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A Lower Effort Per-Hop Behavior (LE PHB)
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Abstract

This document specifies properties and characteristics of a Lower Effort (LE) per-hop behavior (PHB). The primary objective of this LE PHB is to protect best-effort (BE) traffic (packets forwarded with the default PHB) from LE traffic in congestion situations, i.e., when resources become scarce, best-effort traffic has precedence over LE traffic and may preempt it. There are numerous uses for this PHB, e.g., for background traffic of low precedence, such as bulk data transfers with low priority in time, non time-critical backups, larger software updates, web search engines while gathering information from web servers and so on. This document recommends a standard DSCP value for the LE PHB.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on February 2, 2017.

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1. Introduction

This document defines a Differentiated Services per-hop behavior RFC 2474 [RFC2474] called "Lower Effort" (LE) which is intended for traffic of sufficiently low urgency, in which all other traffic takes precedence over LE traffic in consumption of network link bandwidth. Low urgency traffic has got a low priority in time, which does not necessarily imply that it is generally of minor importance. From this viewpoint, it can be considered as a network equivalent to a background priority for processes in an operating system. There may or may not be memory (buffer) resources allocated for this type of traffic.

Some networks carry traffic for which delivery is considered optional; that is, packets of this type of traffic ought to consume network resources only when no other traffic is present. Alternatively, the effect of this type of traffic on all other network traffic is strictly limited. This is distinct from "best-effort" (BE) traffic since the network makes no commitment to deliver LE packets. In contrast, BE traffic receives an implied "good faith" commitment of at least some available network resources. This

document proposes a Lower Effort Differentiated Services per-hop behavior (LE PHB) for handling this "optional" traffic in a differentiated services node.

1.1. Applicability

A Lower Effort PHB is for sending extremely non-critical traffic across a Differentiated Services (DS) domain or DS region. There should be an expectation that packets of the LE PHB may be delayed or dropped when any other traffic is present. Use of the LE PHB might assist a network operator in moving certain kinds of traffic or users to off-peak times. Alternatively, or in addition, packets can be designated for the LE PHB when the goal is to protect all other packet traffic from competition with the LE aggregate while not completely banning LE traffic from the network. An LE PHB should not be used for a customer's "normal internet" traffic nor should packets be "downgraded" to the LE PHB used as a substitute for dropping packets that ought simply to be dropped as unauthorized. The LE PHB is expected to have applicability in networks that have at least some unused capacity at some times of day.

This is a PHB that allows networks to protect themselves from selected types of traffic rather than giving a selected traffic aggregate preferential treatment. Moreover, it may also exploit all unused resources from other PHBs.

There is no intrinsic reason to limit the applicability of the LE PHB to any particular application or type of traffic. It is intended as an additional tool for administrators in engineering networks. For instance, it can be used for filling up protection capacity of transmission links which is otherwise unused. Some network providers keep link utilization below 50% in order to being able carrying all traffic without loss in case of rerouting due to a link failure. LE marked traffic can utilize the normally unused capacity and will be preempted automatically in case of link failure when 100% of the link capacity is required for all other traffic. Ideally, applications mark their packets as LE traffic, since they know the urgency of flows.

Example uses for the LE PHB comprise:

- For traffic caused by world-wide web search engines while they gather information from web servers.

- For software updates or dissemination of new releases of operating systems.

- For backup traffic or non-time critical sychronization or mirroring traffic.
- For content distribution transfers between caches.
- For Netnews and other "bulk mail" of the Internet.
- For "downgraded" traffic from some other PHB when this does not violate the operational objectives of the other PHB or the overall network. LE should not be used for the general case of downgraded traffic, but may be used by design, e.g., to protect an internal network from untrusted external traffic sources. In this case there is no way for attackers to preempt internal (non LE) traffic by flooding. Another use case is mentioned in [RFC3754]: non-admitted multicast traffic.

1.2. Deployment Considerations

Internet-wide deployment of the LE PHB is eased by the following properties:

- No harm to other traffic: since the LE PHB has got the lowest priority it does not take resources from other PHBs. Deployment across different provider domains causes no trust issues or attack vectors to existing traffic.
- No parameters or configuration: the LE PHB requires no parameters and no configuration of traffic profiles and so on.
- No traffic conditioning mechanisms: the LE PHB requires only a queue and a scheduling mechanism, but no traffic meters, droppers or shapers.

Since LE traffic may be starved completely for a longer period of time, transport protocols or applications should be able to detect such a situation and should resume the transfer as soon as possible.

