Network Working Group
Internet-Draft
Intended status: Experimental
Expires: September 22, 2016

J. Chroboczek
PPS, University of Paris-Diderot

March 21, 2016

Homenet profile of the Babel routing protocol
draft-chroboczek-homenet-babel-profile-00

Abstract

This document defines the subset of the Babel routing protocol [RFC6126] and its extensions that a Homenet router must implement.

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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1. Introduction

The core of the Homenet protocol suite consists of HNCP [HNCP], a protocol used for flooding configuration information and assigning prefixes to links, combined with the Babel routing protocol [RFC6126]. Babel is an extensible, flexible and modular protocol: minimal implementations of Babel have been demonstrated that consist of a few hundred of lines of code, while the "large" implementation includes support for a number of extensions and consists of over ten thousand lines of C code.

This document defines the exact subset of the Babel protocol and its extensions that is required by a conformant implementation of the Homenet protocol suite.

1.1. Background

The Babel routing protocol and its extensions are defined in a number of documents:

- The body of RFC 6126 [RFC6126] defines the core, unextended protocol. It allows Babel's control data to be carried over either link-local IPv6 or IPv4, and in either case allows announcing both IPv4 and IPv6 routes. It leaves link cost estimation, metric computation and route selection to the implementation. Distinct implementations of core RFC 6126 Babel will interoperate and maintain a set of loop-free forwarding paths, but given conflicting metrics or route selection policies may give rise to persistent oscillations.

- The informative Appendix A of RFC 6126 suggests a simple and easy to implement algorithm for cost and metric computation that has been found to work satisfactorily in a wide range of topologies.

- While RFC 6126 does not provide an algorithm for route selection, its Section 3.6 suggests selecting the route with smallest metric with some hysteresis applied. An algorithm that has been found to work well in practice is described in Section III.E of [DELAY-BASED].

- The extension mechanism for Babel is defined in RFC 7557 [RFC7557].

- Four RFCs and Internet-Drafts define optional extensions to Babel: HMAC-based authentication [RFC7298], source-specific routing [BABEL-SS], radio interference aware routing [BABEL-Z], and delay-based routing [BABEL-RTT]. All of these extensions interoperate with the core protocol as well as with each other.

2. The Homenet profile of Babel

2.1. Requirements

[Sentences within square brackets are editorial notes and are not intended for publication.]

REQ1: a Homenet implementation of Babel MUST encapsulate Babel control traffic in IPv6 packets sent to the IANA-assigned port 6696 and either the IANA-assigned multicast group ff02::1:6 or to a link-local unicast address.

Rationale: since Babel is able to carry both IPv4 and IPv6 routes over either IPv4 or IPv6, choosing the protocol used for carrying control traffic is a matter of preference. Since IPv6 has some features that make implementations somewhat simpler and more reliable (notably link-local addresses), we require carrying control data over IPv6.

REQ2: a Homenet implementation of Babel MUST implement the IPv6 subset of the protocol defined in the body of RFC 6126.

Rationale: support for IPv6 routing is an essential component of the Homenet architecture.

REQ3: a Homenet implementation of Babel SHOULD implement the IPv4 subset of the protocol defined in the body of RFC 6126. Use of other techniques for acquiring IPv4 connectivity (such as multiple layers of NAT) is strongly discouraged.

Rationale: support for IPv4 will remain necessary for years to come, and even in pure IPv6 deployments, including code for supporting IPv4 has very little cost. Since HNCP makes it easy to

assign distinct IPv4 prefixes to the links in a network, it is not necessary to resort to multiple layers of NAT, with all of its problems.

[BS suggest that this should be a MUST.]

REQ4: a Homenet implementation of Babel MUST implement source-specific routing for IPv6, as defined in draft-boutier-babel-source-specific [BABEL-SS]. This implies that it MUST implement the extension mechanism defined in RFC 7557.

Rationale: source-specific routing is an essential component of the Homenet architecture. The extension mechanism is required by source-specific routing. Source-specific routing for IPv4 is not required, since HNCP arranges things so that a single non-specific IPv4 default route is announced (Section 6.5 of [HNCP]).

REQ5: a Homenet implementation of Babel MUST implement HMAC-based authentication, as defined in RFC 7298, MUST implement the two mandatory-to-implement algorithms defined in RFC 7298, and MUST enable and require authentication when instructed to do so by HNCP.

