Classification of the Current Constraint and Capabilities Protocols in Describing Web Services

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Abstract. We consider three layers of classification applicable to the description of the Web services stack: Policies, Service Level Agreements and Business Level Agreements. We attempt to define what each of these means and what properties each have. We then classify each of several existing protocols and standards with respect to our definitions in order to show any overlaps or gaps among these protocols. We assert that more granular classification of the Business Level Agreement is required as it covers a broad range of requirements.

Background

In the Web services conceptual stack [1], three sub-layers represent constraints and capabilities of Web services in a Service Oriented Architecture (SOA). These are Policy, Service Level Agreement (SLA) and Business Level Agreement (BLA). While other sub-layers, such as the interface description, composition and XML schema, have clear boundaries, there are unfortunately no such clear boundaries for the layers relating to constraints and capabilities. We outline one set of definitions here, but even if these are inadequate the need for definition remains.

Currently there are a number of protocols, standards-to-be and methodologies available to describe various aspects of Web services, including several aimed at constraints and capabilities. We wish to classify each of these proposed methodologies according to our definitions of the three layers in order to discover any gaps or overlaps in the current state of affairs.

Significance

There needs to be a consistent way of communicating constraints and capabilities among service users and service providers. For example, consider a use case in which a Web service wishes to stipulate that clients are required to support a reliable messaging protocol, along with a certain level of security, in order for the messages sent from the clients to be acceptable by the Web service. The Web service may also have its own set of policies for operation. The difficulty arises when the Web service needs to convey such constraints to its clients, as there are a number of protocols that can achieve this task

With the growth and wide acceptance of Web services, users should be able to:

- Match the available tools and products to their needs based on an understanding of the differences among the various classes of constraints and what each class represents.
- Design a reusable, flexible and scalable architecture in enterprise-wide applications by separating concerns that currently overlap.
- Avoid incompatibility among tools that should cover distinct areas, but absent clear boundaries, may in fact overlap in their target responsibilities.

An appropriate classification also allows tool vendors to:

- Target tools for specific purposes, and better integrate those tools into an overall solution for end-users.
- Keep up with the standards and position their products appropriately.

From the point of view of both the end user and the tool provider, a clear consensus about the purpose and limits of each protocol and proposed standard is essential for the growth of their businesses, as each can better understand and meet the needs of the other.

Classifiers

Others have suggested definitions for the constraints and capabilities layers of the Web Services stack [1]. We define classifiers for the three layers of constraints and capabilities as follows:

- *Business Level Agreements (BLA)*: A contractual agreement between two business partners. This type of agreement may involve a human in order for the activity to complete.
- *Service Level Agreement (SLA)*: Specifies performance, costs, metrics, and thresholds to which a service is expected to adhere. Perhaps obviously, Quality of Service parameters are service level agreements.
- *Policy*: Minimal criteria for communications. This excludes addressing and other aspects of connection mechanics (such as host and port), but does include attributes such as privileges, access control, and minimal security requirements.

We hope that these layers are exclusive of each other, and that the definitions have set a clear boundary from one to the next.

Standards to be classified

We now attempt to classify several current standards by the definitions above. Following is a brief summary of the standards examined.

1. *WS-Policy**: Defines a collection of one or more assertions. Assertions may specify traditional requirements such as authentication scheme and transport protocols used, or other requirements such as privacy policy and QoS characteristics [2]

2. *Semantic Web*: May be used to automate discovery and integration of services [3]
3. *RuleML*: Business logic oriented. Also provides a means of discovering Web services [4]
4. *Composite Capabilities/Preferences Profiles (CC/PP)*: Allows for sophisticated content negotiation techniques between web servers and clients, to produce optimized XML-based markup for display and use on a wide variety of web user agents [5]
5. *Platform for Privacy Preferences (P3P)*: Used by various sites or services to declare their privacy practices. Users also state their privacy settings, and browsers crosscheck the two before allowing a user to browse the site [6]
6. *Robots.txt*: Used to put restrictions and rules on spider agents [7]
7. *eXtensible Access Control Markup Language (XACML)*: A policy language and access control request/response language used to describe general access control requirements and where or certain tasks are allowed or disallowed. [8]
8. *IETF Policy Framework*: A framework that can represent, manage, share and reuse policies and policy information [9]
9. *Web Service Level Agreement*: Allows service customers and providers to unambiguously define a wide variety of SLAs, specify the SLA parameters and the way how they are measured, and relate them to managed resource instrumentations [10]
10. *Business Process Execution Language for Web Services (BPEL):* Describes a formal specification for business interaction between processes and their partners [11]
11. *WSDL Features and Properties:* Provides a framework for defining characteristics about abstract and concrete services. [12]

