

Third Party Policy Management in Multimedia Networks

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Abstract – In this paper the capabilities for open access to policy management functions in all Internet protocol based multimedia networks are investigated. The deployment of Open Service Access Policy Management application programming interfaces in architectures that support Policy and Charging Control and User Data Convergence is studied. A mapping of Policy Management interfaces onto Lightweight Directory Access Protocol, Hypertext Transfer Protocol and Diameter protocol is suggested. Examples of policy creation and policy evaluation are presented.

Keywords – Open service access, Policy management, User Data Convergence, Policy and Charging Control.

I. INTRODUCTION

Internet Protocol Multimedia Subsystem (IMS) is access independent service control architecture that enables all kind of multimedia applications over a common IP based backbone. One of the main requirements to IMS is to provide Quality of Service (QoS) control which means capabilities for authorization and usage control on bearer resources intended for IMS traffic. That is why a Policy and Charging Control (PCC) functionality is defined. The PCC encompasses policy control decisions based upon subscription information and flow based charging control functionalities [1].

It is expected that more and more multimedia services will use policies to express operational criteria [2], [3]. It is also expected that network providers will host policy-enabled services that have been created by 3rd party application service providers [4]. In order to manage policy information, to control access to it and to request evaluation of policies, a policy management service is needed.

The necessity of open access to QoS control is substantiated in [5]. A protocol-based approach to QoS management, where the collected information about the network is provided to external applications in a structurally standardized format is presented in [6]. Standardized application programming interfaces (API) for open access to policy management functions are defined in [7]. The Open Service Access (OSA) Policy Management service offers provisioning services and facilitates interactions between 3rd party applications and the policies of any policy enabled service. Implementation of OSA API requires translation between OSA API and network control protocols. The motivation behind the research is the lack of mapping of OSA Policy Management API onto network control protocols.

The paper investigates the capabilities for open access to offer provisioning services in IMS networks. In Section II,

architecture for deployment of OSA Policy Management API in IMS networks with User Data Convergence (UDC) and PCC functionality is suggested. The proposed mapping of OSA Policy Management API onto UDC and PCC control protocols is presented respectively in Section III and Section IV. Examples of policy creation and policy evaluation are designed to illustrate the deployment of 3rd party Policy Management applications in IMS.

II. ARCHITECTURE FOR THIRD PARTY POLICY MANAGEMENT

The OSA Policy Management API may be used to create, update or view policy information for any policy enabled service as well as to subscribe to policy events, to request evaluation of policies, and to request the generation of policy events. The API may be used for policy provisioning and policy evaluation in the context of QoS management in IMS networks with UDC and PCC functions.

The suggested architecture for OSA Policy Management API deployment is shown in Fig.1. OSA Application server runs OSA applications which use Policy Management API to create policy provisioning services for QoS management and to evaluate the provided QoS. OSA gateway is a special type of application server that provides OSA API toward applications and control protocols toward the network. User Data Repository (UDR) stores subscription data as to the architectural model of 3GPP [8]. In the suggested architecture, it plays a role of policy server that stores policy information related to QoS. The OSA gateway communicates with UDR over the Ud reference point. At the application level, the protocol for Ud data access messages is Lightweight Directory Access Protocol (LDAP) and the protocol for Ud subscriptions/notifications is Simple Object Access Protocol (SOAP)/HTTP(S) [9]. Policy and Charging Rule Function (PCRF) encompasses policy control decisions and flow based charging control functionalities. In the suggested architecture, the PCRF plays a role of policy engine which evaluates QoS related policy rules provisioned by 3rd party applications. The Ud reference point is used by the PCRF to access PCC related subscription data when stored in the UDR [8]. The Gx reference point is used by the PCRF to provide network control regarding the service data flow detection, gating control, QoS and flow based charging (except credit management) towards Policy and Charging Enforcement Function (PCEF). The PCEF encompasses service data flow detection, policy enforcement and flow based charging functionalities. The Rx reference point enables transport of application level session information from OSA gateway to PCRF. The Rx reference point also enables the OSA gateway subscription to notifications on bearer level events in the IP

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connectivity access network. The protocol over the Rx and Gx reference points is Diameter [10].

