

## Distribution of Network Management Policies with Emphasis on Quality of Service

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**Keywords:** *PBNM, network management, policy management.*

**Abstract:** This article has as objective to propose the extension of the use of the management based on network policies. To do so, it has been created an approach to the distribution of management policies with emphasis on the quality of service. This approach communicates the managed device to the point of decision, requiring corrective actions for the devices, reporting changes in the configuration, registering the managed resources and applying the policies defined for the network management. In this context, the message is defined in XML format, having HTTP as its policies distributor among the participants of the distributed system. As a contribution, this article has allowed more flexibility in the distribution of policies for the devices and the sharing of a logical group of policies to the management of resources and applications emphasized in quality of service.

## Introduction

- For the network functioning, from the data transmission to the services presented to the users, management is considered essential;
- The PBNM proposal is auxiliary to the management resource in a clever way;
- The PBNM allows the formalization and declaration of the system behavior;
- Proposal for distribution of network management policies and its requirements;

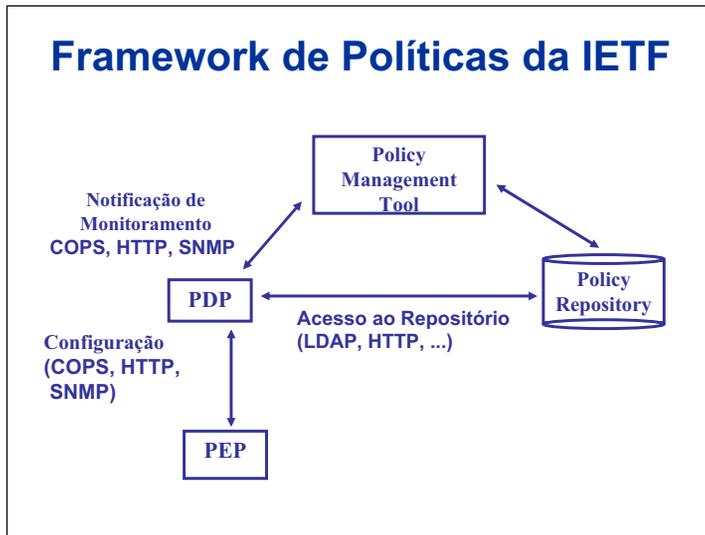
### 1. Introduction

For the network functioning, from the data transmission to the services presented to the users, network management is considered essential. The evolution on network management has been growing significantly in the resource utilization, and performance evaluation optimizing the networks in general.

The parameters and resources necessary for each service are fundamental for its correct execution. In this context, the network management proposal based on policies is auxiliary to the administration resource in a clever way, by defining parameters and characteristic of behavior for the participating devices, through a set of rules concerning users and applications. The management by policies is being researched by the scientific community, where the benefits of management, configuration and resource performance standout. The creation of a group work by IETF for the specific research of management based on policies has been standing out, launching the development and improvement of the management of networks.

This article has as its objective the development of a mechanism for the distribution of the policies using SOAP (Simple Object Access Protocol)/XML (Extensible Markup Language), verifying its applicability and flexibility when applied in distinct conditions, contributing for the research of management of networks based in policies.

In section 2, the main aspects of the architecture of management of networks based on policies – PBNM are presented. In section 3, we have the mechanism proposal for distribution of management policies and its requirements; Application of management in section 4; Conclusion and future works in section 5.



## 2. Architecture of IETF Policy directives

The management based in policies allows the formalization and declaration of the system behavior. Also aims to guide, limit or apply the behavior defined in autonomous entities. In [Sloman et al., 2002] the policies are defined as “rules that govern the choices of behavior of a system” while [Flegkas et al., 2001] describes it as “the way to guide the behavior of a network or system distributed through informative directives of a high level” The policy techniques differ from business rules for being focused in the system management and expressed in a language that is understood and applied by the system. The network management based in policies applies the policies adjusted to the principle of management of computers networks.

The initial IETF works were done by the work group of resource allocation protocol - RAP. They defined the Common Open Policy Service (COPS) [RFC 2748, 2000] as the protocol that allows the exchange of information policies between the policy decision point (PDP) and the Policy Application Point (PEP). They define PDP as the point where the policies are created, while the PEP is the point where the policies of decision are really applied [RFC 2753, 2000]. The COPS is an adaptable protocol because it allows various types of different clients and determines the structure and storage of policy information to be exchanged.

