Position Paper: Modeling Roles in UBL

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Date: 2/22/02

Filename: draft-burcham-rolemodel-03.doc

1 Summary

There was much discussion NDRSC during the recent face-to-face meetings regarding possible rules regarding the cardinality between Tag Names and Types. Various options were explored and candidate rules were put to straw poll. The exercise did not result in firm resolution. At least one candidate rule is still on the docket for further discussion.

This paper presents a fairly complete exploration of the options. The exploration results in the conclusion that none of the candidate rules are viable.

That result (the absence of rule providing guidance in this area) has been termed "anarchy" by some NDR SC members. A new concept – that of *role*, is introduced to address the issue. Rules relating to the identification and definition of roles in UBL are presented.

2 Problem Description

The problem, as it originally arose in the NDR SC seemed to center on the cardinality between tag names and types. In this section we consider various combinations of tag name/type name uniqueness.

In thinking about it some more there are four top-level cases:

- If tag names match then…
- If tag names don't match then…
- If types match then…
- If types don't match then…

Then for each there are three sub-cases, e.g.

a. If tag names match then type names *must* match
b. If tag names match then type names *must not* match
c. If tag names match then we can draw no conclusion regarding types (don't care)

Combining these cases (cross product) we arrive at 12 possibilities:

case	Thing-1	Match	Thing-2	Must Match	Must Not Match	Don't care
1	Tag name	✓	Type	✓		
2	Tag name	✓	Type		✓	
3	Tag name	✓	Type			✓
4	Tag name		Type	✓		
5	Tag name		Type		✓	
6	Tag name		Type			✓
7	Type	✓	Tag name	✓		
8	Type	✓	Tag name		✓	
9	Type	✓	Tag name			✓
10	Type		Tag name	✓		
11	Type		Tag name		✓	
12	Type		Tag name			✓

The way to read this table is, e.g. case 1: if tag names match then types must match, or more formally:

$$tagname_a = tagname_b \rightarrow type_a = type_b$$

Cases 1-6 draw conclusions about type names from statements about tag names. Cases 7-12 do the reverse.

Cases 3, 6, 9, 12 correspond to the absence of any design rule – the default case should we decide to make no rule. Those cases encompass the "may match" and "may not match" cases as well. Those cases are grayed to show that will not be considered further.

Case 2: "if tag names match then type must not match" can be eliminated intuitively.

Cases 4, 8, 10 can be eliminated similarly. Those have been grayed as well.

This leaves for candidate rules, cases: 1, 5, 7, 11.

If we express cases 5 and 7 as propositions, however, we see they are identical:

Case 5 is:	$tagname_a \neq tagname_b \rightarrow type_a \neq type_b$
In propositional form that's:	$NOT(tagname_a \neq tagname_b)\mathrm{OR}(type_a \neq type_b)$
Simplifying:	$(tagname_a = tagname_b)\mathrm{OR}(type_a \neq type_b)$
Case 7 is:	$type_a = type_b \rightarrow tagname_a = tagname_b$
In propositional form:	$NOT(type_a = type_b)\mathrm{OR}(tagname_a = tagname_b)$
Simplifying and rearranging:	$(tagname_a = tagname_b)\mathrm{OR}(type_a \neq type_b)$

Similarly for cases 1 and 11:

Case 1 is:	$tagname_a = tagname_b \rightarrow type_a = type_b$
In propositional form that's:	$\mathit{NOT}(tagname_a = tagname_b)\mathrm{OR}(type_a = type_b)$
Simplifying and rearranging:	$(type_a = type_b)\mathrm{OR}(tagname_a \neq tagname_b)$
Case 11 is:	$type_a \neq type_b \rightarrow tagname_a \neq tagname_b$
In propositional form:	$\mathrm{NOT}(type_a \neq type_b)\mathrm{OR}(tagname_a \neq tagname_b)$
Simplifying:	$(type_a = type_b)\mathrm{OR}(tagname_a \neq tagname_b)$

Similar derivations show that cases 2 and 8 are identical, as are cases 4 and 10. All the duplicate cases have been grayed-out in the table to show that they can be ignored.

So the only options requiring consideration are cases 1 and 5 and possibly combinations of those. These options are explored in subsequent sections.