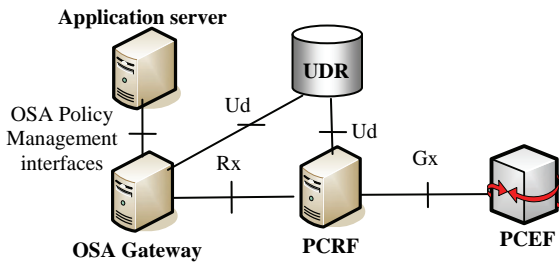


Fig. 1. OSA Policy Management API deployed in IMS

III. POLICY MANAGEMENT OVER UD REFERENCE POINT

This section presents the suggested mapping of OSA Policy Management API onto UCD control protocols.

Applications that perform administrative tasks of behalf of a policy enabled service, e.g. create, update or delete policy information must obtain access to IpPolicyManager. Administrative tasks may then be performed using methods supported by IpPolicyManager.

All procedures related to querying or deleting data from the UDR and creating or updating data within the UDR are controlled by LDAP protocol. The subscription/notification messages related to changes in user data stored within the UDR are transferred by HTTP in SOAP envelopes.

The OSA method startTransaction opens a transaction and all modifications to the policy information base up to the call to either method commitTransaction or abortTransaction will be treated as part of this transaction. To initiate a LDAP session the OSA gateway first establishes a transport connection with the UDR and then initiates a LDAP session by sending a LDAP BindRequest message. In order to allow the application to relate a number of operations and to have them performed in one unit of interaction, a transaction is used as shown in Fig.2.

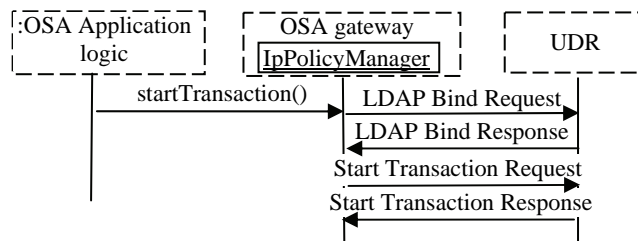


Fig. 2. Opening a link for LDAP session and transaction for modifications of policy information

The OSA method commitTransaction makes all modifications to the policy information base made since the last call to startTransaction to be committed. The OSA gateway ends the transaction within the UDR and if it is the last transaction a termination of the LDAP session will be done as shown in Fig.3.

Applications that wish to participate in Policy Management process use the methods of the IpPolicyManager interface to

access a policy domain of interest, iterate through the names of all policy domains, create a new policy domain, or remove an existing one.

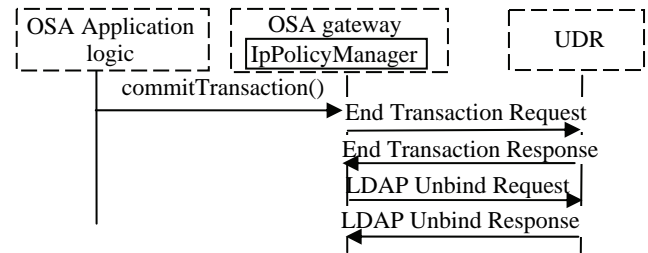


Fig. 3. Closing a transaction and the link for LDAP session

Applications may also use these methods to access policy repository, iterate through the names of all policy repositories, create a new policy repository or remove an existing one. The OSA gateway translates the method invocations in LDAP Query, Create, Delete and Update messages for UDC. Fig.4 shows a top-level policy domain creation and how a reference to a specified top-level repository is got.

