VoIP Dynamic Resource Allocation in IP DiffServ Domain: H.323 vs. COPS interworking

Prof. Stefano Giordano*, Mr. Michele Mancino***, Mr. Alessandro Martucci**, Mr. Saverio Niccolini*

* Department of Information Engineering University of Pisa Via Diotisalvi 2 56126 Pisa – Italy
Tel. +39 050 568511, Fax +39 050 568522
** Alcatel Italia S.p.A. Via Trento, 30 20059 Vimercate (MI) – Italy
Tel. +39 050 915811, Fax +39 050 915823
*** CPR - Multimedia and Telematic Application Centre (META), Corso Italia 115, 56126 Pisa – Italy
Tel: + 39 050 915852, Fax + 39 050 915823
{s.niccolini@iet.unipi.it, alessandro.martucci@alcatel.it,
m.mancino@cpr.it, s.giordano@iet.unipi.it}

Abstract: This short paper presents a proposal and its implementation for dynamic resource allocation in a Voice over IP environment in DiffServ core network. In the paper, some interoperability tests are shown to detail the implementation progress. We will show both the access request to the backbone network and the resource reservation are performed by means of a combination of two signaling protocols (H.323 and COPS). The goal of this short paper is to show that a simple interworking architecture between VoIP and DiffServ can be successfully adopted to provide VoIP users with a scalable and flexible Service Level Agreement scheme. In our proposal network resources are automatically requested with a combination of the "outsourcing" and the "provisioning" scenario at the call setup time, avoiding the waste of resources caused by a static SLA definition.

Keywords: Voice over IP, H.323, Common Open Policy Service, Dynamic Service Level Agreement, Resource Allocation.

1. Introduction and motivation of the work

The current Internet can not provide any Quality of Service (QoS) making the migration from PSTN to Internet Telephony not yet feasible. For this reason, we set-up a trial where a DiffServ [1] core network (which may include one or more DiffServ domains) is the interconnecting architecture of two or more H.323 administrative domains. The dynamic setting of resources allows to achieve the required QoS even in an IP scenario. The reference scenario

is shown in Figure 1; the idea is to assure, when possible, a QoS enabled connection over WANs (Wide Area Networks).

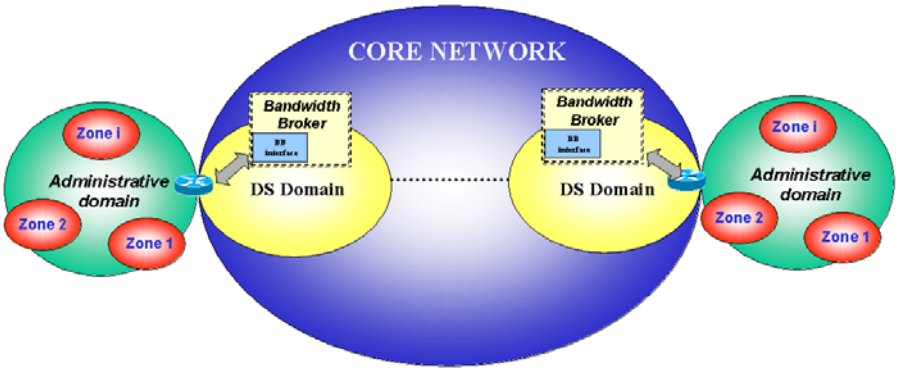

Figure 1: Reference scenario

The implemented solution aims at making the H.323 control plane [2] dynamically interoperate with the QoS architecture and with the DiffServ prototypal router data plane (running on Linux OS). In the DiffServ core the COPS protocol [3] is used for Policy/Admission Control information exchanging between the border router and the central decision unit (Bandwidth Broker).

2. H.323 and COPS protocol

H.323 recommends the use of transport level resource reservation mechanisms to fulfill the QoS requirements of real-time video and audio streams. Although those mechanisms are beyond the scope of H.323, the general method and coordination of such transport level mechanisms between H.323 entities is still to be analyzed.

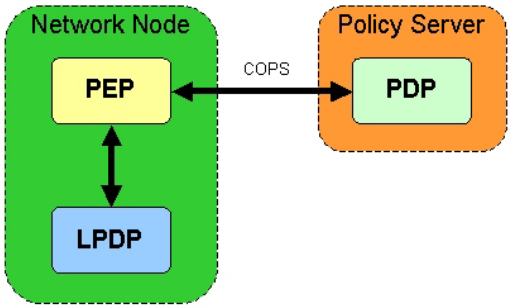

Figure 2: COPS reference architecture

Common Open Policy Service (COPS) is a simple query and response protocol that can be used to exchange policy information within an administrative domain. COPS architecture is based on a policy server, called Policy Decision Point (PDP), also referred to as COPS server, and one or more policy clients, called Policy Enforcement Points (PEPs), referred to as COPS clients.

