AMPS – ANStool: Interoperability of automated tools for the provisioning of QoS services

Christos Bouras[1,2]	Vaggelis Haniotakis[4]	Dimitris Primpas[1,2]	Kostas Stamos[1,2]	Aggelos Varvitsiotis[3]

[1]Research Academic Computer Technology Institute, N. Kazantzaki Str., 26500, University of Patras Campus, Rion, Patras, Greece &
[2]Department of Computer Engineering and Informatics, University of Patras, 26500 Rion, Patras, Greece
[3]Greek Research and Technology Network, Mesogeion 56, Athens, GR 115 27
[4]Network Operation Centre, University of Crete, Heraklion, Crete, GR 711 10

TEL: +302610960375, +302810393315, +302610 960316, +302610 960316, +302107474245}
E-MAIL: bouras@cti.gr, haniotak@ucnet.uoc.gr primpas@cti.gr, stamos@cti.gr, avarvit@grnet.gr

Full paper will not be submitted

Keywords

Quality of Service, web services, automated provisioning

Extended Abstract

1 ANStool and the AMPS system

Modern IP-based packet networks carry a number of varying services, and one of their crucial aspects is the implementation of Quality of Service (QoS) techniques. Packet networks that support QoS can accommodate simultaneously different traffic types, such as data, voice, and video, by handling time-critical traffic appropriately at congestion points. The most widely used architecture for providing QoS in today's packet networks is DiffServ [1], which is based on the concept of traffic classes. Each traffic class is mapped to a Per-Hop Behavior (PHB), and PHBs are implemented at routers by means of queuing and scheduling at congestion points, where queues are formed. By mapping different traffic types into different PHBs, routers are able to ensure service guarantees.

The Greek National Research and Education Network (GRNET) has designed and implemented [2] a complete solution for QoS services which includes a practical QoS service provisioning model that requires only policing at the network perimeter, while core routers implement priority queuing mechanism, and admission control based solely on the availability of IP premium bandwidth at the access links. The implemented QoS framework also includes the specification of the supported QoS classes.

A crucial issue for the operation of the QoS framework is its management, where it is necessary to automate most of the operations. Therefore, GRNET has also designed and implemented a full versatile management tool, called ANStool [2]. Its capabilities include the logical representation of the network and service in a database, a user interface (UI) for QoS requests, real time admission control and automatic network dimensioning, generation of QoS configuration for network devices, automatic check of implemented QoS configuration on network devices and bug reporting. The main characteristics of ANStool are that it is modular, is based on standards (XML, Web Services) and is not vendor and network technology specific. Therefore, it can be adopted and configured on other domains outside GRNET (such as other NRENs) with minimum effort. Users of the tool are all the NOCs (Network Operating Centres) of the subscribers of GRNET, in order to use the QoS services, and the basic network administration team of GRNET that manages the network devices.

While the ANS tool supports automated provisioning in a single managed network, provisioning in a hierarchical federation requires interoperation between the various federation members and the management infrastructure each has developed. This interoperation between such heterogeneous applications is ideally achieved by the use of industry standards such as XML [3] and the Web Services framework [4][5].

A separate effort has taken place in the framework of the GEANT2 project [6]. In this case, GN2 Service Activity 3 (SA3-AMPS project) has implemented a provisioning infrastructure based on Web Services for usage within Géant's federated network. Its main characteristic is that AMPS is a system designed in order to operate end-to-end, across multiple independently managed domains. Provisioning in AMPS is done by cooperating agents, each managing provisioning within a member network ("intra-domain"), while all agents communicate to implement inter-domain provisioning requests.
The GRNET network, has been using its own internal tool (ANStool) for a long time, obtaining experience and trust in its production-level maturity. This made it undesirable for GRNET to replace its own tool with the AMPS intra-domain agent. In this paper, we describe the implementation details in order to provide full interoperability between the two systems and enable requests from the AMPS tool to be propagated and successfully handled by the ANS tool, and vice versa.

2 Implementation

For the interoperability of QoS services in GRNET and Géant domains, we adapted ANStool to serve as the provisioning agent for the GRNET administrative domain, and to provide a user interface to the AMPS service.