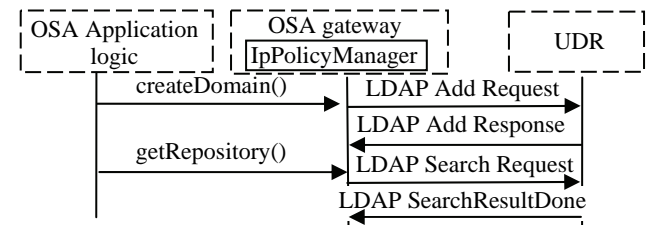


Fig. 4. Creation of policy domain and getting a reference to a specified top-level repository

The IpPolicy is an OSA interface from which are derived all of the Policy interfaces except IpPolicyManager. Using the methods of IpPolicy interfaces the application may manage policy domains, policy groups, policy rules, or policy event definitions. Fig.5 shows the usage of IpPolicy interface to set a generic attribute of a policy object.

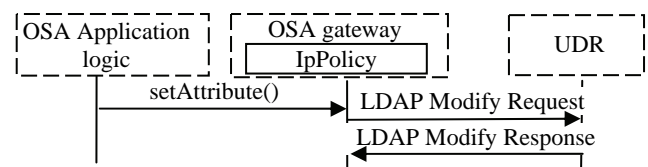


Fig. 5. Value assignment of a policy object attribute

Fig.6 shows how the application removes a specified rule.

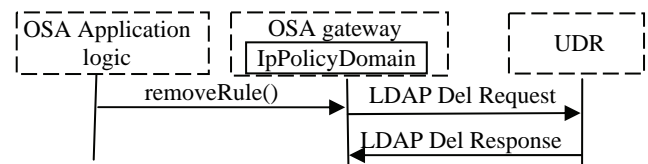


Fig. 6. A policy rule deletion

The OSA Policy evaluation interfaces address evaluation of policy rules upon request of a client application, subscription to and receiving notification of policy events, and ability for authorized clients to generate events. Using the

IpPolicyEvalManager interface an authorized application may request evaluation of policy rules, subscribe to and receive notification of events and to generate policy events. The createNotification method allows applications to specify a set of events that they are interested in receiving, e.g. any changes in policy information, adding policy rules and so on. The destroyNotification method allows the application to indicate that it is no longer interested in receiving events that it previously subscribed to. On receiving subscription request the OSA gateway translates it in HTTP Post method contained in a SOAP message envelope as shown in Fig.7.

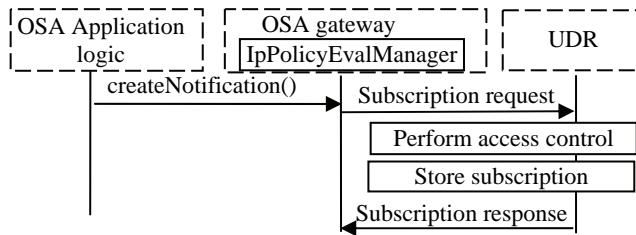


Fig. 7. Subscription to policy information changes

Using the OSA IpAppPolicyDomain interface applications may receive values or error messages resulting from asynchronous method calls sent to this interface. The reportNotification method notifies about the specified event. The UDR notifies the OSA gateway about any changes in policy information using Notify request messages sent by the HTTP Post method in a SOAP message envelope. Notify response messages are coded as HTTP response message and contain a SOAP message envelope as shown in Fig.8.

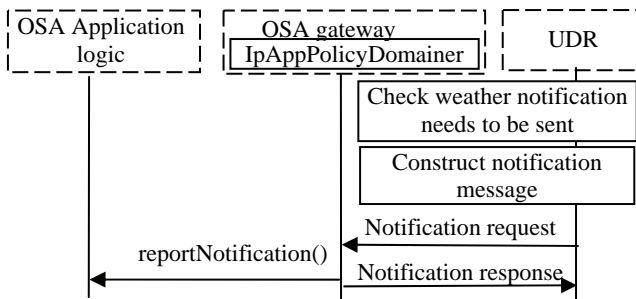


Fig. 8. Notification about policy information change

IV. POLICY MANAGEMENT OVER RX REFERENCE POINT

This section presents the suggested mapping of OSA Policy Management API onto PCC control protocol Diameter.