1.3. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. PHB Description

This PHB is defined in relation to the default PHB (best-effort). A packet forwarded with this PHB SHOULD have lower precedence than packets forwarded with the default PHB. Ideally, LE packets should

be forwarded only if no best-effort packet is waiting for its transmission. A straightforward implementation could be a simple priority scheduler serving the default PHB queue with higher priority than the lower-effort PHB queue. Alternative implementations may use scheduling algorithms that assign a very small weight to the LE class. This, however, may sometimes cause better service for LE packets compared to BE packets in cases when the BE share is fully utilized and the LE share not.

3. Traffic Conditioning Actions

As for most other PHBs an initial classification and marking would usually be performed at the first DS boundary node. In many cases, packets may also be pre-marked in DS aware end systems by applications due to their specific knowledge about the particular precedence of packets. There is no incentive for DS domains to distrust this initial marking, because letting LE traffic enter a DS domain causes no harm. In the worst case it evokes the same effect as it would have been marked with the default PHB, i.e., as best-effort traffic. Thus, any policing such as limiting the traffic rate is not necessary at the DS boundary.

Usually, the amount of LE traffic is implicitly limited by queueing mechanisms and related discard actions of the PHB. Therefore, there is normally no need to meter and police LE traffic explicitly.

4. Recommended DS Codepoint

The recommended codepoint for the LE PHB is 000010.

RFC 4594 [RFC4594] recommended to use CS1 as codepoint (as mentioned in [RFC3662]. This is problematic since it may cause a priority inversion resulting in treating LE packets with higher precedence than BE packets. Existing implementations SHOULD therefore use the unambiguous LE codepoint 000010 whenever possible.

5. Remarking to other DSCPs/PHBs

"DSCP bleaching", i.e., setting the DSCP to 000000 (default PHB) is not recommended for this PHB. This may cause effects that are in contrast to the original intent in protecting BE traffic from LE traffic. In case DS domains do not support the LE PHB, they may treat LE marked packets with the default PHB instead, but they should do so without remarking to the DSCP 000000. The reason for this is that later traversed DS domains may then have still the possibility to treat such packets according the LE PHB.

6. IANA Considerations

This memo includes a request to assign a Differentiated Services Field Codepoint (DSCP) 000010 from the Differentiated Services Field Codepoints (DSCP) registry https://www.iana.org/assignments/dscp-registry/dscp-registry.xml

7. Security Considerations

There are no specific security exposures for this PHB. Since it defines a new class of low forwarding priority, other traffic may be downgraded to this LE PHB in case it is remarked as LE traffic. See the general security considerations in RFC 2474 [RFC2474] and RFC 2475 [RFC2475].

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC2474] Nichols, K., Blake, S., Baker, F., and D. Black, "Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers", RFC 2474, DOI 10.17487/RFC2474, December 1998, <http://www.rfc-editor.org/info/rfc2474>.

[RFC2475] Blake, S., Black, D., Carlson, M., Davies, E., Wang, Z., and W. Weiss, "An Architecture for Differentiated Services", RFC 2475, DOI 10.17487/RFC2475, December 1998, <http://www.rfc-editor.org/info/rfc2475>.

8.2. Informative References

[draft-bless-diffserv-lbe-phb-00] Bless, R. and K. Wehrle, "A Lower Than Best-Effort Per-Hop Behavior", draft-bless-diffserv-lbe-phb-00 (work in progress), September 1999, <https://tools.ietf.org/html/draft-bless-diffserv-lbe-phb-00>.

[RFC3662] Bless, R., Nichols, K., and K. Wehrle, "A Lower Effort Per-Domain Behavior (PDB) for Differentiated Services", RFC 3662, DOI 10.17487/RFC3662, December 2003, <http://www.rfc-editor.org/info/rfc3662>.

[RFC3754] Bless, R. and K. Wehrle, "IP Multicast in Differentiated Services (DS) Networks", RFC 3754, DOI 10.17487/RFC3754, April 2004, <http://www.rfc-editor.org/info/rfc3754>.

[RFC4594] Babiarz, J., Chan, K., and F. Baker, "Configuration Guidelines for DiffServ Service Classes", RFC 4594, DOI 10.17487/RFC4594, August 2006, <http://www.rfc-editor.org/info/rfc4594>.

Appendix A. History of the LE PHB

A first version of this PHB was suggested by Roland Bless and Klaus Wehrle in 1999 [draft-bless-diffserv-lbe-phb-00]. After some discussion in the DiffServ Working Group Brian Carpenter and Kathie Nichols proposed a bulk handling per-domain behavior and believed a PHB was not necessary. Eventually, Lower Effort was specified as per-domain behavior and finally became [RFC3662]. More detailed information about its history can be found in Section 10 of [RFC3662].

Appendix B. Acknowledgments

Since text is borrowed from earlier Internet-Drafts and RFCs the co-authors of previous specifications are acknowledged here: Kathie Nichols and Klaus Wehrle.

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