Q

Quality of Service Issues Associated with Internet Protocols

Jairo A. Gutiérrez
The University of Auckland, New Zealand

Wayne Ting
The University of Auckland, New Zealand

INTRODUCTION

The objective of enabling the development of higher-level multimedia services with guaranteed quality of service (QoS) on networks has prompted developments that attempt to accommodate these new application requirements. Several architectures have been proposed, and a common basic functionality is emerging. Any new architecture that intends to satisfy the ever-growing need for bandwidth in the Internet while providing support for QoS guarantees needs to concern itself with the following aspects (Zhang, Deering, Estrin, Shenker, Zappala, 1993; Biswas, Lazar, Huard, Lim, Mahjoub, Pau, Suzuki, Torstensson, Wang and Weinstein, 1998):

- Flow management: identifying the traffic characteristics of a flow so that the network can specify the QoS to be delivered to that flow
- Compatibility with a wide range of routing protocols (Callon, Doolan, Feldman, Fredette, Swallow, Viswanathan, 1997)
- Resource reservation
- Admission control
- Packet scheduling: including packet filtering and classification.

These aspects clearly call for network devices (routers, switches) with powerful features that can be easily requested and modified in order to support customers' demands for differentiated services.

BACKGROUND

The Internet phenomenon has grown at an exponential rate, causing several new technologies to emerge to cope with the number of users of this global communications network. TCP/IP was the protocol of choice because of its simplicity and ability to a route from a particular source to a particular destination. However, as the network grows, there have been greater demands for additional services and real-time applications to work over the Internet. Because TCP/IP is primarily a best-effort protocol, it is not able to provide the QoS required by real-time applications and its users. To complement this deficiency, other protocols, such as Integrated Services (IntServ), Resource Reservation Protocol (RSVP), Differentiated Services (DiffServ) and Multi-Protocol Label Switching (MPLS), have been developed.

IMPROVING INTERNET PROTOCOLS

The Integrated Services (IntServ) model is based on reservations-based traffic engineering assumptions. It reserves resources explicitly using a dynamic signalling protocol (RSVP) and employs admission control, packet classification and intelligent scheduling to achieve a desired QoS. The Integrated Services model has two services categories: Guaranteed Delay and Controlled Load services (Braden, Clark & Shenker, 1994).

RSVP is a resource reservation set-up protocol designed for an integrated service Internet. It is used by a host to request specific qualities of service from the network for particular application data streams or flows. RSVP is also used to establish and maintain state information in all nodes along a flow so as to provide the requested service. However, RSVP itself is not a routing protocol; instead, it is considered a signalling protocol similar to those used in ATM networks.

The DiffServ model is based on reservation-less traffic engineering assumptions. It classifies packets into a small number of service types and uses priority mechanisms to provide adequate QoS to the traffic. No explicit resource reservation or admission control is employed, although network nodes do have to use intelligent queuing mechanisms to differentiate traffic (Gozdecki, Jajszcyk& Stankiewicz, 2003).

DiffServ allows levels of service discrimination but without the need to maintain per-flow states and signalling (Fineberg, Chen & Xiao, 2002). Packets are classified according to Behaviour Aggregates (BA), and these BAs are encoded using Differentiated Service's Code Points (DSCP). There is a one-to-one correspondence between a BA and a so-called Per-Hop Behaviour (PHB), which will define the actual treatment for that particular BA.

Another requirement for DiffServ is the identification of a well-defined boundary called DiffServ domain. The reason for this is so only the boundary nodes in the DiffServ domain need to classify packets into a particular BA, and maybe condition or shape the ingress traffic accordingly (Gozdecki, Jajszcyk & Stankiewicz, 2003). The result is that only the boundary node needs to carry out sophisticated classifying, marking, policing and shaping operations, while the core nodes only need to match the DSCP in the packet to a PHB and forward accordingly.

Consequently, the DiffServ approach produces a more scalable architecture by having groups of packets with similar QoS requirements matching with a single BA; hence, the number of states kept is proportional to the number of classes defined rather than being proportional to the number of flows. DiffServ is also easier to implement because sophisticated operations are only carried out at the boundary nodes, and the core nodes only carry out the simple operation of matching DSCP to a PHB; therefore, the speed in the core can also be faster.