The fundamental reasons for COPS protocol adoption are in the administration, configuration and enforcement of policies through a QoS IP domain. The resulting client-server architecture is shown in Figure 2.

3. Resource allocation through H.323-COPS interworking

Our work is focused on providing both resource allocation model supported by the COPS protocol: outsourcing and provisioning/configuration. We choose a combination of the two models to take advantage from the dynamics of the former and the scalability provided by the latter. Our objectives can be mainly summarized as:

- perform dynamic resource allocation through the interaction of the two signaling protocol;
- do not modify the client signaling flow keeping the standard H.323 client unchanged.

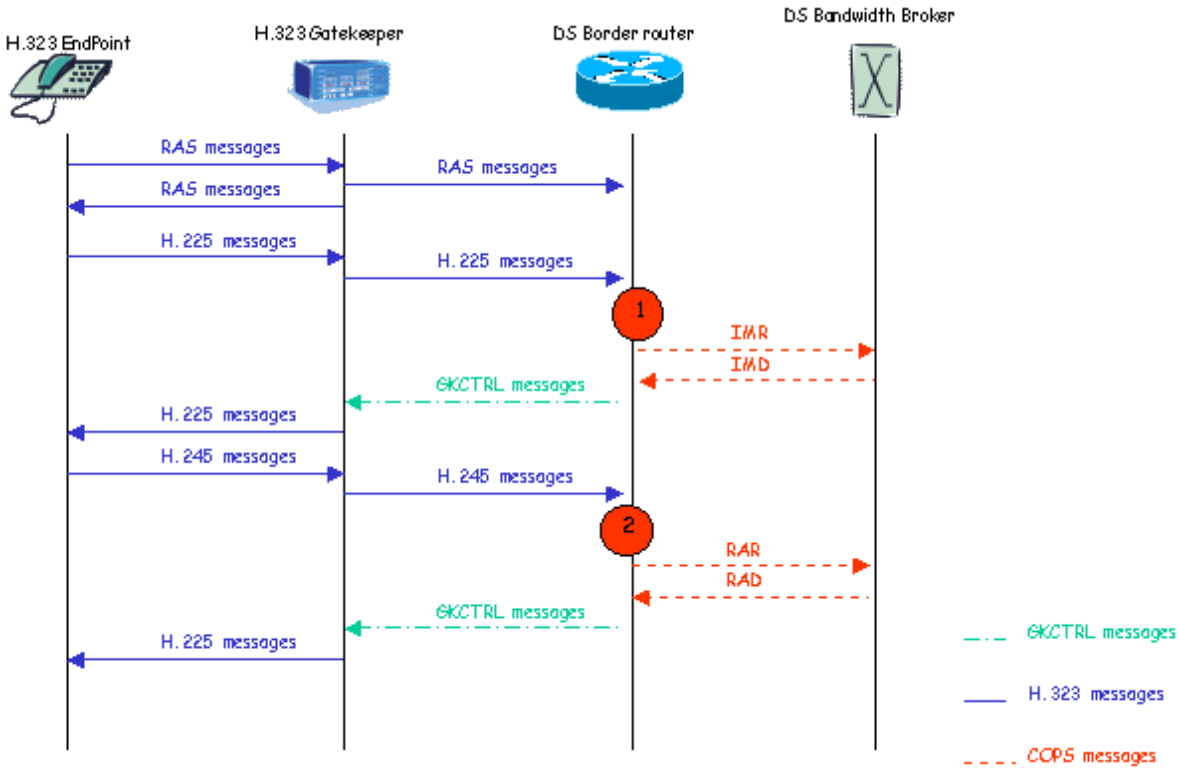

Figure 3: H.323 – COPS signaling exchange

In our implementation, the H.323 GateKeeper (a modified software module based on the OpenH323 project [4], [5]) forwards every H.323 message to the DiffServ Border Router (DS BR) (a prototypal router running on Linux OS using Traffic Control) which, in turn, locally generates the COPS messages to be sent to the prototypal Bandwidth Broker (BB). The DS BR plays two roles in the control plane: from the H.323 side, it has to control the message forwarding from the H.323 GK to itself by means of a simple GKCTRL protocol (with three simple messages such as START, STOP and CALLCTRL), while from the DS side, it has to speak to the COPS server inside the BB to request for outsourcing resource allocation (in the provisioning request the decision is taken locally by the local policy server). The BB is the device in charge of taking outsourcing resource allocation decisions by communicating with the DS BR by means of COPS protocol (we made some extensions to the COPS protocol in order to support the H.323 features [6]). Figure 3 shows an example of signaling exchange obtained from our proposal (the chosen H.323 client is a standard stand-alone client).