The network management based on policies has motivated broaden researches in the last decade among an IETF work group. The work group IETF policy framework has created the COPS, originally to be compatible with the integration of services. Nowadays, it is used as the general proposal of policies protocol and it has different extension such as the Provisioning Extension (COPS-PR) [RFC 3084, 2001] used to support configuration of management.

## Framework Components

- **Tool of management and policies:** It provides an interface in order to do the administration of the network and to store the policies in the repository;
- **Policy repository:** This is the storage that uses the decision point to recover policies;
- **Policy Decision Points:** They are points where all the decisions that must be applied in the network are created;
- **Policy Enforcement Point (PEP):** They are items involved in the execution of the policies that the PDP orders;

The IETF and DMTF (*Distributed Management Task Force*) groups work together to create different standards related to the creation of policy patterns. The IETF is in charge of defining the architecture and the DMTF of specifying how the policies are stored in the repository of policies [Boyle et al., 1999].

### 2.1 Framework Components

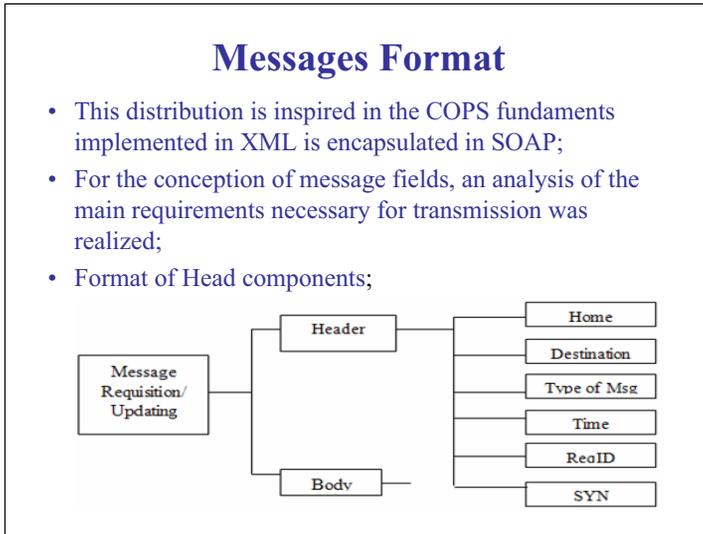
**Tool of management and policies:** It provides an interface in order to do the administration of the network and to store the policies in the repository. It also acts according to the monitor of states and manages the networks through the policies.

**Policy repository:** This is the storage that uses the decision point to recover policies. The policies are stored in a high level, independently from the network devices and according to the information model. The model indicated by IETF is Common Information Model – CIM, however repositories such as data base, directories or web services are broadly used. The use of an access protocol is required with the necessity of integration to other components.

The IETF suggests the use of Lightweight Directory Access Protocol - LDAP [RFC 2251], however again, other solutions are possible such as the HTTP, SNMP and SSH etc. In slide 3, we have the basic architecture of policies management and also the most used protocols for distribution, configuration and access to policies repository.

## Messages Format

- This distribution is inspired in the COPS fundamentals implemented in XML is encapsulated in SOAP;
- For the conception of message fields, an analysis of the main requirements necessary for transmission was realized;
- Format of Head components;



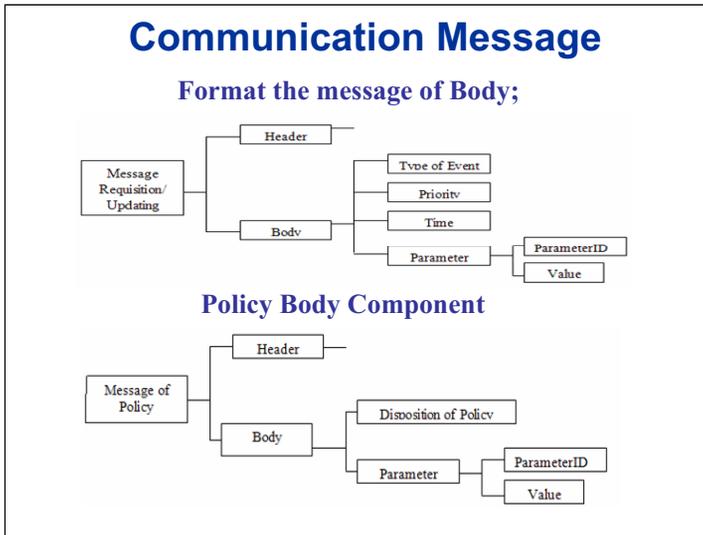
**Policy Decision Points:** They are points where all the decisions that must be applied in the network are created. PDPs process the policies and information about the states of the network in order to decide which policies are necessary to apply. These policies are sent according to data configuration for the PEP or correspondent PEPs. The architecture considers the possibility of having a PDP component for one or various PEPs and these stay with all the device rules.

