Policy Management Approach for IP over WDM Networks: A Synthesis Study

N Vardalachos†, E Grampin‡, A Galis† and J Serrat‡

† University College London, {n.vardalachos, a.galis}@ee.ucl.ac.uk

‡ Universitat Polytachnica de Catalunya, {grampin, serrat}@tsc.upc.es

Abstract: This paper describes the policy based management architecture devised for management of IP over WDM networks and is part of the work carried out in the IST Project WINMAN, whose aim is to develop and validate an open and flexible integrated management system for this type of networks.

1. Introduction

Most trends in IP-WDM integration are extensions of the distributed Internet network control approach to the Optical Layer using signalling mechanisms either in an Overlay model or a Peer model. This paper proposes an alternative approach for managing Internet services over the Optical Transport Network by extending the telecom-style policy based network management approach to the IP layer over WDM [1]. The proposed management solution has been adopted and is being investigated by WINMAN [2] an ongoing European research and development project, whose aim is to offer an integrated network management solution for the provisioning of end-to-end IP connectivity services derived from Service Level Agreements (SLAs).

2. WINMAN System Architecture

The WINMAN management systems will be designed by applying mainly Open Distributed Processing (ODP) principles taking also into consideration the Telecommunications Management Network (TMN) framework. The TMN architecture structures the management complexity by layering the management applications, defining a common data model, enabling re-use of management data, and specifying system interfaces. ODP goes one step further, enabling the design of management applications that are independent of distribution, the underlying infrastructure and management protocols.

As shown in Figure 1, the WINMAN architecture consists of an Inter-Domain Network Management System (INMS) for Configuration, Fault and Performance Management on top of two Network Management Systems (NMS) for both IP and WDM technologies. As shown in the figure, the management systems for ATM and SDH are considered as well although they are not going to be taken into consideration at the design and development phases.

The INMS has open interfaces to the Service Management and the Network Management Systems of the different domains (WDM, IP, ATM, and SDH) and it is accessed by some categories of users through a GUI. The roles and actors in WINMAN are so diverse that other categories of users may prefer the access though an API instead of a closed GUI.

The development of the WINMAN architecture will be based on a subset of the CORBA Component Model (CCM) [3] with extensions specially conceived for the integrated management of IP and WDM. This approach will adhere to WINMAN all the benefits of the component-based technology. The components of the WINMAN systems could be distributed over a number of nodes connected by a Data Communication Network. The degree of distribution in that case is transparent to the components of the WINMAN solution. The components do not have knowledge on the location of the other components, whether they are collocated on the same node or running on a node thousands of kilometres away.

A fundamental part of the architecture is the information database of all the physical and logical data needed to manage the network. This database can be viewed as a large directory with open, standard interfaces as for instance LDAP. WINMAN will make use of Common Information Model - Directory Enabled Networks (CIM-DEN) models [4].

Furthermore, the architecture defines the functionality of each building block as well as the open interfaces encapsulating the different network elements and, thereby, logically decoupling the high level applications from the physical infrastructure. As previously stated WINMAN takes into account the management functional areas of Configuration Fault and Performance.

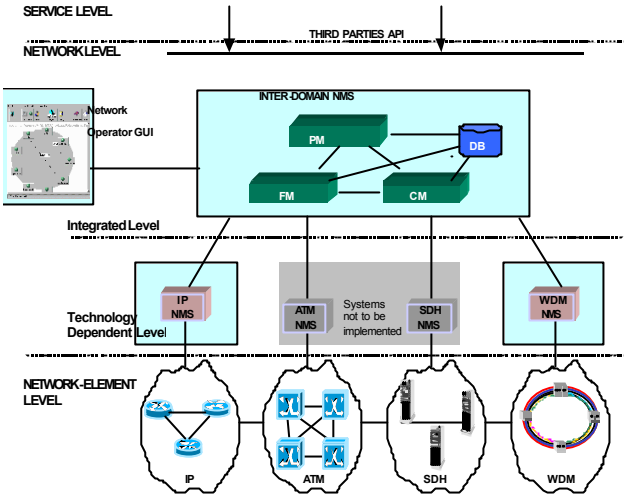

Figure 1: WINMAN Management Architecture

3. Policy Based Management

Policy Based Management (PBM), has been a 'hot' research topic in the last period. The aim of the policy based management is to apply integrated management so that system management, network management, and application management can cooperate. There are standardisation activities for policy management in IETF but the discussion is mainly about QoS issues. IETF's RAP working group has developed Common Open Policy Server (COPS) [5] protocol to manage policy information and there is also special Policy Framework working group [6], which is defining common framework for policy management, information model and specific schemata to framework and directory schema. The proposed information model is the Common Information Model (CIM) [7], which is specified in DMTF and proposed directory schema uses Light Weighted Directory Access protocol (LDAP) and Directory Enabled Networks (DEN). Having a closer look there are the two IETF groups, which are involved in the policy based management area:

- The Policy Framework Working Group (Policy)

  The Policy work group has developed a general model (for policy representation, policy management, policy sharing/reuse) as well as the Information model for representing policies. A policy is considered to be a set policy rules, and each policy rule is composed by set of conditions and a set of corresponding actions. All policy rules have the format 'if a condition occurs, then perform an action'. The main entities comprising the Policy Framework can be seen in figure 2.

- The Resource Allocation Protocol Working Group (RAP)

  The RAP working group has developed a framework specifically for policy based admission control, by specifying two main elements, known as the Policy Decision Point (PDP) and the Policy Enforcement Point (PEP). The PDP, as it's name implies, is the point at which the policy decisions are made. The PEP, on the other hand, is the point at which the policies are enforced (a network element that supports policy enforcement).

For more detailed description of the Frameworks described above, refer to [6], [8]. Apart from the IETF, the research community has been involved in the area of policies for management of networks as well. Furthermore the different types of policies have been identified by [9], [10].

The proposed architecture of the WINMAN specifications makes it possible for the development, provision and validation of a novel Integrated Network Management architecture for future IP networks, making use of Policy Based Network Management, viewing the policy management approach as a 'vehicle' for making late modifications to the functionality of it's management system.

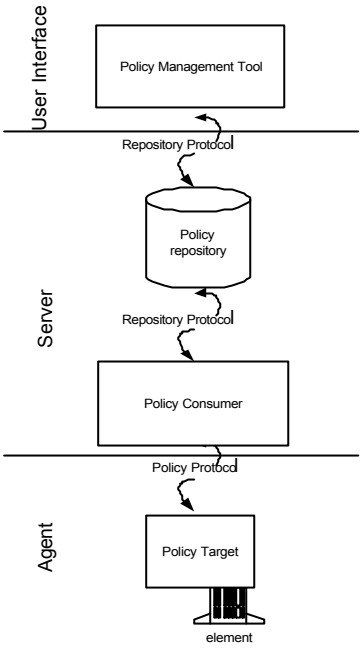

Figure 2: Policy Work Group Framework

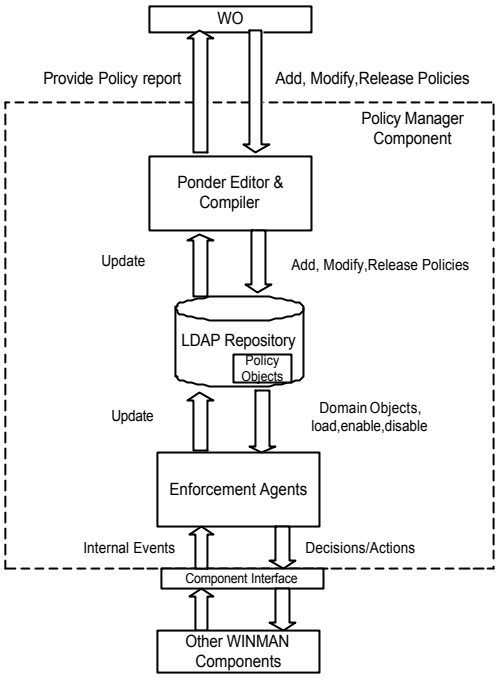

Figure 3: WINMAN Policy Manager Component

4. WINMAN Policy Manager Design

The WINMAN Policy Manager component consists of three main entities (figure 3), the PONDER editor/compiler (Policy Management Tool), an LDAP repository (Policy Repository) and some enforcement agents (Policy Consumer). The Policy Management Tool is composed by PONDER editor/compiler. Ponder is a declarative, object-oriented language [11], [12] for specifying security policies with role-based access control, as well as general-purpose management policies for specifying what actions are carried out when specific events occur within the system or what resources to allocate under specific conditions. Unlike many other policy specification notations, Ponder supports typed policy specifications. Policies can be written as parameterised types, and the types instantiated multiple times with different parameters in order to create new policies. Furthermore, new policy types can be derived from existing policy types, supporting policy extension through inheritance. The LDAP repository is used for storing the policies derived from the Policy management tool.