MPLS is a protocol that assigns a particular FEC (Forwarding Equivalence Class) to a particular packet as it enters the network. The FEC to which the packet is assigned is encoded as a short, fixed-length value known as a "label." Once a packet is assigned to a FEC, no further header analysis is done by subsequent MPLS capable routers and all forwarding is driven by the labels (Rosen, Viswanathan & Callon, 2001).

MPLS, used with or without RSVP (Zhang, Deering, Estrin, Shenker & Zappala, 1993; Baker, Krawczyk, Sastry, 1998), fits within the framework of Integrated Services (Braden, Clark & Shenker, 1994). Before suggesting detailed interfaces for IP routers or switches, it is necessary to understand the basic operations of this proposed standard. The roots of MPLS originated from technologies such as IP switching, developed by Ipsilon Networks (Sunnyvale, Calif.), and tag switching, developed by Cisco Systems (San Jose, Calif.). Thus, MPLS is the use of fixed-length labels to decide packet handling (Xiao & Ni, 1999). An MPLS router, called the label-switch router (LSR), examines only the label in forwarding the packet. The network protocol used can be IP or others. MPLS also needs a protocol to distribute labels to set up label-switched paths (LSPs). The protocol used to distribute labels is known as the label distribution protocol (LDP). Whether a generic LDP should be created or RSVP should be extended for this purpose is an issue yet to be decided (Xiao & Ni, 1999). MPLS can also be piggybacked by routing protocols. A LSP is similar to an ATM virtual circuit (VC) and is unidirectional from the sender to the receiver. MPLS LSRs use the protocol to negotiate the semantics of how each packet with a particular label from its peer is to be handled. Therefore, when a packet enters an MPLS domain, it is classified and routed at the ingress LSR. MPLS headers are then inserted into the packet. When an LSR receives a labelled packet, it will use the label as the index to look up the forwarding table. This is faster than the processes of parsing the routing table in search of the longest match done in IP routing. The packet is processed as specified by the forwarding table entry. The outgoing label then replaces the incoming label, and the packet is switched to the next LSR. Inside an MPLS domain, packet forwarding, classification and QoS service is determined by the labels and the COS fields. This makes core LSRs simple. Before a packet leaves a MPLS domain, its MPLS label is removed (Xiao & Ni, 1999). As far as the original packet is concerned, the routers carrying it through the MPLS network appear as a single hop (Stephenson, 1998).

Despite its advantages, MPLS does, however, have one major drawback as the protocol to implement QoS in the Internet. The architecture and protocols defined by MPLS require a much more

Related Content

A Distance-Window Approach for the Continuous Processing of Spatial Data Streams
Salman Ahmed Shaikh, Akiyoshi Matonoand Kyoung-Sook Kim (2020). *International Journal of Multimedia Data Engineering and Management (pp. 16-30).*
www.irma-international.org/article/a-distance-window-approach-for-the-continuous-processing-of-spatial-data-streams/260962

Content Adaptation in Mobile Learning Environments
Sergio Castilloand Gerardo Ayala (2010). *International Journal of Multimedia Data Engineering and Management (pp. 1-15).*
www.irma-international.org/article/content-adaptation-mobile-learning-environments/49146

Improved Illumination Independent Moving Object Detection Algorithm Applied to Infrared Video Sequences
(2014). *Video Surveillance Techniques and Technologies (pp. 58-63).*
www.irma-international.org/chapter/improved-illumination-independent-moving-object-detection-algorithm-applied-to-infrared-video-sequences/94125

V-Card: Mobile Multimedia for Mobile Marketing
Holger Nosekabeland Wolfgang Rockelein (2006). *Handbook of Research on Mobile Multimedia (pp. 430-439).*
www.irma-international.org/chapter/card-mobile-multimedia-mobile-marketing/20981

Information Security Management
Mariana Hentea (2009). *Encyclopedia of Multimedia Technology and Networking, Second Edition (pp. 675-681).*
www.irma-international.org/chapter/information-security-management/17465