forward more relationships among user-generated content in such sites. The studies of semantic web over the years have not proved successful in extracting relationships and integrate social network sites, so the authors propose a framework to be used to address the issue.

The main challenge of social networks is their inherent nature and the fact that multiple accounts could likely exist for the same user. Furthermore, because of data inconsistency, it is difficult to implement inter-operability and it is also difficult to link multiple social network accounts. Sematic Web was introduced as a technology to make social web sites more connected and to gain more interoperability through metadata creation and inter-connected vocabularies. Existing semantic web vocabulary frameworks such as SIOC (Semantically Interlinked Online Communities) and FOAF (Friend of-a-Friend) could help on this; hence the authors explain multiple vocabularies could be used together to build a good interoperability framework.

As an example of their use, the authors explain a likely scenario, saying that “SIOC ontology uses FOAF vocabulary to explore a person’s attributes, and DC (Dublin Core) vocabulary to illustrate SIOC content properties” [2]. The paper goes on presenting and describing the most dominant and practical ontologies in existence for Semantic Web and how they can be combined to help build an exhaustive framework for social networks; hence proposing a possible solution to the problem.

Literature Review:

Given the previous definition of social networks, we can see what the impact of using a semantic network can be. According to the authors, “a semantic network is conceptually a group of entities that are connected through their relationships” [2]. This kind of network provides useful information about individual users that could be used to extract relationships between social network sites. Plainly said, “Sematic Web is the use of new technologies and standards which allow data interpretation and information processing on the World Wide Web” [2]. Technologies such as RDF (Resource Description Framework) and OWL, can be used in Semantic Web for this purpose. Acquiring related data from social network sites has been challenging, because of the intense amount of data and its varying nature. However, Semantic Web and its technologies such as ontologies and vocabularies have methods for better data presentation and provide the ability to machines to automatically originate data from the web, which is an improvement made possible through these new technologies.

Ontologies are “tools to analyze and extract relationships among web sites” [2], since as the authors explain, ontologies can “describe the meaning of a formal vocabulary, identify knowledge within the vocabulary and extract semantics from interconnections on the web” [2]. This capability makes them extremely useful for Sematic Web: they can discover and categorize relationships that exist and delineate relationships between terms within the documents or files that form the Semantic Web Services.

The four main ontologies and vocabularies extensively employed on the web which are explained in the paper are presented in the list below, the way the authors described them:

* Dublin Core (DC): It is explained in the paper as a system combining fifteen elements that are used to describe resources. This set of elements assists the search and information retrieval by capturing basic descriptive categories on the web. DC characteristics are: simplicity of creation and maintenance, interoperability among collections and indexing systems, international applicability, extensibility and modularity. These characteristics allow for compiling metadata and creating a mode elaborated description for data resources.
* Friend of a Friend (FOAF): It is mentioned in the paper that this ontology has been built on top of a RDF based schema to “semantically express individuals and their social networks” [2].
* Semantically-Interlinked Online Communities (SIOC): Mentioned to be a Semantic Web technology which has methods that enable interconnection between social network sites (such as Blogs, forums and others). This ontology is an open-standard machine readable format to extract metadata useful for semantic browsing, content management and social web.