**Policy Enforcement Point (PEP).** They are items involved in the execution of the policies that the PDP orders. Some examples of these PEPs are routers, firewalls, host etc. Each of the PEP receives the policies in the form of specific action configurations, being responsible for the stability in the device. The PEP can also inform the PDP when any unknown situation is existent.

The IETF framework establishes the COPS [RFC 2753, 2000] for transference of policies decisions for the PEPs e for requisitions of PEPs for the policies server. The model is open for the use of other mechanisms such as the HTTP, FTP or SNMP. Having a great number of PDP in the network interior will raise the difficulty of managing the PEPs, because they will need to be informed of the location of the PDPs of each type of policy.

Regarding the policy distribution, it basically has two forms:

- In the push model, the management tool lowers the policy of the policies repository and sends (uploads) for the PDP. The upload for PDP can be executed using FTP, HTTP, and SNMP among other protocols;

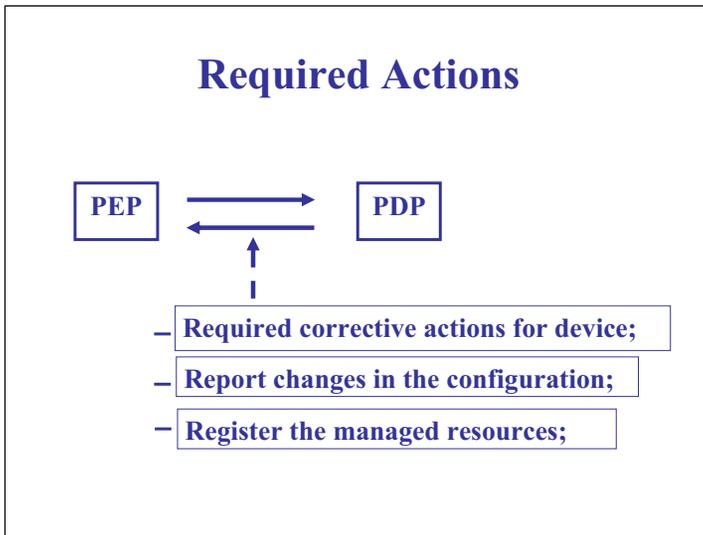


- In the pull model, the management tool only informs the PDP about the location (URL) of the policy that needs to be developed for the PEP component. In the pull model each PEP is responsible for the communication with the PDP and for reestablish the configuration. The PEP should also notify changes in communication and events for the PDP, when a new policy decision is done. Also, in this case FTP, HTTP, SNMP and proprietary protocols can be used. The IETF creates patterns for the LDAP use;

Concerning the device configuration, we have outsourcing and provisioning:

In the *outsourcing*, the PEP initiates the communication with the PDP by asking for the decisive policy in a determined instant of time according to the intern event of the policy petitioner. Particularly, outsourcing is interesting in an InterServ/RSVP domain, where RSVP requires message for routing resources [Durhame, 2000].

In the *provisioning*, the PDP initiates the communication by indicating the PEP on how it should behave. *Provisioning*, on the contrary of outsourcing is more adequate, for DiffServ domains. Seen that the reserve protocol is not expected, the routes have to be configured appropriately in order to support the requirements of QoS from Diffserv aggregation. In this case, the PDP configures the DiffServ route capable of completing the expected behavior. Through COPS-PR (COPS used to Policy Provisioning) the access provisioning support starts being defined. Many others protocols may also be used. Typically the protocols used for the device configuration (e.g. telnet, SSH and HTTP).