3 Option 1: if tag names match then types must match

(from Case 1) dictates that for each type there be a set of reserved tag names, usable only for elements of that type. It would be ok for two elements of the same type to have different tag names so long as both names came from the list for that type.

– Requires LC SC to record with each type, the list of (local) tag names used for that type, and to reconcile candidate tag names against those lists – changing candidate names when clashes occur.

+ When a (local) tag name is encountered it would be possible (using the aforementioned lists of type-to-tag-name associations) to infer the type name from the (local) tag name. If those lists were mostly short (length 1) then this might even be possible from memory.

– If the lists are short (length 1) then we have essentially devolved into a 1-1 correspondence between type and tag names. (1-1 correspondence is considered in section 5 below).

4 Option 2: if types match then tag names must match

(from Case 5[1]) dictates that for each type there be a single tag name. Every element of that type would use that tag name. However, two types would be allowed to share a tag name.

[1] In the NDRSC we were discussing case 7 (disguised as it's twin – case 5). When it is worded as in 5 it may be harder to understand. This may have led to confusion.

This option precludes the creation/use of tag names tailored for their role in a particular type. Instead, given the type of the element, you'd be stuck with a particular tag name.

– If a type contained two (local) elements of the same type, you'd have to either break this rule (and give one element a different tag name), or use *position* to distinguish the meaning of the two elements (in the context of the type).

– This option allows for elements of two different types to share tag names, so it is not possible to infer the type from the tag name when reading an instance document.

5 Option 3: 1-1 Correspondence Between Types and Tag Names

We can also express these situations simply in terms of their cardinality. For instance in Case 1 the cardinality is: *type* (1-0..*) *tag name,* and for Case 5: *type* (1..*-0..1) *tag name*.

In order to arrive at a 1-1 cardinality we would have to take these two rules together.

(from Case 1 and 5 taken together): each tag name corresponds to one Type and all elements of a particular Type share the same tag name.

– This option is tantamount to global tag names. That option has already been rejected by the SC.

6 Recommendation

During the face-to-face there was some discussion of high level design drivers. Three important ones that kept coming up were:

- Readability of an instance document
- Ease of instance construction
- Ease of instance processing

When considered against those three drivers, none of the candidate rules (options 1-3 above) has significant value.

The illusory benefits of options 1 or 2 taken in isolation devolve quickly into option 3 (1-1 correspondence of type name to tag name). The latter has already been rejected by the NDR SC.

Perhaps the story doesn't end there though. There is may be a need to capture recurring patterns of structure *use*. The problem with global element names is that in our zeal to capture usage patterns we enforce *everywhere* the overhead of formulating a globally unique and meaningful name.

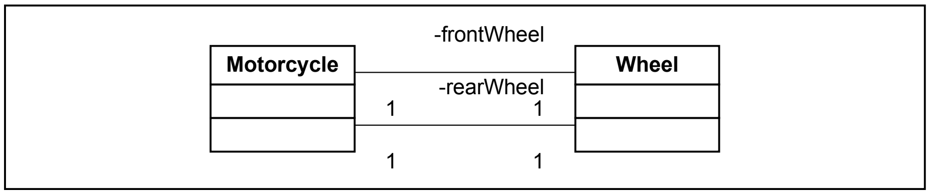
We already capture recurring *structures*/semantics with XML types (corresponding to CC ABIE's). Is there a way to capture (and identify) recurring *usage* patterns while not imposing the use of a globally unique name for every single element in the schema?

6.1 Enter: Properties and Roles

Roles[2] are an essential part of many modeling languages, such as UML and Entity Relationship or ER. Unfortunately roles and associations seem to be absent in the UBL model , and the UN Core Components [CC-UN] and ISO 11179 [NAMING-ISO] models upon which it is based.

[2] There is a difference between a role and an association. Generally, a role is one side of an association. A role is a one-way mapping. An association is usually 2-way, but may in general be n-way. The "arity" of the association corresponds to the number of roles in that association. Also an association in most modeling methods may also carry its own data and is usually given a "first class" identifier whereas roles generally are simply named (and described) concepts.

A simple example will illustrate the role concept. The following picture depicts a motorcycle with two wheels, front and rear.