|  |  |
| --- | --- |
| **URL** | **Definition** |
| skos:Concept | A SKOS concept can be viewed as an idea or notion, a unit of thought. |
| skos:ConceptScheme | A SKOS concept scheme can be viewed as an aggregation of one or more SKOS concepts. The notion of a concept scheme is useful when dealing with data from an unknown source, and when dealing with data that describes two or more knowledge organization systems. |
| skos:inScheme |
| skos:hasTopConcept |
| skos:topConceptOf |
| skos:altLabel | A lexical label is a string of UNICODE characters in a given natural language, such as English. SKOS provides soma basic vocabulary for associating lexical labels with resources of any type. In particular, SKOS enables a distinction to be made between the preferred alternative and “hidden” lexical labels for any given resource. |
| skos: |
| skos:prefLabel |
| skos:notation | A notation is a string of characters such as “TS8.5” used to uniquely identify a concept within the scope of a given concept scheme. |
| skos:changeNote | Notes are used to provide information relating to SKOS concepts. There is no restriction on the nature of this information, e.g. it could be plain text, hypertext, or an image; it could be a definition, information about the scope of a concept, editorial information, or any other type of information. |
| skos:definition |
| skos:editorialNote |
| skos:example |
| skos:historyNote |
| skos:note |
| skos:scopeNote |
| skos:broader | SKOS sematic relations are links between SKOS concepts, where the link is inherent in the meaning of the linked concepts. SKOS distinguishes between two basic categories of semantic relation: hierarchical and associative. A hierarchical link between two concepts indicates that one is in some way more general (“broader”) than the other (“narrower”). An associative link between two concepts indicates that the two are inherently “related”, but that one is not in any way more general than the other. |
| skos:broaderTransitive |
| skos:narrower |
| skos:narrowerTransitive |
| skos:related |
| skos:semanticRelation |
| skos:Collection | SKOS concept collections are labeled and/or ordered groups of SKOS concepts. Collections are useful when a group of concepts shares something in common, and it is convenient to group them under a common label, or where some concepts can be placed in a meaningful order. |
| skos:OrderedCollection |
| skos:member |
| skos:memberList |
| skos:broadMatch | The SKOS mapping properties are skos:closeMatch, skos:exactMatch, skos:broadMatch, skos:narrowMatch and skos:relatedMatch. These properties are used to state mapping (alignment) links between SKOS concepts in different concept schemes, where the links are inherent in the meaning of the linked concepts. The properties skos:broadMatch and skos:narrowMatch are used to state a hierarchical mapping link between two conepts. The property skos:relatedMatch is used to state an associative mapping link between two concepts. The property skos:closeMatch is used to link two concepts that are sufficiently similar that they can be used interchangeably in some information retrieval applications. In order to avoid the possibility of “compound errors” when combining mappings across more than two concept schemes, skos:closeMatch is not declared to be a transitive property. The property skos:exactMatch is used to link two concepts, indicating a high degree of confidence that the concepts can be used interchangeably across a wide range of information retrieval applications. skos:exactMatch is a transitive property and it is a sub-property of skos:closeMatch. |
| skos:closeMatch |
| skos:exactMatch |
| skos:mappingRelation |
| skos:narrowMatch |
| skos:relatedMatch |

**TABLE I. SKOS Classes and Properties**

* Simple Knowledge Organization System (SKOS): As expressed in the paper, it is a set of characteristics that provide a standard over RDF documents’ vocabularies. Because SKOS can capture organizational knowledge provided in RDF documents, extract similarities and enable technology and information sharing among organization systems, it can be regarded as a “data model to interlink organization knowledge and facilitate knowledge sharing through the web” [2].

Based on the classes and properties related to each ontology, the authors explain that such ontologies can prove to be useful at extracting relationships among diverse social network sites and thus aid in the goal of the paper. Hence, it is the authors’ claim that ontologies such as SIOC, FOAF and DC can be combined with other ontologies such as SKOS to obtain more relationships and create a more semantic web.

The classes and properties of each mentioned ontology are shown in TABLE I, TABLE II, TABLE III, and TABLE IV. These tables were taken from the original paper, as well as complemented using sources [skos source], [foaf source], [sioc source], and [dc source].