### 3. Proposal for the Policy Distribution with Emphases in QoS

The proposal of policy distribution through the SOAP/XML has as its objective a new approach on the distribution of network policy management with emphasis on service quality. Contemplating flexibility, portability and aggregating functions in the superior layers of the OSI reference model.

The policy management distribution through the standard IETF COPS protocol, predicts at least one policy server (PDP) existing in each administrative domain, establishing the transport through a TCP protocol and supporting diverse specific clients. However, its limitation of warning and using only layer functions of transport doesn't allow the increase of functionalities in its application layer.

For the efficient distribution of policies some factors of extreme importance must be considered.

- All of the PDPs in the domain must support the protocol adapted for distribution;
- For different domains, the policy management tool must translate the used protocol.

The idea of applying the XML, as a mean of policy management distribution came from the idea of purporting support to the integration of a great variety of web applications, putting limitations of HTML [W3C]. The most popular mark language is the html, broadly used by thousands of applications in various computational system levels, e.g. browser, communication soft wares and other.



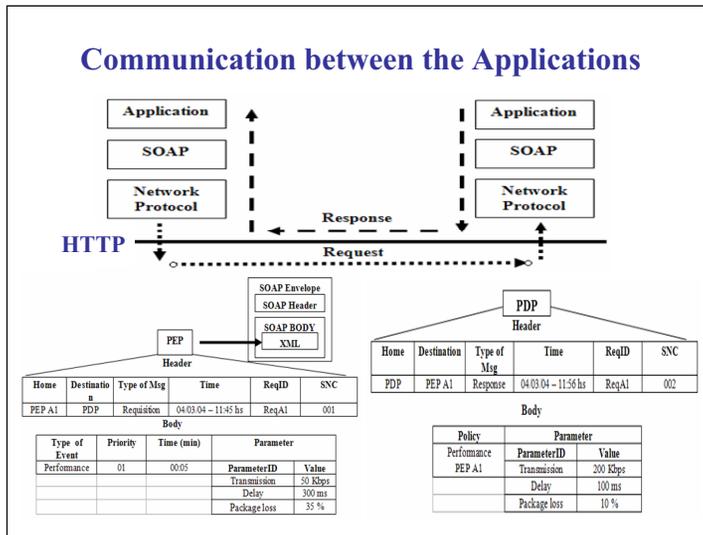
The XML utilization for the diffusion of policies allows and others. The XML utilization for the diffusion of policies allows more flexibility for being a W3C pattern. Its great acceptance comes from its portability, HTTP as a mean of communication and extensibility. In order to enable the exchange of management information in a definition of a XML document is necessary. The SOAP protocol predicts the definition of a XML document, allowing the communication among gadgets and objects of any platform [Clements, 2002]. O SOAP message is a XML document that contains the following parts according to above:

### 3.1 Implementation Aspects

The scenery of the proposal concentrates between the Policy Decision Point - PDP and the Policy Enforcement Point - PEP, where a policy management distribution mechanism is created. This distribution is inspired in the COPS fundamentals, implemented in a mark language developed by W3C, the XML is encapsulated in SOAP.

For the conception of message fields, an analysis of the main requirements necessary for transmission was realized. As a result the following requirements were obtained: performance, efficiency, functionally, flexibility and range in the managed environment. The proposal concentrates on the following actions, according to slide pre:

In the construction of the DTDs (Document Type Definitions), the types of elements and attributes necessary for the valid XML document were defined, as well as the necessary order for functioning.



#### 4. Distribution and Application of Policy Management

For the construction of the protocol for the distribution of management policies, the abstraction of some points of the IETF framework is necessary. With this, you can limit better the focus of the work. As mentioned on the proposal the concentration area of work is between the PDP and the PEP. This is where all the messages exchange is developed and the effective use of the approach is suggested.

The proposal of this policies distribution stands-out for the distribution of “Pull” policies and for the configuration of “outsourcing devices”. The distribution of the “Pull” policy predicts that the management tool inform the location of the policy to the PDP, and the “outsourcing” device configuration defines the policy requisition from the PEP to the PDP. The abstractions mentioned are: management tool and the monitoring of data from the devices.