It is common practice when *realizing* a model including roles (in a modeling language such as UML or ER), in particular implementation language (such as XSD, Java or SQL) to use the role name in the implementation. This mapping is very natural, for instance:

- In Java, role names become names of fields (of reference types) (see section 23.4.2 on page 300 of [UML-APPLY])
- In SQL, role names become names of foreign key fields
- In XML role names become element names (see section *Mapping UML Compositions* on page 107 of [XML-UML])

So mapping the UML model into XML might yield a scheme like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <xs:complexType name="Motorcycle">
        <xs:all>
            <xs:element name="FrontWheel" type="Wheel"/>
            <xs:element name="RearWheel" type="Wheel"/>
        </xs:all>
    </xs:complexType>
    <xs:simpleType name="Wheel">
        <xs:restriction/>
    </xs:simpleType>
</xs:schema>
```

Notice how type Motorcycle has e.g. an element called FrontWheel of type Wheel. Notice also, how the role name “frontWheel” from the model was used to arrive at the element name “FrontWheel” in the schema.

Much of the contention over element naming in UBL stems from the imprecise treatment of “properties” in UN Core Components Technical Specification [CC-UN]. While that specification *does* talk extensively about “property terms” – which are part of a “dictionary entry name” for a “data element” (a la [NAMING-ISO]), we are left to *infer* the existence and makeup of a “first class” property concept.

The term “property” is used often in that specification, but it is never formally defined[3]. Further, it never appears in any of the conceptual diagrams. Little wonder therefore, that the concept of *role* as discussed here would be entirely absent, tied up as it is with the concept of property.

[3] Additionally, the term “child field” is used in some of the examples in that specification. That term is used synonymously to “property”, and is also left undefined.

