           Experience with the Label Distribution Protocol (LDP)

Status of This Memo

   This memo provides information for the Internet community. It does
   not specify an Internet standard of any kind. Distribution of this
   memo is unlimited.

Abstract

   The purpose of this memo is to document how some of the requirements
   specified in RFC 1264 for advancing protocols developed by working
   groups within the IETF Routing Area to Draft Standard have been
   satisfied by LDP (Label Distribution Protocol). Specifically, this
   report documents operational experience with LDP, requirement 5 of
   section 5.0 in RFC 1264.

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1. Introduction

   The purpose of this memo is to document how some of the requirements
   specified in [RFC1264] for advancing protocols developed by working
   groups within the IETF Routing Area to Draft Standard have been
   satisfied by LDP. Specifically, this report documents operational
   experience with LDP, requirement 5 of section 5.0 in RFC 1264.

   LDP was originally published as [RFC3036] in January 2001. It was
   produced by the MPLS Working Group of the IETF and was jointly
   authored by Loa Andersson, Paul Doolan, Nancy Feldman, Andre
   Fredette, and Bob Thomas. It has since been obsoleted by [RFC5036].

2. Operational Experience

   This section discusses operational experience with the protocol. The
   information is based on a survey sent to the MPLS Working Group in
   October 2004. The questionnaire can be found in the MPLS Working
   Group mail archives for October 2004.

   11 responses were received, all but 2 requesting confidentiality.
   The survey results are summarized to maintain confidentiality. The
   networks surveyed span different geographic locations: US, Europe,
   and Asia. Both academic and commercial networks responded to the
   survey.

2.1. Environment and Duration

   The size of the deployments ranges from less than 20 Label Switching
   Routers (LSRs) to over 1000 LSRs. Eight out of the 11 deployments
   use LDP in the edge and the core, two on the edge only, and one in
   the core only.

   Sessions exist to peers discovered via both the basic and the
   extended discovery mechanisms. In half the cases, more than one
   adjacency (and as many as four adjacencies) are maintained per
   session. The average number of LDP sessions on an LSR ranges from
   under 10 to just over 80. The responses are spread out as follows:
   under 10: 4 responses, 20-50: 4 responses, and over 80: 1 response.

   In the surveyed networks, the time LDP has been deployed ranges from
   under 1 year to over 4 years. The responses are spread out as
   follows: under 1 year: 3 responses, 2 years: 2 responses, 3 years: 3
   responses, and over 4 years: 3 responses.

2.2. Applications and Motivation

   Nine of the 11 responses list Layer 3 Virtual Private Networks
   (L3VPNs) as the application driving the LDP deployment in the
   network.

   The list of applications is as follows: L3VPNs: 9, pseudowires: 4
   current (and one planned deployment), L2VPNs: 4, forwarding based on
   labels: 2, and BGP-free core: 1.

   There are two major options for label distribution protocols, LDP and
   Resource Reservation Protocol-Traffic Engineering (RSVP-TE). One of
   the key differences between the two is that RSVP-TE has support for
   traffic engineering, while LDP does not. The reasons cited for
   picking LDP as the label distribution protocol are:

       o The deployment does not require traffic engineering - 6

       o Inter-operability concerns if a different protocol is used - 5

       o Equipment vendor only supports LDP - 5

       o Ease of configuration - 4

       o Ease of management - 3

       o Scalability concerns with other protocols - 3

       o Required for a service offering of the service provider - 1

2.3. Protocol Features

   All deployments surveyed use the Downstream Unsolicited Label
   Distribution mode. All but one deployment use Liberal Label
   retention (one uses conservative).

   LSP setup is established with both independent and Ordered Control.
   Five of the deployments use both control modes in the same network.

   The number of LDP Forwarding Equivalence Classes (FECs) advertised
   and LDP routes installed falls in one of two categories: 1) roughly
   the same as the number of LSRs in the network and 2) roughly the same
   as the number of IGP routes in the network. Of the 8 responses that
   were received, 6 were in the first category and 2 in the second.

2.4. Security Concerns

   A security concern was raised by one of the operators with respect to
   the lack of a mechanism for securing LDP Hellos.

2.5. Implementations and Inter-Operability

   Eight of the 11 responses state that more than one implementation
   (and as many as four different ones) are deployed in the same
   network.

   The consensus is that although implementations differ, no inter-
   operability issues exist. The challenges listed by providers running
   multiple implementations are:

      o Different flexibility in picking for which FECs to advertise
         labels.

      o Different flexibility in setting transport and LDP router-id
         addresses.

      o Different default utilization of LDP labels for traffic
         resolution. Some vendors use LDP for both VPN and IPv4 traffic
         forwarding, while other vendors allow only VPN traffic to
         resolve via LDP. The challenge is to restrict the utilization
         of LDP labels to VPN traffic in a mixed-vendor environment.

      o Understanding the differences in the implementations.

2.6. Operational Experience

   In general, operators reported stable implementations and steady
   improvement in resiliency to failure and convergence times over the
   years. Some operators reported that no issues were found with the
   protocol since deploying.

   The operational issues reported fall in three categories:

      1. Configuration issues. Both the session and adjacency endpoints
         must be allowed by the firewall filters. Misconfiguration of
         the filters causes sessions to drop (if already established) or
         not to establish.

      2. Vendor bugs. These include traffic blackholing, unnecessary
         label withdrawals and changes, session resets, and problems
         migrating from older versions of the technology. Most reports
         stated that the problems reported occurred in early versions of
         the implementations.

   3. Protocol issues.

       - The synchronization required between LDP and the IGP was
          listed as the main protocol issue. Two issues were
          reported: 1) slow convergence, due to the fact that LDP
          convergence time is tied to the IGP convergence time, and 2)
          traffic blackholing on a link-up event. When an interface
          comes up, the LDP session may come up slower than the IGP
          session. This results in dropping MPLS traffic for a link-
          up event (not a failure but a restoration). This issue is
          described in more detail in [LDP-SYNC].

       - Silent failures. Failure not being propagated to the head
          end of the LSP when setting up LSPs using independent
          control.

3. Security Considerations

   This document is a survey of experiences from deployment of LDP
   implementations; it does not specify any protocol behavior. Thus,
   security issues introduced by the document are not discussed.

4. Acknowledgments

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   survey for their valuable input: Shane Amante, Niclas Comstedt, Bruno
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   Not all who participated are listed here, due to confidentiality
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   Loa Andersson for their input to the survey questionnaire.

5. References

5.1. Normative References

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5.2. Informative References

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