



A provision-aware fair bandwidth distribution marker algorithm for DiffServ networks

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ABSTRACT

The rise in demand for real-time applications on the Internet necessitates Quality of Service (QoS). Differentiated Services (DiffServ) is one of the technologies used currently to provide QoS and service differentiation. It is simple and scalable. It provides service differentiation to aggregates, mainly through the Assured Forwarding (AF) per-hop behaviour. Previous work on fair sharing of network bandwidth did not adequately address the Under-Provisioned Network (UPN) condition. In this paper, we propose a new three-colour marker, named paltswTCM (provision-aware Improved TSW based Three-Colour Marker). We compare our new algorithm with both time-sliding window markers and token-bucket-based markers using simulations. Results show that our new provision-aware marker outperforms these previous algorithms not only in the UPN condition but also for low to medium network provision levels. We conclude that to achieve proportional sharing of bandwidth, no packet type should be injected at the expense of others.

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1. Introduction

The assumption that all packets are the same and should be accorded equal treatment, as was the case in the early days of the Internet, is certainly not tenable today. Real-time applications are by their inherent nature sensitive to delay and loss. An ever-increasing demand to transfer these applications over the Internet forced the Internet Engineering Task Force (IETF) to proposed two Quality-of-Service (QoS) frameworks, namely Integrated Services (IntServ) (Braden et al., 1994) and Differentiated Services (DiffServ) (Blake et al., 1998).

IntServ was the first real attempt to alter the model of the Internet, from best effort to a QoS-compliant network (Braden et al., 1994). The IntServ model is based on per-flow resource reservation. First, explicit reservation, with details of all the resources needed, is made by any would-be-user, through the *Reservation Setup Protocol (RSVP)*. The IP router checks whether the resources requested are available or not, and then allows traffic transfer to begin if the result of the check is positive, with a guarantee of exclusive access to the resources. The main drawback of IntServ is that it is not scalable (Carpenter and Nichols, 2002). To address this issue, among other disadvantages of IntServ, the IETF proposed the DiffServ model, with the aim of providing efficient and scalable edge-to-edge QoS within a single domain.

DiffServ differentiates packets by aggregating individual flows that require common treatment, typically based on the Service Level Agreement (SLA) between the subscriber and service provider, into predefined forwarding classes (Blake et al., 1998). A single DiffServ Code Point (DSCP) is then assigned to each packet in a behaviour aggregate. Flows with the same DSCP are said to belong to one Per-Hop Behaviour (PHB) (Nichols et al.). Currently, the IETF defines two PHB mechanisms: Expedited Forwarding (EF), which has one class (Jacobson et al., 1999), and Assured Forwarding (AF), which has four classes, each having three levels of drop precedence, commonly called green, yellow and red (Heinanen et al., 1999). The priority that a packet receives is based on the colour assigned to it. Green packets receive the highest priority, red packets the lowest priority and yellow packets an in-between priority. A DiffServ network is divided into two parts: the edge and the core. All complex tasks, such as traffic classification and traffic conditioning, are done at the edge routers. The core routers are left with only the forwarding mechanism. This mechanism relies heavily on active queue management schemes such as RED with In and Out (RIO) (Clark and Fang, 1998) and Fuzzy Explicit Marking In/Out (FIO) (Chrysostomou et al., 2009).

Ideally, in the DiffServ model, we expect traffic with same SLA to be given the same treatment. When there is excess bandwidth, we expect it to be fairly shared; also, when the bandwidth supply is less than the demand, we expect the loss of packets to be proportionate. In reality, the converse is true (Su and Atiquzzaman, 2001, 2003; Ibanez and Nichols, 1998; Hongwei and Xiumei, 2009). Many factors have been found to be responsible for this unfairness, among which are: interaction between TCP and UDP traffic (Baines et al, 2000; Sudha and Ammasaigounden, 2008); marking of packets without

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