MPLS Working Group
Internet Draft

Document: draft-vaananen-mpls-svc-diff-framework-00.txt
Expiration Date: September 2000

Muckai Girish
SBC Technology Resources, Inc.
Rayadurgam Ravikanth
Nokia Research Center

Pasi Vaananen
Nokia Telecommunications
March 2000

A Framework for Service Differentiation in MPLS Networks

Status of this Memo

1. Abstract

It has been recognized that the success of the MPLS depends on the ability to better support the multiservice traffic integration with some levels of service guarantees, which are not feasible to implement with the current destination prefix only based packet forwarding paradigms.

The efficient support for these services throughout the network is expected to be possible using label based forwarding paradigm in the network. Through the use of either RSVP based or LDP/CR-LDP based signaling, MPLS can also provide certain QoS guarantees using the LSPs.

The goal of this document is to define a framework for service differentiation in MPLS networks. We discuss a set of services that have been identified so far for IP, and describe the traffic management mechanisms in various network elements that are needed for enabling the implementation of these more advanced services in MPLS networks.

This document describes the mechanisms and their applications with the intent to approach the level of the traffic management capabilities that are currently available in hybrid router/ATM or frame relay networks using the MPLS. This document concentrates on the issues from the public network operators point of view, although most of the discussion applies as well in the local network environments.

Concepts and mechanisms described in this document are based on the previous work done in various working groups of IETF and other standardization bodies. Applicable concepts and terminology from previous work has been used as much as possible. This document concentrates on the MPLS specific issues, number of related mechanisms and concepts are only briefly presented for the sake of completeness, and the other related work is referred, where applicable.

2. Introduction

The ability of IP networks to support service level differentiation and traffic engineering is becoming very important. This area has been addressed in various working groups of IETF (e.g. INTSERV, RSVP, ISSLL, RAP, DIFFSERV, IPPM, QOSR, TEWG), IRTF (E2E), ATM Forum (TM), Frame Relay Forum, ITU-T, and various other organizations and user consortiums.

We build on the ideas and previous work done in these working groups, and try to construct a coherent set of capabilities around the label based packet forwarding technology discussed in the MPLS working group of IETF, as described in the MPLS framework document [Callon99] and the MPLS architecture document [Rosen99a].

The starting point is to identify a set of possible services that are implementable using current IP standards which will also cater to the various needs of customers and service providers in IP networking. We then move on to the focus of this draft which is to describe the set of traffic management functions and elements both in the control plane and the data plane that are needed for service differentiation. The TM functions done by the various network elements such as hosts, CPE devices, edge routers and core routers are then presented. Finally, the TM functions that are mandatory and optional for providing the services are listed for each of the network elements.

The main purpose of this draft is to explicitly specify how the various technologies fit together in creating a multi-service IP network. In a sense this draft describes, in generality, the kind of functional blocks, in addition to the standard protocols, that may need to be present in MPLS capable nodes. In presenting a consolidated view of how service differentiation may be achieved, this document points to how varying technologies developed in possibly different groups in IETF are tied together. Further, such a

view also strives to identify work items which may have implications in various IETF groups. It should be emphasized, however, that this draft only identifies rather generic functional blocks that would be needed, and it is fully recognized that actual implementations may vary depending on the functions that the node aims to support. In the light of this, the objective of this paper is simply informational.

The document tries to take an evolutionary rather than revolutionary approach. We feel that the deployment of the technologies presented can be started on a small scale, and without changes to the host communication and application protocols, while this framework attempts to be flexible enough to be able to accommodate such changes when the technology matures and the incremental deployment is determined to be feasible and necessary.

We hope that MPLS will evolve towards supporting the capabilities outlined in this document, but do realize that much more detailed discussions, research and specification work needs to be done before the complete set of "wishes" can be accomplished.

3. Service Differentiation

The advanced services requiring the use of the traffic management mechanisms can be broadly divided into two categories on the basis of (i) the level of assurance on service guarantees that can be achieved and (ii) the granularity of guarantees (simple to complex) that is provided. This division is made here to support the discussion of the related traffic management issues.

MPLS will be used to provide the services that are being defined in the IETF, such as those based on Differentiated Services and Integrated Services. MPLS label switched paths can be used to construct aggregate paths, with the result that less state needs to be maintained.

This document primarily deals with the components of traffic management that will be necessary to support the various services, and the issues discussed here are generic enough to apply to the various service categories that MPLS will need to support. The basic service categories differ from each other on basis of the end-to-end assurance with respect to the certain performance metrics, such as packet loss, delay, and delay variation these services expect from the network.

