Chapter 32
Scalable Internet Architecture Supporting Quality of Service (QoS)

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ABSTRACT

The evolution of Internet and its successful technologies has brought a tremendous growth in business, education, research etc. over the last four decades. With the dramatic advances in multimedia technologies and the increasing popularity of real-time applications, recently Quality of Service (QoS) support in the Internet has been in great demand. Deployment of such applications over the Internet in recent years, and the trend to manage them efficiently with a desired QoS in mind, researchers have been trying for a major shift from its Best Effort (BE) model to a service oriented model. Such efforts have resulted in Integrated Services (Intserv), Differentiated Services (Diffserv), Multi Protocol Label Switching (MPLS), Policy Based Networking (PBN) and many more technologies. But the reality is that such models have been implemented only in certain areas in the Internet not everywhere and many of them also faces scalability problem while dealing with huge number of traffic flows with varied priority levels in the Internet. As a result, an architecture addressing scalability problem and satisfying end-to-end QoS still remains a big issue in the Internet. In this chapter the authors propose a policy based architecture which they believe can achieve scalability while offering end to end QoS in the Internet.

INTRODUCTION

The concept of Policy Based Networking has long been in use by networks for controlling traffic flows and allocating network resources to various applications. A network policy defines how traffic, user and/or applications should be treated differently within the network based on QoS parameters, and may include policy statements. In most cases, such statements are defined and managed manually by the

network administrator based upon the Service Level Agreements (SLA) between the network and its customers. Management of network devices for policy conditions to be satisfied is usually performed by a set of actions performed on various devices. For example, Internet Service Providers (ISPs) rely on network operators to monitor their networks and reconfigure the routers when necessary. Such actions may work well within the ISPs own network, but when considered across the Internet, may have serious effect in balancing traffic across many ISPs on an end-to-end basis. Hence, managing traffic over multiple Autonomous System (AS) domains requires an obvious need for change in the architecture for the current Internet and the way they function.

Traffic control and policy management between these AS domains also encounter an additional set of challenges that are not present in the intra-domain case, including trust relationship between different competing ISPs. We demonstrated the architecture based on these heterogeneous policy issues and identified various architectural components which may contribute significantly towards simplification of traffic management over the Internet. Validity of the architecture and its deployment in the Internet heavily depends on the following factors:

1. Service Level Agreements (SLAs)
2. Autonomous Systems (ASs) relationship
3. Traffic engineering and Internet QoS routing
4. Internet wide resource and flow management
5. Device configuration in support for QoS

The architecture takes into account above-mentioned factors in an integrated approach in order to support end-to-end QoS over the Internet. These factors are discussed and the design objectives of our architecture are presented throughout this chapter. We first discuss the design objectives of the architecture. In section two, we introduce background knowledge about the Internet topology and hierarchy, and identify various relationships which exist between those hierarchies. We also discuss how this knowledge of relationship between Autonomous Systems affects key design decisions. Section three provides an overview of our architecture with a brief description on various components involved within them. Section four summarizes the key features of the architecture and concludes this chapter.

DESIGN OBJECTIVES

Service Level Agreement (SLA) is one of the first requirements towards implementing policy based network architecture in the Internet. With a growing demand for better QoS, AS domains and network operators need to enforce strong SLA at various service boundaries by having some additional mechanisms for such support. Hence, in order to achieve end-to-end QoS over the Internet, the SLAs must be extended beyond the standard customer and provider relationships as used in the past and the architecture should incorporate necessary components to build such SLAs dynamically spanning different ASs in the end-to-end path.

Current Internet is a connection of ASs where the connection between the ASs are very much influenced by the relationship based on which such connectivity are formed. Fundamentally, the relationships between those ASs may be categorized as peer-to-peer, client-server and sibling (Gao, 2001), and are the driving forces behind economic benefits of individual domains. Most of the ASs try to perform load

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