Using operator defined policy rules the PCRF is able to apply QoS control on a per service data flow basis in the PCEF, to support control of QoS reservation procedures for bearer resources, and to apply usage monitoring for the accumulated usage of network resources. The Rx reference point defines transport of application level session information from OSA gateway to PCRF. The Rx reference point enables the application server subscription to notifications on bearer level events (e.g. signaling path status of multimedia session) in the IP connectivity access network.

Using the evalPolicyReq method of the OSA IpPolicyEvalManager interface the application may invoke an evaluation of policy rules. The evalPolicyRes or evalPolicyErr methods of the OSA IpAppPolicyDomain interface are invoked to pass back the results of an evalPolicyReq invocation. The Diameter messages AA-Request (AAR) and AA-Answer (AAA) over the reference point Rx may be used to request notifications of specific IP connectivity access network session events. In case of successful subscription for notifications, the PCRF sends a Re-Auth-Request (RAR) command when a corresponding event occurs. The OSA gateway acknowledges by Re-Auth-Answer (RAA) command. Applications may use the createEventDefinition method of the OSA IpPolicyDomain interface to define a new event type, specifying the definition's name and the required and optional attributes that appear in an instance of that event. Having a subscription for notifications of policy events, the application is notified when an event occurs. The application may also invoke an evaluation of policy rules related to the specified event type. Fig.9 shows the information flow when the application requests an evaluation of policies associated for example with QoS events related to a given session in the IP connectivity access network.

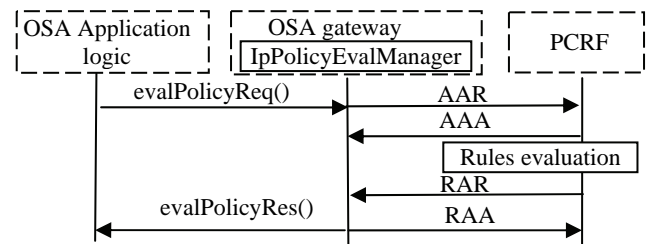


Fig. 9. Evaluation of policy

V. EXAMPLE APPLICATION

To illustrate the applicability of the suggested mapping we design an application that uses OSA Policy Management API.

Let us assume that an enterprise operator has used the OSA Connectivity Manager interfaces to establish QoS parameters for enterprise network packets travelling through the provider network. Using these interfaces the enterprise operator can create virtual provisioned pipes in the provider network to carry the enterprise traffic and support it with pre-specified QoS attributes. The OSA Connectivity Manager interfaces have been used to set and negotiate QoS parameters between the enterprise operator and provider network operator but these interfaces do not support means for evaluation of the QoS provided. For the purpose OSA Policy Management interfaces may be used. The enterprise operator may decide to enable a policy rule to be hosted in the policy engine (PCRF) of the provider network operator and thus to evaluate the QoS parameters of the virtual provisioned pipes created in the provider network. The enterprise operator then subscribes for notifications of events related to the actual QoS parameters with respect to the negotiated one monitored by the subscription mechanism. The sequence diagram is shown in Fig.10. First the policy event is defined and then the event is triggered when the action part of a rule fires. This may happen when, e.g. a pre-defined threshold (say, a guaranteed bit rate)

is reached causing the conditions of a policy rule to be satisfied thus resulting in execution of the action part.

VI. CONCLUSION

The paper investigates the capabilities for open access to policy management functions in all IP-based multimedia networks. The behavior of OSA gateway that supports Policy Management interfaces is studied. A functional mapping of OSA Policy Management interfaces for policy provisioning onto User Data Convergence protocols LDAP and HTTP/SOAP is suggested. Further, OSA Policy Management interfaces for policy evaluation are mapped onto Diameter protocol in Policy and Charging Control architecture. An example application is designed to illustrate the applicability of open access to policy creation and evaluation.

The results may be used in implementation of open access to policy management functions in multimedia networks.