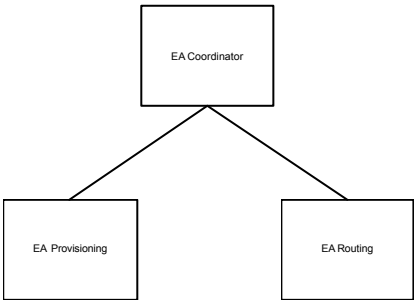

Figure 4: The policy Enforcement Agents

The enforcement agents (EA) are composing the heart of the policy manager. They can be split in two types: the coordinator and the enforcers. The coordinator is carrying the core of the Enforcement Agents functionalities. It provides common functions needed by all the other EAs and as it name states; it coordinates the enforcers in order to achieve the required interpretation of the policy to configuration parameters. Its main functionality can be summarised as follows: 1. It selects the appropriate EA to perform a given PDP/PEP function, 2. Accesses the external components and the internal policy repository (retrieve/store policy objects), 3. Reads the actual policy object status, (to provide policy status reports), 4. Performs the policy conflict check, using meta-policies. The EAProvisioning and EARouting, implement the required PDP/PEP functionality for provisioning and

routing. They communicate with the corresponding managers (provisioning the first one and routing the latter) in order to perform the enforcement of provisioning and routing policies. The Enforcement agents' functionality will be developed and integrated with the aforementioned entities in order to have a complete policy management system capable of setting, modifying, removing and executing policies.

5. Conclusions.

This paper gives an overview of the work carried out in the IST Project WINMAN (whose main task is to develop and validate an open and flexible integrated management system for IP over WDM networks), focusing on the policy based management approach adopted by the project. The project will contribute to the establishment and operation of worldwide IP over WDM networks. The trials envisaged in the WINMAN project would demonstrate inter-connectivity across a worldwide network management infrastructure in a multi-provider and multi-domain environment. During its two-year and a half life span, the WINMAN project will develop and validate innovative solutions in the field of integrated management of IP over WDM networks. The proposed management approach makes possible the development, provision and validation of a novel Integrated Network Management architecture for future IP over WDM networks.

6. Acknowledgements

This paper describes work undertaken and in progress in the context of the WINMAN – IST 13305, a two and a half years research and development project during 2000-2002. The IST programme is partially funded by the Commission of the European Union.

References.

[1] Vardalachos, N., Galis, A., Serrat, J., Garcia, J., Hoekstra, G.,"Policy Based Network Management for IP over WDM Networks", IEEE ICT 2001 Conference proceedings, Bucharest, Romania, 4-7 June 2001; ISBN 973-99995-3-0

[2] WINMAN project website, http://www.winman.org

[3] CORBA Component Model (CCM), http://ditec.um.es/~dsevilla/ccm/index.shtml

[4] Strassner J. "Directory Enabled Networks". MacMillan, Indianapolis, USA, 1999

[5] Durham, D., Boyle, J., Cohen, R., Herzog, S., Rajan, R, Sastry, A, "The COPS (Common Open Policy Service) Protocol, RFC: 2748, January 2000, ftp://ftp.funet.fi/rfc/rfc2748.txt

[6] IETF's Policy Framework Working Group policy web page http://www.ietf.org/html.charters/policy-charter.html

[7] Distributed Management Task Force, Common Information Model (CIM) Specification, Version 2.2, June 14, 1999.http://www.dmtf.org/spec/cim_spec_v22/

[8] IETF's Resource Allocation Working Group policy web page http://www.ietf.org/html.charters/rap-charter.html

[9] DSE website, Imperial College London, "Policies for Distributed Systems", http://www-dse.doc.ic.ac.uk/policies/

[10] Sloman, M., "Policy Driven Management for Distributed Systems", Journal of Network systems and systems management, vol 3,pp. 333-360, December 1994, Plenum Publishing

[11] Damianou, N., Dulay, N., Lupu, E., Sloman, M., "Ponder: A Language for specifying Security and Management Policies for Distributed Systems, V 2.3", *Imperial College Research Report DoC 2000/1* Oct. 2000.

[12] Damianou, N., Dulay, N., Lupu, E., Sloman, M., "The Ponder Policy Specification Language", *Proc. Policy 2001:Workshop on Policies for Distributed Systems and Networks,* Bristol, UK, Jan. 2001, Springer-Verlag LNCS 1995

[13] Galis, A. (ed.), -"Multi-Domain Communication Management," - CRC Press LLC, Boca Raton, Florida, USA, ISBN 0-8493-0587-X, July 2000