Autonomic Policy-based Management using Web Services

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ABSTRACT

Network management requires a lot of manual work. Due to ongoing growth of the Internet, more self-management is needed in order to deal with the growing complexity. Policy-based management is an approach to simplify management by the use of rules. Policy refinement, i.e. breaking down high-level policies to technical configurations is still a task that needs manual work. We propose an architecture that uses Web services and automatic Web services composition as a complementary technique to policy refinement in order to automate policy-based management.

Categories and Subject Descriptors

C.2.3 [**Computer-Communication Networks**]: Network Operations

General Terms

Autonomic Communications, Policy-based Management, Web Services

1. INTRODUCTION

Network management currently requires a lot of manual interaction. The current growth of the Internet is expected to continue, so the number of connected devices will rise. Therefore, automation in network management not only helps reducing (personnel) costs, it becomes a need in order to handle the rising complexity.

Recently, self-management has come to the research focus in the networks and distributed systems domain. The term "Autonomic Communications" is often used to refer to networks that are partly autonomous, but still contain certain management interfaces.

The idea of addressing management from a more abstract point of view is not new. Extensive research under the keyword "Policy-based Management" has been done for more than a decade. Policy-based approaches ease management of complex networks and systems by separating functions and the description of the system's behavior using rules. These rules ("policies") can be expressed on different levels of abstraction. Generally speaking, there are high-level policies (HLP) and policies on a more technical level (LLP). Translating HLP into LLP is called policy refinement. There is no generic solution for policy refinement, but recent research results have shown that Semantic Web technology may be the first toolkit to solve this problem [1, 5, 2].

In the last years, Web services have been discussed as a possible base for management architectures [7, 6]. We believe, that Web services, enriched with semantic information, are well suited for policy-based management. Automatic Web services composition is a complementary technique to policy refinement and can help to make management more autonomic.

2. PROPOSED ARCHITECTURE

2.1 Device Layer

The network devices are located on the bottom layer of our architecture (see Figure 1). Some of them will offer Web services for configuration, for monitoring, and/or for notifications. They can conform to a (proposed) standard such as WSDM, WS-Management, of NETCONF, or they can be proprietary. Devices that do not support Web services can be accessed through gateways. The services that are provided by the devices either directly or via gateways are called low-level services (LLS).

2.2 Policy Engine

The policy engine is the core of our architecture. It contains the registry for management Web services, the repository where policies are stored and the component that makes policy decisions.

Network devices register their LLS in the registry, along with information about its structure and semantics. In addition to this data base, the registry contains a service composition engine that allows for combining LLS to higher-level services (HLS). The policy repository is quite similar to the Web services registry. It not only stores the policies, it also contains a policy refinement engine, that allows for breaking down HLP to LLP.

The decision component uses the services stored in the registry to monitor the devices. Based on these monitoring information, policies stored in the repository are enforced. These policy decisions lead to changes in the device config-

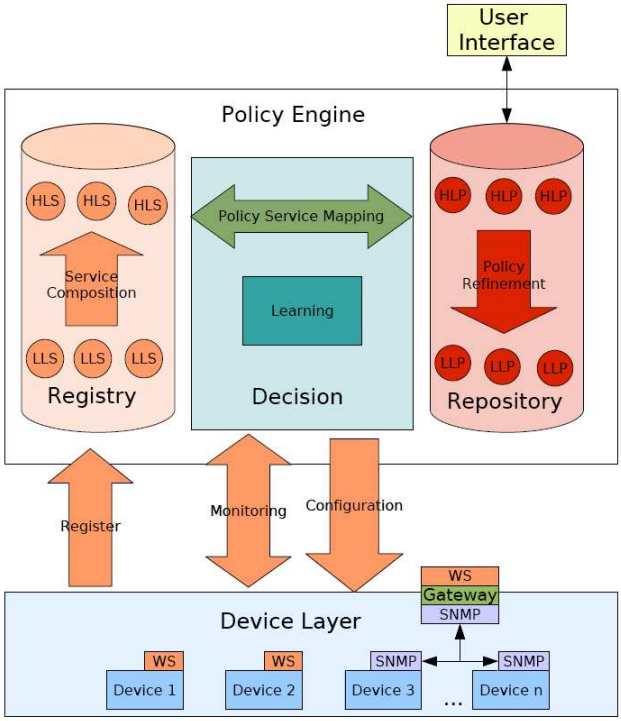

Figure 1: A Policy-based Architecture for Autonomic Communications

urations. They are realized by calling the appropriate configuration Web services of the devices. In order to find the appropriate Web services for monitoring and configuration, policies must be mapped to Web service calls.