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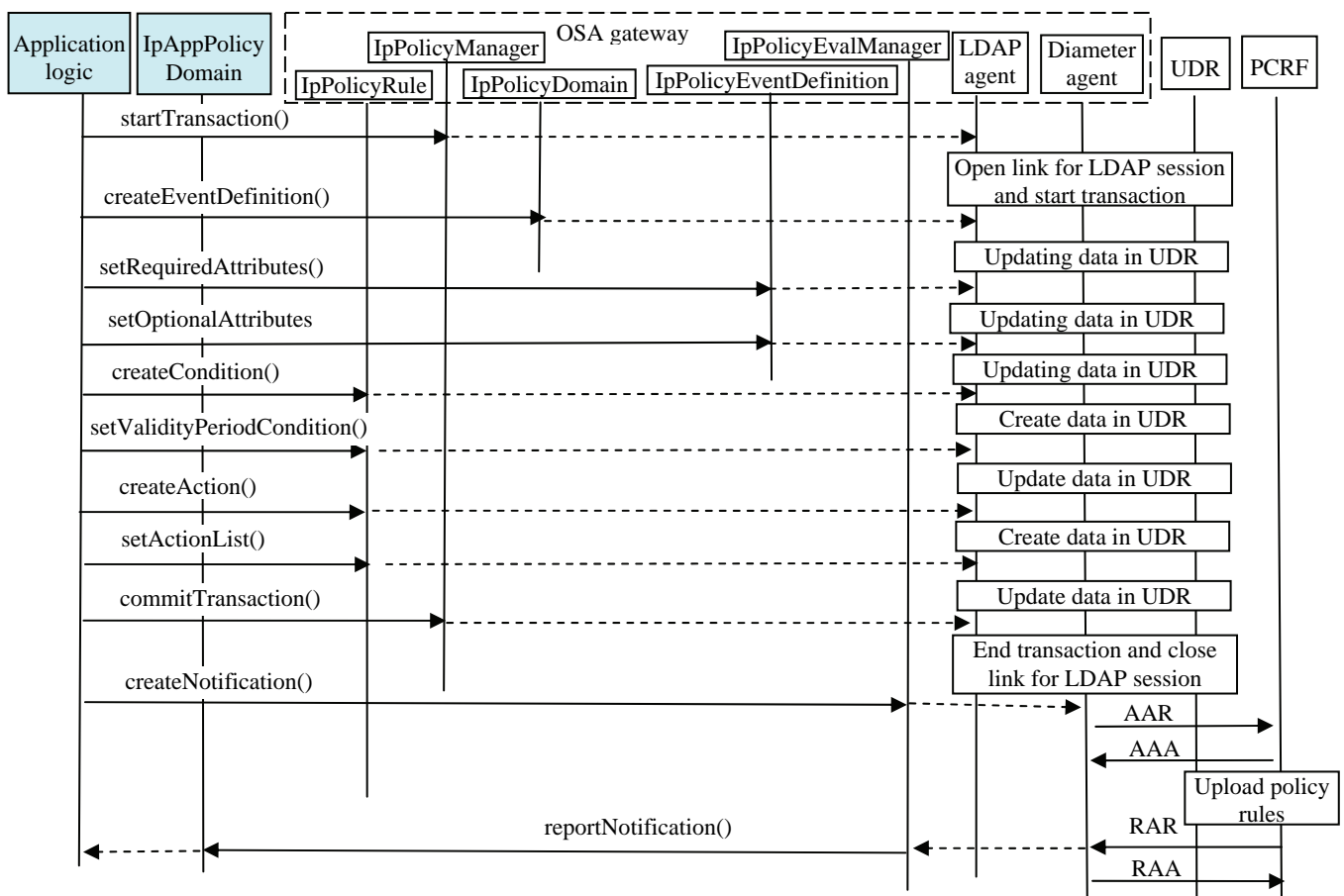


Fig. 10. An example application that defines policy events, subscribes to and receives notification about a policy event