2.1 ANStool enhancements

Additionally, some enhancements to the ANStool were mandatory. Before any other development, ANStool was adapted to support the uni-directional PIP bandwidth allocation model used by AMPS (previously, ANStool always assumed bi-directional, symmetric-bandwidth requests). By means of this new functionality, ANStool now allows the allocation of Premium IP bandwidth from a "source" to a "destination" direction in either or in both directions.
Additionally, AMPS requests assume that only the incoming network interface (IP address of interface) is known and the destination one is calculated using a pathfinding service. On the other hand, ANStool requires both source and destination interfaces to be known, therefore in order to be able to process the requests that come from AMPS, ANStool needs a pathfinding service too. In order to support the "pathfinder" functionality, we implemented our own module as a Web Service that follows the "pathfinder" XML schema (version 1) defined by AMPS. Our pathfinding algorithm is significantly different from its AMPS counterpart, which is based on a traceroute. This is so because of our method of pre-provisioning priority queuing for PIP on every interface in the network core. Therefore, ANStool only needs the terminal border-router interface and next-hop, based on the "destination" of the request and does not need the internal path. Because our network core is MPLS-enabled, the above information can be easily obtained by querying the network routers just twice, as follows: (a) we query the GRNET ingress router for the MPLS FEC (forward equivalence class) for the destination IP address and (b) having obtained from the first step the FEC for the terminal border router in the path, we query the terminal border router for the next-hop information, which is then returned as the egress information.

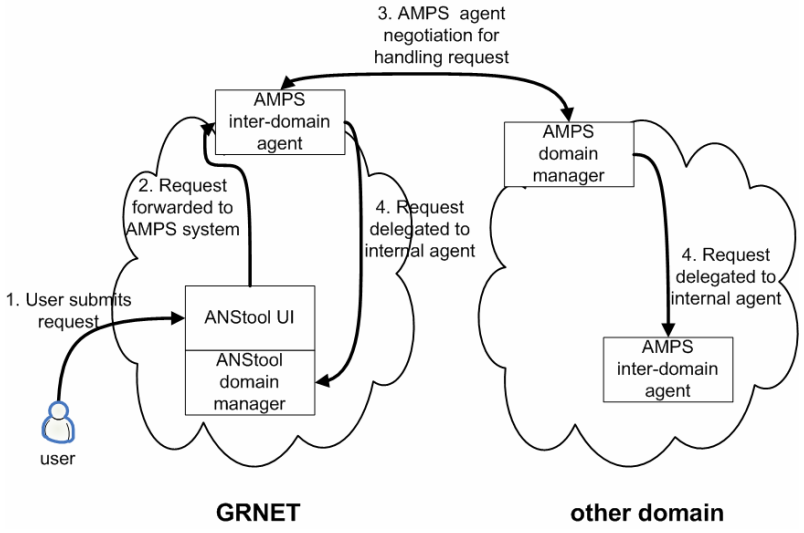

Figure 1: Workflow for an inter-domain request made at the ANStool and forwarded to AMPS

2.2 ANStool: intradomain agent of AMPS

The AMPS system has been implemented in a modular manner, allowing for different implementations of its various components to be "dropped in", as long as they provide a Web Service that complies with a specified interface. .ANStool has been adapted in the following manner in order to be compatible with this interface.

- Request from ANS User Interface to AMPS

We have used the ANS user interface (UI) as a client of the AMPS Web Service (WS). Users can make request through the ANS UI that have one or more endpoints belonging to Géant's administrative domain and those requests are forwarded to the AMPS WS. This functionality enhances and simplifies the user's actions as the user only has to learn how to use the ANS UI and it is presented in Figure 1.

- Request from the AMPS system to ANStool

Requests that arrive in AMPS with one or more endpoints belonging to the GRNET domain (managed by ANStool) are forwarded for implementation to ANStool. The ANS WS receives the request information through SOAP calls made by AMPS and creates a local request object, which is then handled in the same fashion as other requests created through the ANS UI.

For each service request the two tools exchange minimal topology information, the service type, endpoints for the request, amount of Premium bandwidth requested, request start and end dates, as well as police function details.