|  |  |
| --- | --- |
| **Class** | **Properties** |
| foaf:Agent | [gender](http://xmlns.com/foaf/spec/#term_gender) [yahooChatID](http://xmlns.com/foaf/spec/#term_yahooChatID) [account](http://xmlns.com/foaf/spec/#term_account) [birthday](http://xmlns.com/foaf/spec/#term_birthday) [icqChatID](http://xmlns.com/foaf/spec/#term_icqChatID) [aimChatID](http://xmlns.com/foaf/spec/#term_aimChatID) [jabberID](http://xmlns.com/foaf/spec/#term_jabberID) [made](http://xmlns.com/foaf/spec/#term_made) [mbox](http://xmlns.com/foaf/spec/#term_mbox) [interest](http://xmlns.com/foaf/spec/#term_interest) [tipjar](http://xmlns.com/foaf/spec/#term_tipjar) [skypeID](http://xmlns.com/foaf/spec/#term_skypeID) [topic\_interest](http://xmlns.com/foaf/spec/#term_topic_interest) [age](http://xmlns.com/foaf/spec/#term_age) [mbox\_sha1sum](http://xmlns.com/foaf/spec/#term_mbox_sha1sum) [status](http://xmlns.com/foaf/spec/#term_status) [msnChatID](http://xmlns.com/foaf/spec/#term_msnChatID) [openid](http://xmlns.com/foaf/spec/#term_openid) [holdsAccount](http://xmlns.com/foaf/spec/#term_holdsAccount) [weblog](http://xmlns.com/foaf/spec/#term_weblog) |
| foaf:Group | Member |
| foaf:Organization | Subclass Of Agent Disjoint with: Person, Document |
| foaf:Person | [plan](http://xmlns.com/foaf/spec/#term_plan) [surname](http://xmlns.com/foaf/spec/#term_surname) [geekcode](http://xmlns.com/foaf/spec/#term_geekcode) [pastProject](http://xmlns.com/foaf/spec/#term_pastProject) [lastName](http://xmlns.com/foaf/spec/#term_lastName) [family\_name](http://xmlns.com/foaf/spec/#term_family_name) [publications](http://xmlns.com/foaf/spec/#term_publications) [currentProject](http://xmlns.com/foaf/spec/#term_currentProject) [familyName](http://xmlns.com/foaf/spec/#term_familyName) [firstName](http://xmlns.com/foaf/spec/#term_firstName) [workInfoHomepage](http://xmlns.com/foaf/spec/#term_workInfoHomepage) [myersBriggs](http://xmlns.com/foaf/spec/#term_myersBriggs) [schoolHomepage](http://xmlns.com/foaf/spec/#term_schoolHomepage) [img](http://xmlns.com/foaf/spec/#term_img) [workplaceHomepage](http://xmlns.com/foaf/spec/#term_workplaceHomepage) [knows](http://xmlns.com/foaf/spec/#term_knows) |
| foaf:Document | [topic](http://xmlns.com/foaf/spec/#term_topic) [primaryTopic](http://xmlns.com/foaf/spec/#term_primaryTopic) [sha1](http://xmlns.com/foaf/spec/#term_sha1) |
| foaf:Image | [depicts](http://xmlns.com/foaf/spec/#term_depicts) [thumbnail](http://xmlns.com/foaf/spec/#term_thumbnail) |
| foaf:OnlineAccount | [accountName](http://xmlns.com/foaf/spec/#term_accountName) [accountServiceHomepage](http://xmlns.com/foaf/spec/#term_accountServiceHomepage) |
| foaf:PersonalProfileDocument | Status: testing Subclass Of Document |
| foaf:Project | Status: testing Disjoint With: Person, Document |
| foaf:LabelProperty | Status: unstable |
| foaf:OnlineChatAccount | Status: unstable Subclass Of Online Account |
| foaf:OnlineEcommerceAccount | Status: unstable Subclass Of Online Account |
| foaf:OnlineGamingAccount | Status: unstable Subclass Of Online Account |

