A Domain Specific Language for Usage Management

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ABSTRACT

In the course of this paper we will develop a domain specific language (DSL) for expressing usage management policies and associating those policies with managed artifacts. We begin by framing a use model for the language, including generalized use cases, a loose ontology, an general supported lifecycle, and specific extension requirements. We then develop the language from that model, demonstrating key syntactic elements and highlighting the technology behind the language while tracing features back to the initial model. We also compare and contrast this DSL with others developed for rights management (e.g. Ponder). We then demonstrate how the DSL supports common usage management and DRM-centric environments, including creative commons, the extensible rights markup language (XRML), and the open digital rights language (ODRL).

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous; D.2.8 [**Software Engineering**]: Metrics—*complexity measures, performance measures*

General Terms

Theory

Keywords

DRM, usage management, software architecture

1. INTRODUCTION

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1.1   Previous Work

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2.   LANGUAGE MODEL

In developing this DSL, we needed to have a clear understanding of the specific domain, and develop and appropriate domain model to guide our efforts. Admittedly, there exist many possible models that can describe this area of policy and policy management, and the model that we chose to initially use is purposefully simple to help ease development and implementation efforts. We did however provide arbitrary language-level extensibility to support future extension into more demanding policy implementation areas.

We developed this model to help us understand how policy-centric DSLs would be used, to visualize how the various elements are inter-related, and to clarify important areas upon which to focus effort. Through this model, we were able to conceptualize the initial language structure and generate performance hierarchies, as well as to tailor expected DSL use.

2.1   Expected Use

In order to develop the appropriate DSL giving users the power and expressivity they need to easily express usage management concepts, we begin by developing a model describing how we expect it to be used, and by whom, identifying key functional and non-functional characteristics. We use roles codified as actors to identify the primary user base, and link those roles to specific use cases we expect to be common in day to day DSL use. We also identify common inputs and outputs from expected activities, and show how those input and output elements are related. We finally specify the essential core structure of the DSL, as well as extension points and default implementations of those points.

In general day to day use, we expect that certain activities will be much more common that others. For example, each *policy* requires a *context* in order to both be developed and to run. That *context* describes the actors using an artifact protected by a policy, the artifact itself, and the environment in which the artifact is both expected to be used (during policy design) and is being used (at evaluation). That said, the expectation is that the number of policies is much greater than the number of contexts associated with those policies.

Likewise, we expect that the number of times a policy is evaluated is much greater than the number of times that policy is designed and created. Policies should be read, evaluated, or combined with other policies frequently. This gives us a magnitude ordering for these activities, where the number of supported contexts is much less than the number of created policies, which is in turn much less than the number of times that policy is evaluated or otherwise used.

This has specific implications on both the DSL syntax and performance profile. For example, as it is much more common for policies to be evaluated than contexts to be created, our efforts and tuning the system and increasing performance are best focused on policy evaluation rather than contextual activities. In a similar vein, the language itself should be as simple to comprehend as possible for policies at the expense of contextual elements if necessary.

Figure 1 shows the primary system actors we have identified as well as the use cases with which they will be involved. Actors include:

- *Context Author*. The context author is responsible for defining the context in which a policy will be applied
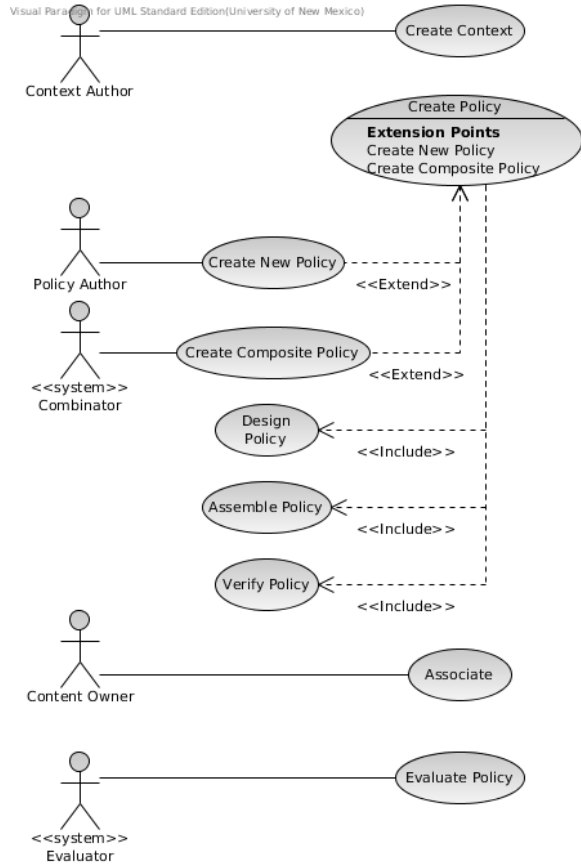
Figure 1: General DSL Use Cases

Figure 2: Basic Language Ontology

Figure 3: Policy Development Lifecycle

to a given resource. The context itself defines the environment in which the policy executes, the resource to which the policy is applied, and the subject that attempts to use the resource.