The implementation of the more advanced service categories than pure best-effort affects the implementation of both data and control plane functionality in intermediate nodes. Some of the affected datapath functions are congestion control, queuing, packet classification, policing, scheduling, shaping and service mapping to interfaces. The associated control plane functions that are affected

include signaling protocols, accounting, policy control and routing

protocols.

As a starting point we describe a set of services that can be supported in IP networks, using already defined mechanisms such as IntServ, DiffServ, congestion control etc. In later sections we will define the set of traffic management mechanisms that will be necessary/useful to support this service differentiation.

3.1 Differentiated and Integrated Services

3.1.1 Differentiated services

Packet forwarding and queuing treatments for differentiated services are specified in the IETF DiffServ working group. The DiffServ working group does not standardize services, instead, it standardizes a small number of packet treatment mechanisms or PHBs (Per Hop Behaviors). End-to-end services can be constructed from these PHBs with appropriate traffic conditioning actions. The differentiated services architecture is documented in [RFC2475], while the differentiated services framework is documented in [Bernet99a]. The expedited forwarding (EF) PHB is proposed in [RFC2598], whereas the assured forwarding (AF) PHB group is presented in [RFC2597].

3.1.1.1 Differentiated services in MPLS environments

Generally no per LSP state need to be maintained in the network elements and the goal is to support a small, fixed number of service categories. It is expected that the state maintenance for the scoped services (defined later in this section) can be done in behavioral aggregate basis, although the parameters have to be specified on per-LSP basis, as well as admission control needs to be done for individual LSPs. Measurement based admission control may help in achievement of better utilization of the resources (subject to verification by simulation). Per stream attributes distributed using the label distribution mechanisms can include the differentiated service categories associated with the LSP. The mappings from Differentiated Service classes to MPLS paths are specified in [Francois99]. The support of differentiated services in MPLS environments requires signaling support for the association of the desired category with the label, or alternatively each packet needs to carry the information of the desired service category.

MPLS allows the allocation of the bandwidth for the differential services in conjunction with other services in a controlled manner. This allows the network operator to allocate the available bandwidth between the differentiated service category and other categories, on a per LSP basis, providing good basic mechanisms required by the efficient network traffic engineering.

3.1.2 Integrated Services

Several scalability issues related to RSVP signaling have been

identified that suggest that the support of the Integrated services in the backbone networks is not feasible at reasonable cost. Therefore, there are efforts ongoing in IETF for mapping these services to simpler mechanisms, i.e. DiffServ and/or MPLS on the backbone level (see [Bernet99b]). The model that is seen as enabling the provisioning of these services on the backbone level are based on the running full RSVP/IntServ in the stub networks and mapping the packets to simpler mechanisms in the border nodes of the public IP network.

Services are specified in IntServ working group, while associated signaling mechanisms are specified in the RSVP working group. DiffServ and ISSLL working group are currently working on the service mappings, with most of the data plane work completed, biggest open issue is currently how to do admission control for the DiffServ capable backbone network.

3.1.3 Scoped (and guaranteed) services

These services provide hard guarantees that are explicitly specified for different granularities, and specific topological scopes, such as from network boundary to network boundary or end-to-end. Services are further specified using different, service specific set of parameters, such as bandwidth and/or delay, determined by the requested service class. The scoped / guaranteed services may be based on the contractual guarantees or user-network signaling, such as RSVP. Signaling protocol to disseminate associated service parameter information is required inside network.

In IETF, guaranteed services have been specified by INTSERV and MPLS working groups. Integrated service framework is described in [RFC1633]. There are currently two services that have been defined by INTSERV; controlled load [RFC2211] and guaranteed service [RFC2212]. These services should be supported in MPLS environments.

Service parameter mappings to different link layers specified in the ISSLL working groups should be applicable to MPLS, when augmented with the label encapsulation procedures specified in the MPLS WG.

3.2 A Framework for Services

We specify a framework for services here and all of the proposed services can be specified with appropriate attributes of this framework. The framework is described by two components: the traffic contract and the service objectives. The traffic contract describes the packet arrival patterns that the customer has contractually agreed to adhere to which is enforced by the service provider. The service objectives can be described by a combination of throughput, loss, delay and jitter parameters. Note that all parameters are not

necessarily specified for all the services that are described in the ensuing sections.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.