2.3 User Interface

The user interface is located on top of the architecture. Administrators can use this interface to enter, remove, or change policies in the repository. Usually, administrators will specify HLP, which will be broken down to LLP in the repository.

3. INITIAL RESULTS

We have analyzed automatic Web service composition as a possibility to further automate network management. Furthermore, we have developed aNeMaC, a composition engine for network management Web services which allows to manage ontologies and service descriptions, and can generate plans from given task descriptions. Automatic Web service composition can be used to simplify complex network management tasks. aNeMaC with its network management ontology enables automatic composition that covers large parts of network management tasks. In order to use automatic service composition, the registry data base must support semantic information.

To avoid a constant polling for monitoring information, notification systems can be used. We compared several notification systems that support Web services (WS-Eventing, NETCONF notifications, WS-BaseNotification, and our own simple prototype) with traditional widely deployed solutions (syslog and SNMP traps). None of the analyzed notification system posed requirements that our architecture could not fulfill, so they all can be used in our architecture.

Our initial results on policy refinement show, that it is better to map policies to HLS as soon as possible, instead of completely breaking down HLP to LLP. However, these initial results still have to be validated.

4. FURTHER WORK

One of the first steps to take is to choose an appropriate information model. For policy modelling, a lot of different approaches have been developed. The IETF has specified a Policy Core Information Model, DMTF developed CIM. Furthermore, there are DEN-ng and NGOSS Shared Information and Data Model (SID). Recently, papers about integrating different models into an ontology have been published [3, 4, 8]. We will compare the different approaches and choose the best suited model. An additional requirement for the model is that it must be compatible with the service descriptions in the registry in order to enable policy-service-mapping.

Further research has to be done on policy refinement and policy-service-mapping. Moreover, the components of the architecture have to be implemented and tested in case studies.

5. REFERENCES

[1] D. Agrawal, K.-W. Lee, and J. Lobo. Policy-based Management of Networked Computing Systems. *IEEE Communications Magazine*, 43(10), Oct. 2005.

[2] S. Davy, K. Barrett, S. Balasubramaniam, et al. Policy-Based Architecture to Enable Autonomic Communications – A Position Paper. In *Proc. IEEE Consumer Communications and Networking Conference (CCNC)*, Las Vegas, USA, Jan. 2006.

[3] J. E. L. de Vergara, V. A. Villagrá, and J. Berrocal. On the Formalization of the Common Information Model Metaschema. In *Proc. 16th IFIP/IEEE International Workshop on Distributed Systems: Operations and Management (DSOM)*, Barcelona, Spain, Oct. 2005.

[4] A. Guerrero, V. A. Villagrá, J. E. L. de Vergara, et al. Ontology-Based Integration of Management Behaviour and Information Definitions Using SWRL and OWL. In *Proc. 16th IFIP/IEEE International Workshop on Distributed Systems: Operations and Management (DSOM)*, Barcelona, Spain, Oct. 2005.

[5] D. Lewis, K. Feeney, K. Carey, et al. Semantic-based Policy Engeneering for Autonomic Systems. In *Proc. 1st IFIP International Workshop on Autonomic Communication (WAC)*, Berlin, Germany, Oct. 2004.

[6] G. Pavlou, P. Flegkas, S. Gouveris, et al. On Management Technologies and the Potential of Web Services. *IEEE Communications Magazine*, 42(7), July 2004.

[7] J. Schönwälder, A. Pras, and J.-P. Martin-Flatin. On the Future of Internet Management Technologies. *IEEE Communications Magazine*, 41(10), Oct. 2003.

[8] A. K. Y. Wong, P. Ray, N. Parameswaran, et al. Ontology Mapping for the Interoperability Problem in Network Management. *IEEE Journal on Selected Areas in Communications*, 23(10), Oct. 2005.