4. Field trial description

The running field trial at the University of Pisa is depicted in Figure 4. At the moment of writing the field trial is a single domain; future extensions are planned to implement a multi-domain field trial (inter-BB communications have to be taken into account). As detailed in Table 2, each H.323 access island is equipped with a H.323 GK and with several H.323 standard clients.

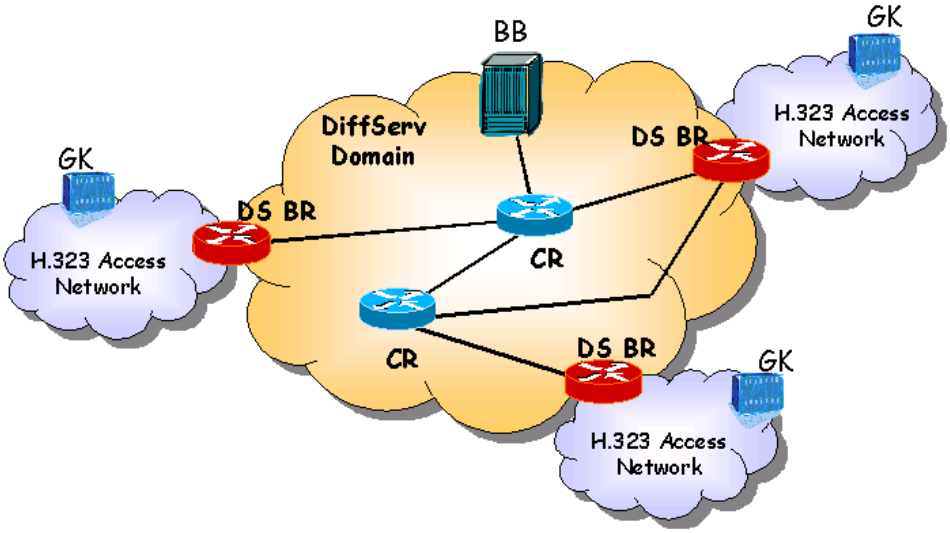

Figure 4: University of Pisa field trial

5. Interoperability tests: supported signaling modes and client types

The trial as depicted in Figure 4 is now running at the University of Pisa; to date, we have performed some interoperability tests with some H.323 standard clients with different signaling methods.

In our field trial, the H.323-COPS interworking has been tested in all the three possible signaling scenarios supported by an H.323 GK and with the Fast Connect and the H.245 Tunneling procedures.

Table 1 summarizes the call signaling modes and the procedures supported by the current implementation.

Signaling Mode	**Notes**
Direct Endpoint Call Signaling	Successfully tested
Call Signaling Channel Routing	Successfully tested
Call Control Channel Routing	Successfully tested
H.323 Procedure	**Notes**
Fast Connect	Not yet implemented
H.245Tunneling	Not yet implemented

Table 1: Notes on current implementation report

Table 2 describes the interoperability tests performed with several H.323 clients registered with our modified H.323 GK. The dynamic H.323-COPS resource allocation scenario is the one described in Section 3.

Caller / Called	NetMeeting v3.01	ADTECH Phone	Snom 100 Phone	Ohphone	OpenAM	Openmcu	OpenISDNgw	Callgen323
NetMeeting v3.01 [8]	X	NO	NO	X	N/A	X	X	NO
ADTECH Phone [9]	X	N/A	N.T.	N.T.	N/A	N.T.	N.T.	NO
Snom 100 Phone [10]	X	N.T.	N/A	X	N/A	N.T.	X	NO
Ohphone [5]	X	N.T.	NO	X	N/A	N.T.	X	NO
OpenAM [5]	X	N.T.	N.T.	X	N/A	N.T.	X	NO
Openmcu [5]	X	N.T.	N.T.	X	N/A	N.T.	N.T.	NO
OpenISDNgw [7]	X	N.T.	N.T.	X	N/A	N.T.	N/A	NO
Callgen323 [11]	X	N.T.	NO	X	N/A	N.T.	X	NO

Table 2: Interoperability tests with dynamic H.323-COPS resource allocation

The tests were performed with all the three signaling modes; the test success ('X' in the table) means that the signaling exchange (for resource allocation) was clearly understood by the prototypal devices and that resources were properly allocated in the prototypal routers (DiffServ Border and Core Router). The test failure ('NO' in the table) was mainly due to the failure of the Fast Connect and H.245 Tunneling procedures. Unsufficient hardware or difficulties of end points to generate a call caused so tests not be feasible ('N/A' in the table). Finally N.T. stands for Not yet Tested.

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