|  |  |
| --- | --- |
| **Class** | **Properties** |
| sioc:Community | Community is a high-level concept that defines an online community and what it consists of. A Community may consist of different types of objects (people, sites, etc.) joined by a common topic, interests or goals. A Community is different from a Site: a Site describes a single community site whilst a Community can consist of a number of Sites and other resources described in SIOC or other ontologies (e.g., FOAF). Community is linked to its constituent parts using the property dcterms:hasPart. |
| sioc:Container | An area in which content Items are contained.  in-range-of: [sioc:has\_container](https://www.w3.org/Submission/sioc-spec/#term_has_container) [sioc:has\_parent](https://www.w3.org/Submission/sioc-spec/#term_has_parent) [sioc:owner\_of](https://www.w3.org/Submission/sioc-spec/#term_owner_of) [sioc:parent\_of](https://www.w3.org/Submission/sioc-spec/#term_parent_of) [sioc:subscriber\_of](https://www.w3.org/Submission/sioc-spec/#term_subscriber_of) in-domain-of: [sioc:container\_of](https://www.w3.org/Submission/sioc-spec/#term_container_of) [sioc:has\_owner](https://www.w3.org/Submission/sioc-spec/#term_has_owner) [sioc:has\_parent](https://www.w3.org/Submission/sioc-spec/#term_has_parent) [sioc:has\_subscriber](https://www.w3.org/Submission/sioc-spec/#term_has_subscriber) [sioc:parent\_of](https://www.w3.org/Submission/sioc-spec/#term_parent_of) |
| sioc:Forum | A discussion area on which Posts or entries are made. sub-class-of: [sioc:Container](https://www.w3.org/Submission/sioc-spec/#term_Container) in-range-of: [sioc:has\_scope](https://www.w3.org/Submission/sioc-spec/#term_has_scope) [sioc:host\_of](https://www.w3.org/Submission/sioc-spec/#term_host_of) [sioc:moderator\_of](https://www.w3.org/Submission/sioc-spec/#term_moderator_of) in-domain-of: [sioc:has\_host](https://www.w3.org/Submission/sioc-spec/#term_has_host) [sioc:has\_moderator](https://www.w3.org/Submission/sioc-spec/#term_has_moderator) [sioc:scope\_of](https://www.w3.org/Submission/sioc-spec/#term_scope_of) |
| sioc:Item | A content Item that can be posted to or created within a Container. sub-class-of: [foaf:Document](http://xmlns.com/foaf/0.1/Document) in-range-of: [sioc:container\_of](https://www.w3.org/Submission/sioc-spec/#term_container_of) [sioc:creator\_of](https://www.w3.org/Submission/sioc-spec/#term_creator_of) [sioc:has\_reply](https://www.w3.org/Submission/sioc-spec/#term_has_reply) [sioc:modifier\_of](https://www.w3.org/Submission/sioc-spec/#term_modifier_of) [sioc:next\_by\_date](https://www.w3.org/Submission/sioc-spec/#term_next_by_date) [sioc:next\_version](https://www.w3.org/Submission/sioc-spec/#term_next_version) [sioc:previous\_by\_date](https://www.w3.org/Submission/sioc-spec/#term_previous_by_date) [sioc:previous\_version](https://www.w3.org/Submission/sioc-spec/#term_previous_version) [sioc:reply\_of](https://www.w3.org/Submission/sioc-spec/#term_reply_of)  in-domain-of: [sioc:about](https://www.w3.org/Submission/sioc-spec/#term_about) [sioc:has\_container](https://www.w3.org/Submission/sioc-spec/#term_has_container) [sioc:has\_creator](https://www.w3.org/Submission/sioc-spec/#term_has_creator) [sioc:has\_modifier](https://www.w3.org/Submission/sioc-spec/#term_has_modifier) [sioc:has\_reply](https://www.w3.org/Submission/sioc-spec/#term_has_reply) [sioc:ip\_address](https://www.w3.org/Submission/sioc-spec/#term_ip_address) [sioc:next\_by\_date](https://www.w3.org/Submission/sioc-spec/#term_next_by_date) [sioc:next\_version](https://www.w3.org/Submission/sioc-spec/#term_next_version) [sioc:previous\_by\_date](https://www.w3.org/Submission/sioc-spec/#term_previous_by_date) [sioc:previous\_version](https://www.w3.org/Submission/sioc-spec/#term_previous_version) [sioc:reply\_of](https://www.w3.org/Submission/sioc-spec/#term_reply_of) |
| sioc:Post | An article or message that can be posted to a Forum. sub-class-of: [sioc:Item](https://www.w3.org/Submission/sioc-spec/#term_Item) in-range-of: [sioc:related\_to](https://www.w3.org/Submission/sioc-spec/#term_related_to) [sioc:sibling](https://www.w3.org/Submission/sioc-spec/#term_sibling) in-domain-of: s[ioc:attachment](https://www.w3.org/Submission/sioc-spec/#term_attachment) [sioc:content](https://www.w3.org/Submission/sioc-spec/#term_content) [sioc:note](https://www.w3.org/Submission/sioc-spec/#term_note) [sioc:num\_replies](https://www.w3.org/Submission/sioc-spec/#term_num_replies) [sioc:related\_to](https://www.w3.org/Submission/sioc-spec/#term_related_to) [sioc:sibling](https://www.w3.org/Submission/sioc-spec/#term_sibling) |