So here we are (in particular the LC SC) trying to build analysis artifacts. We are trying to give "property terms" to things. What things are we trying to give them to? Well CC doesn't tell us! Let us propose:

P0: The UBL model must include the concept of *property*. Property is the model element named by a *property term* in the same way as a *BIE* or a *CC* is the model element named by an object class (name).

Further, once we identify and describe these properties, what shall we call them? Could a set of rules around role definition satisfy our need to capture recurring component usage patterns (and name them)? Perhaps the central tenet would be:

P1: Role-based element/property naming: *every* element's tag name should reflect the role played by that element's content *relative to* the XSD type in which that element is declared.

In this way, roles are divorced from types. Then we might make rules like this:

P2: A catalog of roles will be maintained. Each role will be uniquely named and described.

For instance, we might have roles: ***Header**, **Summary*** and ***Detail*** in such a catalog. When these came up in NDR SC it was amazing to me how polarized we were. One faction believed that since Order and Invoice both have these components that they should be called the same thing in both situations. The other thought that would be confusing since an OrderHeader is different from an InvoiceHeader. Both factions felt that their approach would be less confusing.

This catalog need *not* require an entry for *every* element/property/child field. Such a requirement would cause devolution into an element catalog, which is not what we're after. It would also dilute the strength of the more powerful entries such as Header, Summary, Detail.

P3: Candidacy for this catalog could be left to a matter of taste, or we could come up with a metric that e.g. only roles occurring or expected to occur more than once are candidates. It will boil down to a combination of experience and taste.

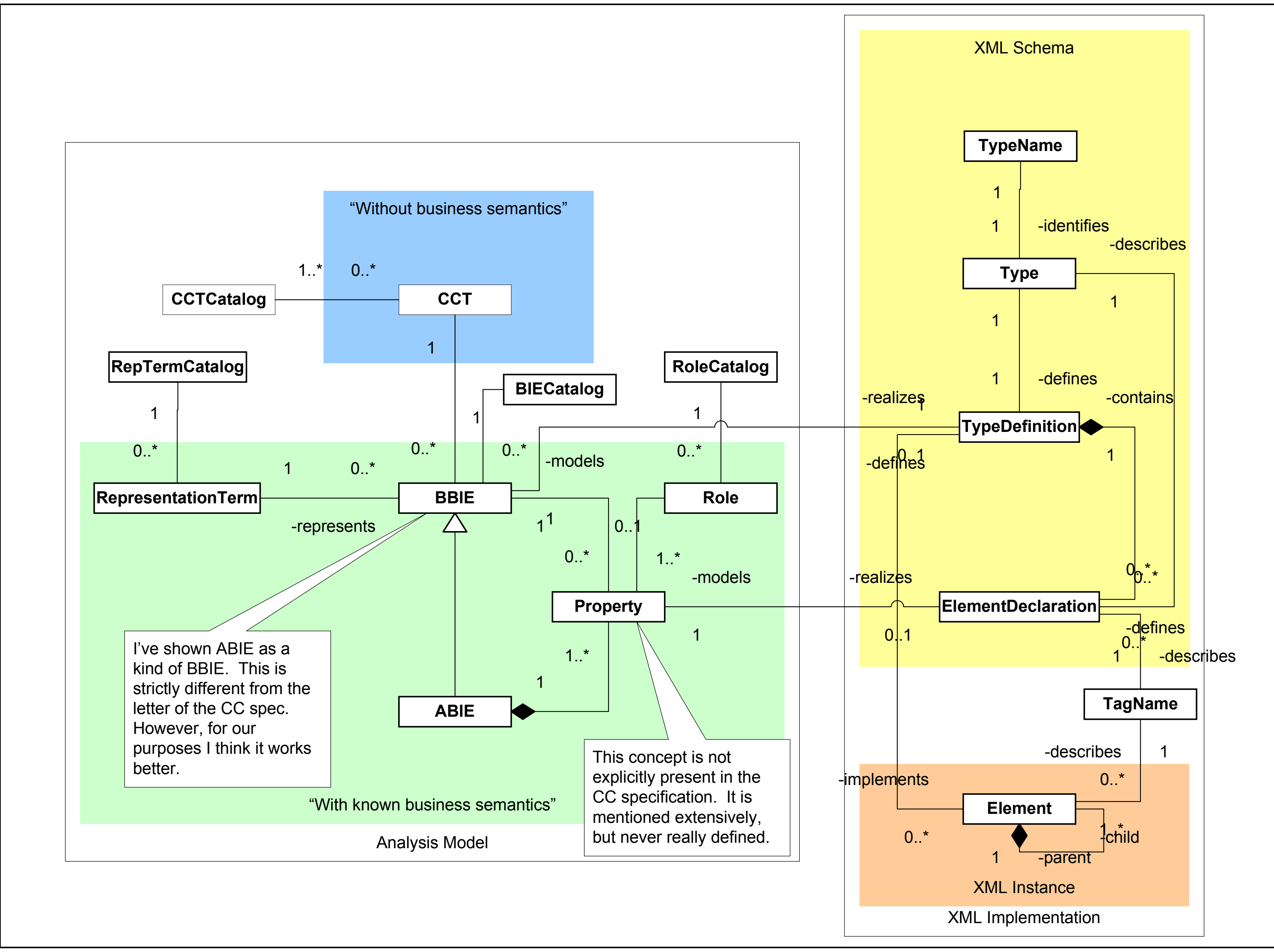