Rationale: some home networks include "guest" links that can be used by third parties that are not necessarily fully trusted. In such networks, it is essential that either the routing protocol is secured or the guest links are carefully firewalled.

Generic mechanisms such as DTLS and dynamically keyed IPsec are not able to protect multicast traffic, and are therefore difficult to use with Babel. Statically keyed IPsec, perhaps with keys rotated by HNCP, is vulnerable to replay attacks and would therefore require the addition of a nonce mechanism to Babel.

[There is no consensus about this requirement. A simpler solution is to disable Babel on guest interfaces. MS suggests this might be a SHOULD.]

[This needs expanding with an explanation of how HNCP is supposed to signal the use of authentication.]

REQ6: a Homenet implementation of Babel MUST use metrics that are of a similar magnitude to the values suggested in Appendix A of RFC 6126. In particular, it SHOULD assign costs that are no less than 256 to wireless links, and SHOULD assign costs between 32 and 196 to lossless wired links.

Rationale: if two implementations of Babel choose very different values for link costs, combining routers from different vendors will lead to sub-optimal routing.

REQ7: a Homenet implementation of Babel SHOULD distinguish between wired and wireless links; if it is unable to determine whether a link is wired or wireless, it SHOULD make the worst-case hypothesis that the link is wireless. It SHOULD dynamically probe the quality of wireless links and derive a suitable metric from its quality estimation. The algorithm described in Appendix A of RFC 6126 MAY be used.

Rationale: support for wireless transit links is a "killer feature" of Homenet, something that is requested by our users and easy to explain to our bosses. In the absence of dynamically computed metrics, the routing protocol attempts to minimise the number of links crossed by a route, and therefore prefers long, lossy links to shorter, lossless ones. In wireless networks, "hop-count routing is worst-path routing".

[This should probably be MUST, but it might be difficult or even impossible to implement in some environments, especially in the presence of wired-to-wireless bridges.]

2.2. Non-requirements

NR1: a Homenet implementation of Babel MAY perform route selection by applying hysteresis to route metrics, as suggested in Section 3.6 of RFC 6126 and described in detail in Section III.E of [BABEL-RTT]. However, it MAY simply pick the route with the smallest metric.

Rationale: hysteresis is only useful in congested and highly dynamic networks. In a typical home network, stable and uncongested, the feedback loop that hysteresis compensates for does not occur.

NR2: a Homenet implementation of Babel MAY include support for other extensions to the protocol, as long as they are known to interoperate with both the core protocol and source-specific routing.

Rationale: delay-based routing is useful in redundant meshes of tunnels, which do not occur in typical home networks (which typically use at most one VPN link). Interference-aware routing, on the other hand, is likely to be useful in home networks, but the extension requires further evaluation before it can be recommended for widespread deployment.

3. Acknowledgments

4. References

4.1. Normative References

[BABEL-SS] Boutier, M. and J. Chroboczek, "Source-Specific Routing in Babel", draft-boutier-babel-source-specific-01 (work in progress), January 2015.

[RFC6126] Chroboczek, J., "The Babel Routing Protocol", RFC 6126, February 2011.

[RFC7298] Ovsienko, D., "Babel Hashed Message Authentication Code (HMAC) Cryptographic Authentication", RFC 7298, July 2014.

[RFC7557] Chroboczek, J., "Extension Mechanism for the Babel Routing Protocol", RFC 7557, May 2015.

4.2. Informative References

[BABEL-RTT] Jonglez, B. and J. Chroboczek, "Delay-based Metric Extension for the Babel Routing Protocol", draft-jonglez-babel-rtt-extension-01 (work in progress), May 2015.

[BABEL-Z] Chroboczek, J., "Diversity Routing for the Babel Routing Protocol", draft-chroboczek-babel-diversity-routing-00 (work in progress), July 2014.

[DELAY-BASED] Jonglez, B. and J. Chroboczek, "A delay-based routing metric", March 2014.

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[HNCP] Stenberg, M., Barth, S., and P. Pfister, "Home Networking Control Protocol", draft-ietf-homenet-hncp-09 (work in progress), August 2015.

Author's Address

Juliusz Chroboczek
PPS, University of Paris-Diderot
Case 7014
75205 Paris Cedex 13
France

Email: jch@pps.univ-paris-diderot.fr