| sioc:Role | A Role is a function of a User within a scope of a particular Forum, Site, etc. in-range-of: [sioc:has\_function](https://www.w3.org/Submission/sioc-spec/#term_has_function) [sioc:scope\_of](https://www.w3.org/Submission/sioc-spec/#term_scope_of) in-domain-of: [sioc:function\_of](https://www.w3.org/Submission/sioc-spec/#term_function_of) [sioc:has\_scope](https://www.w3.org/Submission/sioc-spec/#term_has_scope) |
| sioc:Site | A Site can be the location of an online community or set of communities, with Users and Usergroups creating Items in a set of Containers. It can be thought of as a web-accessible data Space. sub-class-of: [sioc:Space](https://www.w3.org/Submission/sioc-spec/#term_Space) in-range-of: [sioc:administrator\_of](https://www.w3.org/Submission/sioc-spec/#term_administrator_of) [sioc:has\_host](https://www.w3.org/Submission/sioc-spec/#term_has_host) in-domain-of: [sioc:has\_administrator](https://www.w3.org/Submission/sioc-spec/#term_has_administrator) [sioc:host\_of](https://www.w3.org/Submission/sioc-spec/#term_host_of) |
| sioc:Space | A Space is a place where data resides, e.g., on a website, desktop, fileshare, etc. in-range-of: [sioc:has\_space](https://www.w3.org/Submission/sioc-spec/#term_has_space) [sioc:usergroup\_of](https://www.w3.org/Submission/sioc-spec/#term_usergroup_of) in-domain-of: [sioc:has\_usergroup](https://www.w3.org/Submission/sioc-spec/#term_has_usergroup) [sioc:space\_of](https://www.w3.org/Submission/sioc-spec/#term_space_of) |
| sioc:Thread | A container for a series of threaded discussion Posts or Items. sub-class-of: [sioc:Container](https://www.w3.org/Submission/sioc-spec/#term_Container) |
| sioc:UserAccount /  sioc:User | A User account in an online community site. sub-class-of: [foaf:OnlineAccount](http://xmlns.com/foaf/0.1/OnlineAccount) in-range-of: [sioc:function\_of](https://www.w3.org/Submission/sioc-spec/#term_function_of) [sioc:has\_administrator](https://www.w3.org/Submission/sioc-spec/#term_has_administrator) [sioc:has\_creator](https://www.w3.org/Submission/sioc-spec/#term_has_creator) [sioc:has\_member](https://www.w3.org/Submission/sioc-spec/#term_has_member) [sioc:has\_moderator](https://www.w3.org/Submission/sioc-spec/#term_has_moderator) [sioc:has\_modifier](https://www.w3.org/Submission/sioc-spec/#term_has_modifier) [sioc:has\_owner](https://www.w3.org/Submission/sioc-spec/#term_has_owner) [sioc:has\_subscriber](https://www.w3.org/Submission/sioc-spec/#term_has_subscriber) in-domain-of: [sioc:account\_of](https://www.w3.org/Submission/sioc-spec/#term_account_of) [sioc:administrator\_of](https://www.w3.org/Submission/sioc-spec/#term_administrator_of) [sioc:avatar](https://www.w3.org/Submission/sioc-spec/#term_avatar) [sioc:creator\_of](https://www.w3.org/Submission/sioc-spec/#term_creator_of) [sioc:email](https://www.w3.org/Submission/sioc-spec/#term_email) [sioc:email\_sha1](https://www.w3.org/Submission/sioc-spec/#term_email_sha1) [sioc:has\_function](https://www.w3.org/Submission/sioc-spec/#term_has_function) [sioc:member\_of](https://www.w3.org/Submission/sioc-spec/#term_member_of) [sioc:moderator\_of](https://www.w3.org/Submission/sioc-spec/#term_moderator_of) [sioc:modifier\_of](https://www.w3.org/Submission/sioc-spec/#term_modifier_of) [sioc:owner\_of](https://www.w3.org/Submission/sioc-spec/#term_owner_of) [sioc:subscriber\_of](https://www.w3.org/Submission/sioc-spec/#term_subscriber_of) |
| sioc:Usergroup | A set of User accounts whose owners have a common purpose or interest. Can be used for access control purposes. in-range-of: [sioc:has\_usergroup](https://www.w3.org/Submission/sioc-spec/#term_has_usergroup) [sioc:member\_of](https://www.w3.org/Submission/sioc-spec/#term_member_of) in-domain-of: [sioc:has\_member](https://www.w3.org/Submission/sioc-spec/#term_has_member) [sioc:usergroup\_of](https://www.w3.org/Submission/sioc-spec/#term_usergroup_of) |