Analysis

Figure 1 shows how we classify existing efforts based on our proposed definitions. As shown in the figure, only the IETF Policy Framework stays within the boundaries of the scope of a particular sub-layer of the Web services description layer. The rest of the protocols either fall short or try to do more than they should.

For example, WS-Policy and WS-Policy framework try to address requirements such as QoS and privacy policy, which would be considered SLA requirements. In contrast, P3P is limited in scope and useful mainly for browsers. The scope of robots.txt is also very limited, but well defined and unlikely to conflict with other efforts. XACML describes policies well, but is also capable of representing such things as rules and policies on resource itself, which is part of the SLA classification.

The IETF Policy is just right as this protocol fits the description of the policy sub-layer given earlier. Web Semantics is hardest to describe as it is capable of covering all constraints and capabilities aspects of Web services, but this technology is still in its early stages of development.

BPEL also spans multiple classifications. The BLA capabilities of BPEL are far more mature; they are capable of concisely representing business–to-business relationships through “partner links”. BPEL allows for purchase orders, within which SLA properties such as the price (among others) can be transmitted, which pushes us to classify this effort as an SLA protocol as well. BPEL also supports the concept of

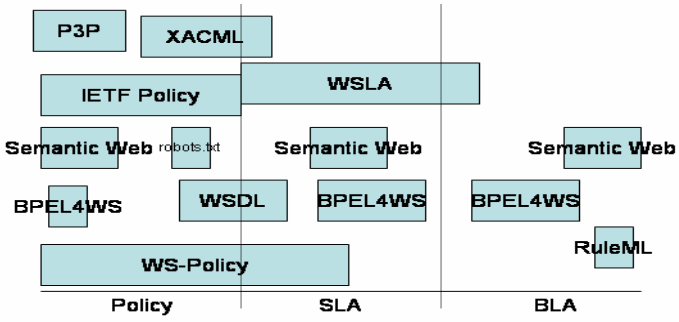
endpoints and other WSDL type properties that are used to link to partners, which suggests that it has a Policy nature as well.

RuleML is a simple protocol that can be used to represent business rules and relationship rules. It cannot fulfill either of the BLA requirements as it cannot model partnership.

WSLA is new protocol being developed by IBM. It has the potential to handle all the requirements of the SLA, and even some of the BLA partnership representations. It is still in early stages of being finalized, and further study is required for this protocol.

Finally, the WSDL features and properties potentially span a range. Properties can be used for the mechanics of establishing a connection, perhaps by identifying a protocol version, timeout values, or even a protocol implementation. If used in this way (as suggested by the August 3rd Working Draft of WSDL 2.0), these values do not even fit into the "Policy" classification. As currently specified, a WSDL "feature" could be used to describe minimal criteria for connection, but it could also identify a response-time range. This dual nature means that features could be classified as both Policy and SLA.

Figure 1. The classification of the current protocols



Future Trends

The Business Level Agreement sub-layer of the Web service stack description layer is still very much untouched in terms of protocols that are capable of modeling business partnerships. Among the protocols examined here, Semantic Web has the potential to automate business partner relationships. Areas for growth here include automatic searches for appropriate services, and dynamic rule-base development for further automating processes that would otherwise involve humans.

Conclusion

In this paper, we have attempted to classify ten constraints and capabilities efforts into three distinct groups: protocols that are capable of representing policies, SLA's and BLA's. We have considered a use case where a Web services wanted to stipulate a certain level of policies and constraints to its clients. We have shown that even though there are a number of protocols available, there still exists a gap between our definitions of appropriate layers, and the coverage and range of existing efforts to concisely and completely model the constraint and capabilities of Web services. Our suggestion is to pursue a dual strategy of more clearly defining the boundaries, while simultaneously working to fit existing or new standards into whatever appropriate framework is understood at the time, perhaps one such as the classification we present here. Further efforts may make Semantic Web a viable solution for describing BLA's.

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