Where the management tool was abstracted by fact that the objective being the policies distribution, in which the function of the management tool and PDP policy repository was concentrated. This posture was adopted in order to give more emphasis on the approach proposed and to diminish the complexity of the IETF framework. Regarding the monitoring technologies of the devices, there are various mechanisms broadly used and contextualized in diverse tasks. However, we can also mention the SNMP and the WMI and the construction of agents for this purpose.

To exemplify how the distribution of policies works, a Java application was developed for this purpose. This is where this application communicates with the web service (PDP) that contains the policy and returns it through the application. In this process, the messages are transformed in XML encapsulated in the SOAP protocol and sent for the web service that processes them and returns in the same format. The WSDL file is the message interpreter, which means that besides verifying the integrity and the types of requisition. Above represent this process.

## Screen application

The screenshot shows a web application window titled "Distribution of Management Policies". It is divided into two main sections: "Request" on the left and "Response" on the right. Each section has a "Head" and a "Body" area.

Request				Response			
Head				Head			
Source	PEP01	Destine	PDP	Source	PDP	Destine	PEP01
Type MSG	Request	Time	11/07/2005 10:07	Type MSG	Resposta	Time	07/2005 - 10:07:51
ReqID	1122	SYN	1234	ReqID	1122	SYN	1235
Body				Body			
Type Event	Performance	Priority	1	Type Event	Desempenho		
Time	2	Transmission	75 Kbps	Transmission	150 kbps		
Delay	120 ms	Package loss	35%	Delay	10 ms		
				Package loss	15%		

At the bottom of the Request section, there is a "Send" button.

Scenery: The device checks the conditions that were not foreseen by the management. The PEP creates an XML document containing the actual information, requiring a corrective policy. The message is encapsulated using SOAP and transmitted over the HTTP through requirement. The HTTP infra-structure sends the message to the PDP. the format and all of the occurring information in the devices in order to send it to the PEP.

The HTTP protocol sends the message to the PDP, the format and all of the occurring information in the devices to send to the PEP. The PDP is responsible for the processing of the requisition and for the generation of a response. The response will also be encapsulated by SOAP using the same header requisition fields with correspondent values. In slide pre the realization of the communication between the devices and the management policies. For presentation ends, the applicative represented on the left is the managed device (PEP) and on the right is the PDP (web service).

When detecting the device degradation the parameters are collected, converted and sent. To give more flexibility in the policies distribution the PDP is presented by the Apache Tomcat, which deals with the requisitions through door 8080. Once the requisition is done and sent to the PDP, it is then treated and answered according to its solicitation.

## Conclusion

- **Proposed allows the management among domains;**
- **Policies distribution like the HTTP due to its portability and extensibility;**
- **The utilization of the SOAP protocol to define the XML format for message exchange;**
- **This mechanism would enable a distribution management, extensibility, flexibility, portability and evolution capacity;**
- **In future works, performance parameters shall be researched ;**

### 5. Conclusion

The distribution of management policies as it was proposed allows the management among domains. Once all of the domains that use COPS need a local PDP, the conceived protocol stands out for not having this condition, for its architectural flexibility and for management of distributed devices. Due to the fact that this task is done in the application layer, it is possible to aggregate new functions which are different from standard ones that work in the transport layer.

Another point of benefit is the mean of communication used for policies distribution like the HTTP due to its portability and extensibility. Complementing, the capacity of development and evolution of the XML is one of the fundamental pieces for the flexibility of the protocol. The utilization of the SOAP protocol to define the XML format for message exchange is decisive for the distribution, besides proportioning platforms independence and using a protocol of great credibility such as the HTTP and SMTP. These factors along with the web service, contribute so that the utilization of SOAP can increase as a communication technology for distribution systems.

The device configuration through reception of policies is not mentioned in this article. The protocol used has, as its function, the exchange of message between the PEP and the PDP. However, the mechanisms to establish the required policies to the devices can be created (agents) or adapted to the existing ones (SNMP, WMI etc.)

The contributions of this research are in the distribution policies through XML, where an approach for policy distribution was suggested. This approach would enable a distribution management, extensibility, flexibility, portability and evolution capacity. In future works, performance parameters shall be researched in order to verify the efficiency of the mechanism, adding a variety of managed device as well as broader management policies.

## Thanks For your Attention

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