Then where these roles occur in the analysis model, we could use the role name to induce the tag name:

P4: When naming an element/property consider its role. Reconcile against the role catalog.

The roles would be linked to the element catalog. Where appropriate, a (local) element definition would refer to the (cataloged) role represented by that element.

P5: The element catalog would associate an element with its role definition (if any).

The following conceptual class diagram sums up the recommendation:

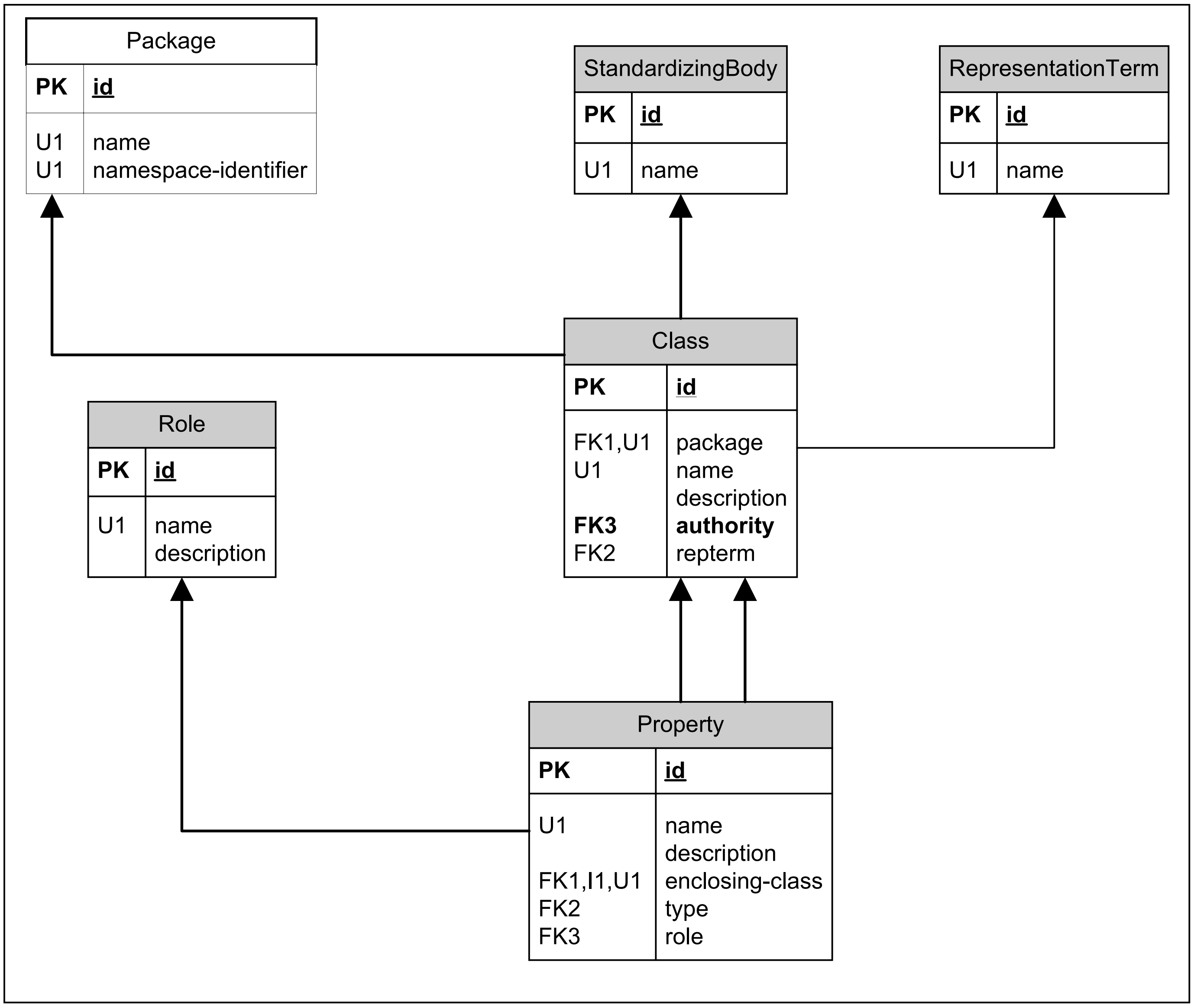


XML Schema
TypeName
Type
TypeDefinition
ElementDeclaration
TagName
Element
XML Instance
XML Implementation
"Without business semantics"
CCTCatalog
CCT
RepTermCatalog
BIECatalog
RoleCatalog
RepresentationTerm
BBIE
Role
Property
ABIE
-identifies
-describes
-defines
-contains
-realizes
-models
-represents
-implements
-child
-parent
I've shown ABIE as a kind of BBIE. This is strictly different from the letter of the CC spec. However, for our purposes I think it works better.
This concept is not explicitly present in the CC specification. It is mentioned extensively, but never really defined.
"With known business semantics"
Analysis Model

We propose the addition of the *property* and *role* concepts to our model, along with a *role catalog* and accompanying design rules. This constitutes a nice middle ground between "anarchy" and a "flat namespace" for properties/elements. This will allow us to capture *recurring usage patterns* of structures while allowing for efficient construction of property names appropriate to their use.

7 Appendix: Sample UBL Modeling Artifact Schema

Here is a non-normative peek at an actual catalog structure supporting the recommendations:



8 References

CC-UN	*UN/CEFACT Draft Core Components Specification, Part 1*, 15 January, 2002, version 1.75	
NAMING-ISO	*ISO/IEC 11179,* Final committee draft, Parts 1-6.	
UML-APPLY	*Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design*	
XML-UML	*Modeling XML Applications with UML: Practical e-Business Applications,* David Carlson, 2001, Addison-Wesley.	