- *Policy Author.* The policy author creates a policy to control the use of a subject defined in the policy context.

- *Combinator.* A system element, generally. A combinator in this context combines two or more policies into a single composite policy.

- *Content Owner.* The owner of a protected resource.

- *Evaluator.* Another system element, an evaluator evaluates a given policy with a specific context.

When a context author creates a context, that author compiles the elements of that context for use both at policy creation and policy execution. When the policy is initially created, the resource is the only defined element. Generally both the subject, representing the eventual user, and the environment, containing information describing the evaluation environment, are only defined at the classifier level. That is to say, they both are defined, but individual properties have yet to be assigned.

Creating a policy is an activity undertaken by either a policy author or a combinator. This step requires a *declared* (but
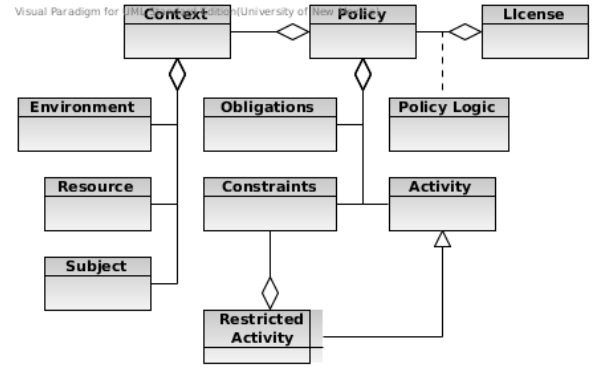
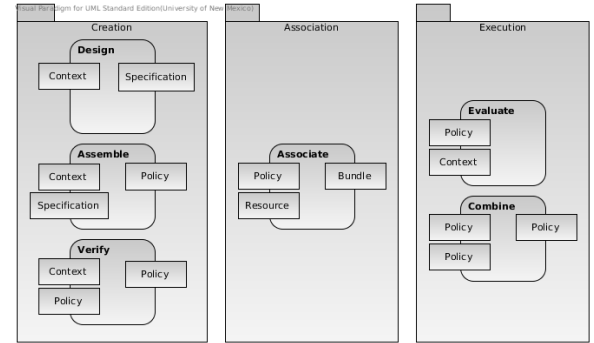not *defined*) context. This is also undertaken in tandem with some kind of policy specification that describes roughly what the policy should manage and how it should be managed. In the ontology we have defined, this is the step at which the author defines the various constraints, activities, restricted activities, and obligations. Creating a new policy is precisely what it describes - creating a brand new policy applied to a context. Creating a composite policy, on the other hand, involves creating a new derivative policy from two or more previously existing policies.

The included cases define policy, assemble policy, and verify policy are common development steps through which the policy is essentially designed, developed, and then tested against a context.

Once a policy has been created, the content owner can then associate that policy with a resource, essentially instantiating the resource in the associated context.

Finally, a policy is evaluated by an evaluator, a system actor, after creation and association with a resource. At this point, the context has a fully instantiated context, with defined resource, subject, and environmental elements.

2.2 Domain Ontology
2.3 Envisioned Lifecycle
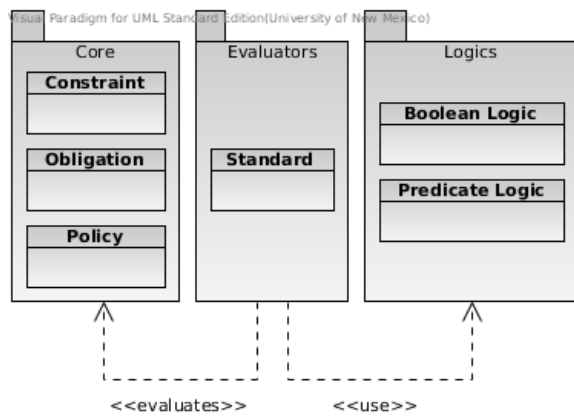## 2.4 Language Components
3. LANGUAGE
Language implementation

Figure 4: Language Elements

4. APPLIED

Application section

4.1 Creative Commons

Creative commons applied

4.2 XRML

XRML applied

4.3 ODRL

ODRL applied

5. CONCLUSIONS AND FUTURE WORKS

Conclusion & future works