2.3 Testing

Tests were executed using an instance of the ANS software that was deployed at a sandbox machine. In order to test the new functions and their usage with the SOAP protocol, we executed tests in two phases:

- At the first phase of testing, a simple SOAP client was created, which would connect to the SOAP server wrapper of the new ANS functions. This way, we were able to test a variety of combinations and scenarios for all the implemented functions without inserting any complexity from the interaction with the AMPS tool.
- During the second testing phase, the new functions were tested at the instance of the AMPS tool that has been setup by GRNET for testing purposes. In this case, the AMPS Web GUI environment was responsible for operating as a SOAP client upon a user action (creation / cancellation of request, query) and contacting the ANS function implementations.

3 References

[1] RFC 2475, "An Architecture for Differentiated Services", S. Blake, D. Black, M. Carlson, E. Davies, Z. Wang, W. Weiss, December 1998

[2] A. Varvitsiotis, V. Siris, D. Primpas, G. Fotiadis, A. Liakopoulos, C. Bouras, "Techniques for DiffServ - based QoS in Hierarchically Federated MAN Networks - the GRNET Case", The 14th IEEE Workshop on Local and Metropolitan Area Networks (LANMAN 2005), Chania. Island of Crete, Greece, 18 - 21 September 2005

[3] F. Yergeau, T. Bray, J. Paoli, C. M. Sperberg-McQueen and E. Maler, "Extensible Markup Language (XML) 1.0 (3rd Edition)", W3C, Feb 2004, http://www.w3.org/TR/2004/REC-xml-20040204/

[4] SOAP/1.1 TR, W3C, Jun 2003, http://www.w3.org/TR/soap/

[5] E. Christensen, F. Curbera, G. Meredith and S. Weerawarana, "Web Services Description Language (WSDL) 1.1", W3C TR, Mar 2001, http://www.w3.org/TR/wsdl/

[6] GN2 project, http://www.geant2.net

Biographies

Christos Bouras obtained his Diploma and PhD from the Department Of Computer Engineering and Informatics of Patras University (Greece). He is currently an Associate Professor in the above department and a scientific advisor of Research Unit 6 in Research Academic Computer Technology Institute (CTI). He has published over 200 papers in various well-known refereed conferences and journals. He is a co-author of seven books in Greek. He has been a PC member and referee in various international journals and conferences and he has participated in numerous R&D projects.

Vangelis Haniotakis works for the Network Operations Center in the University of Crete located in Iraklion, Greece. His primary interests include designing and implementing web applications,

automation of network and system management tasks, and next-generation web services and technologies. He has been involved in the design and implementation of ANStool since its inception in 2004, and has worked in multiple Greek and European-funded projects. He holds a BSc in Mathematics from the University of Crete.

Dimitris Primpas obtained his diploma and Master Degree from Computer Engineering and Informatics Department of the Polytechnic School of the University of Patras and he continues the postgraduate studies in the same department to receive PhD. He works in the Research Unit 6 of CTI and has participated in numerous R&D projects. His interests include: networks, protocols, Quality of Service and Network applications. He is co-author of 2 books in Greek Language and he has published more than 20 research papers in various well-known refereed conferences and 4 research papers in scientific journals.

Kostas Stamos obtained his diploma and Master Degree from Computer Engineering and Informatics Department of the Polytechnic School of the University of Patras and he continues the postgraduate studies in the same department to receive PhD. He currently works with Research Unit 6 of CTI and has participated in numerous R&D projects. He has published more than 20 research papers in international refereed conferences and 5 research papers in scientific journals.

Angelos Varvitsiotis received the Dipl. Ing. degree in Computer Engineering from the University of Patras and the Ph.D. degree in Electrical and Computer Engineering from the National Technical University of Athens (NTUA). He has been with the Telecommunications Laboratory, Dept. of Electrical and Computer Engineering, NTUA as a Research Associate and with the Institute of Communications and Computer Systems (ICCS – NTUA) as a researcher. He is currently with GRNET, the Greek National Research and Educational Network, where he coordinates network operations, administration and development of next-generation networking services. He has published numerous papers in well-known refereed conferences, journals and books.