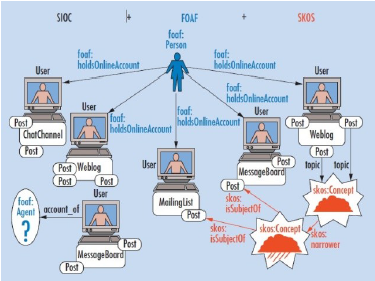
**TABLE III. SIOC Classes and Properties**

**TABLE II. FOAF Classes and Properties**

Figure 1 also shows the relationships between the four ontologies and it helps explain how to create a framework using them. FOAF documents can be used to describe personal information of social network profiles, which can be enhanced by the use of DC’s elements that in turn would help describe the user’s information more meaningfully. Then, the SIOC ontology can be used to map its classes and properties that describe activities in online social community sites to existing vocabularies such as FOAF, RSS and SKOS. The authors use a common example to illustrate these relationships, saying that the property foaf:Person describes a person who also happens to have different online accounts. Then, the sioc:User class defines the same person on different online community sites. This person/user can create any content on his/her sites by using sioc:Item or post content by using sioc:Post. They are related since the class sioc:User is a sub-class of foaf:OnlineAccount and the property foaf:holdsOnlineAccount is able to link a person to all his/her online accounts. SKOS classes and properties such as skos:Concept and skos:isSubjectOf describe the contents of the posts and the information itself within the user’s online accounts. Therefore, the three ontologies (SIOC, FOAF and SKOS) can be used together in collaboration to produce an integrated framework.

|  |  |
| --- | --- |
| **Elements** | **Definition** |
| Contributor | An entity responsible for making contributions to the resource. |
| Coverage | The spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant. |
| Creator | An entity primarily responsible for making the resource. |
| Date | A point or period of time associated with an event in the lifecycle of the resource. |
| Description | An account of the resource. |
| Format | The file format, physical medium, or dimensions of the resource. |
| Identifier | An unambiguous reference to the resource within a given context. |
| Language | A language of the resource. |
| Publisher | An entity responsible for making the resource available. |
| Relation | A related resource. |
| Rights | Information about rights held in and over the resource. |
| Source | A related resource from which the described resource is derived. |
| Subject | The topic of the resource. |
| Title | A name given to the resource. |
| Type | The nature or genre of the resource. |

**Fig. 1 Relationships between Ontologies**



Conclusion for this paper:

In the authors’ opinion, the related classes and properties of the discussed semantic web ontologies would help build a holistic framework that can describe user-generated content in social network sites and connect them appropriately. They propose that the use of FOAF can help define multiple accounts in social network sites belonging to the same user, which would allow for SIOC to articulate user-content on the sites. Then by using SKOS, it would be possible to define the most related ontology to each user-content and tag it appropriately.

**TABLE IV. Dublin Core (DC) Elements which describe properties of SIOC content items.**

However, the authors only explored the current ontology technologies and their possible interaction to build the mentioned framework, but neither implemented such framework nor tested it empirically on social network sites to see whether it achieved the goals of creating more connectivity and having a better user content management system. They mentioned further work was necessary to convert the theoretical framework into a practical one.

Sources for tables (these sources are enclosed in [] and highlighted yellow above when mentioning TABLES I to IV):

Sioc source: <https://www.w3.org/Submission/sioc-spec/>

dc source: <http://dublincore.org/documents/usageguide/elements.shtml>

Foaf source: <http://xmlns.com/foaf/spec/>

Skos source: <https://www.w3.org/TR/2005/WD-swbp-skos-core-spec-20051102/#classesTitle>