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6LoWPAN Roadmap and Implementation Guide

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Abstract

6LoWPAN is defined in RFC 4944 in conjunction with a number of specifications that are currently nearing completion. The entirety of these specifications may be hard to understand, pose specific implementation problems, or be simply inconsistent.

The present guide aims to provide a roadmap to these documents as well as provide specific advice how to use these specifications in combination. In certain cases, it may provide clarifications or even corrections to the specifications referenced.

This guide is intended as a continued work-in-progress, i.e. a long-lived Internet-Draft, to be updated whenever new information becomes available and new consensus on how to handle issues is formed. Similar to the ROHC implementation guide, RFC 4815, it might be published as an RFC at some future time later in the acceptance curve of the specifications.

This document does not describe a new protocol or attempts to set a new standard of any kind -- it mostly describes good practice in using the existing specifications, but it may also document emerging consensus where a correction needs to be made.

The current version -00 of this document is just an initial draft that is intended to spark the collection of relevant information.

Status of this Memo

Table of Contents

1. Introduction

(To be written - for now please read the Abstract.)

1.1. Terminology

This document is a guide. However, it might evolve to make specific recommendations on how to use standards-track specification. Therefore: 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. They indicate requirement levels for compliant 6LoWPAN implementations [RFC2119]. Note that these keywords are not only used where a correction or clarification is intended; the latter are explicitly identified as such.

The term "byte" is used in its now customary sense as a synonym for "octet".

2. 6LoWPAN

What is a 6LoWPAN?

The term, originally just the name of the IETF WG that created the specifications, nowadays refers to a specific way of building IP-connected wireless networks for embedded use cases. The 6LoWPAN core specifications are:

- o [RFC4944], as updated by
- o [I-D.ietf-6lowpan-hc] and
- o [I-D.ietf-6lowpan-nd].

While [RFC4944] defines 6LoWPAN specifically for IEEE 802.15.4 networks, 6LoWPAN concepts have been applied to other PHY/MAC layers.

6LoWPANs MAY use additional protocols, such as [I-D.ietf-roll-rpl] for routing, or [I-D.ietf-core-coap] for application data transfer. However, the "6LoWPANness" of a network is caused by adherence to the core specifications.

3. 6LoWPAN MTU

IPv6 defines a minimal value for the "Minimum Transmission Unit", MTU, of 1280 bytes. This means that every IPv6 network must be able to transfer a packet of at least 1280 bytes of IPv6 headers and data without requiring fragmentation.

A common Internet MTU is 1500 bytes (motivated by the Ethernet MTU). The gap between 1280 and 1500 allows tunneling protocols to insert headers on the way from the source of a packet to a destination without breaking the overall MTU of the path. As various tunneling protocols do indeed insert bytes, it is unwise to simply assume an end-to-end MTU of 1500 bytes even with the current dominance of Ethernet. Path MTU discovery [RFC1981] [RFC4821] has been defined to enable transport protocols to find an MTU value better than 1280 bytes, but still reliably within the MTU of the path being used. Path MTU discovery places, however, additional strain on constrained nodes, which therefore may want to stick with an MTU of 1280 bytes for all IPv6 applications.

6LoWPAN was designed as a stub network, not requiring any tunneling. As IEEE 802.15.4 packets are rather small (127 bytes maximum at the physical layer, minus MAC/security and adaptation layer overhead), 1280 bytes was already considered a somewhat large packet size. Therefore, the 6LoWPAN network MTU was simply set at the minimum size allowable by IPv6, 1280 bytes, although the 6LoWPAN fragmentation mechanism is able to support packets with total lengths (including the initial IPv6 header) of up to 2047 bytes.

As a more recent development, some modes of operation of the RPL protocol [I-D.ietf-roll-rpl] do indeed operate by tunneling data packets between RPL routers. Maintaining the MTU visible to applications at 1280 therefore requires making a larger MTU available to the tunnels.

6LoWPAN routers that employ RPL therefore MUST support a more appropriate MTU between routers that make use of tunneling between them. [The specific MTU value is TBD, to be chosen between 1280 and 2047 based on RPL considerations that need to be added to this document.]

4. PAN identifiers in IPv6 addresses

[RFC4944] incorporates PAN identifiers in IPv6 addresses created from 16-bit MAC addresses, in a somewhat awkward way (one of the 16 bits needs to be cleared to enable the U/L bit.).

As the use of PAN identifiers in 6LoWPAN networks has since become less and less meaningful, [I-D.ietf-6lowpan-hc] provides specific support only for interface IDs of the form 0000:00ff:fe00:XXXX, i.e. PAN identifiers of zero. (Other forms can be supported by creating sufficiently long pieces of compression context information for each non-zero PAN identifier; however there is a limited number of context elements and each consumes space in all nodes of a 6LoWPAN.)

It is therefore RECOMMENDED to employ a PAN identifier of zero with 6LoWPAN.

5. IANA Considerations

This document has no actions for IANA.

6. Security Considerations

(None so far; this section will certainly grow as additional security considerations beyond those listed in the base specifications become known.)

7. Acknowledgements

(The concept for this document is borrowed from [RFC4815], which was invented by Lars-Erik Jonsson. Thanks!)

8. References

8.1. Normative References

[I-D.ietf-6lowpan-hc]
Hui, J. and P. Thubert, "Compression Format for IPv6 Datagrams in Low Power and Lossy Networks (6LoWPAN)", draft-ietf-6lowpan-hc-15 (work in progress), February 2011.

[I-D.ietf-6lowpan-nd]
Shelby, Z., Chakrabarti, S., and E. Nordmark, "Neighbor Discovery Optimization for Low-power and Lossy Networks", draft-ietf-6lowpan-nd-15 (work in progress), December 2010.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4944] Montenegro, G., Kushalnagar, N., Hui, J., and D. Culler, "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", RFC 4944, September 2007.

8.2. Informative References

[I-D.ietf-core-coap]
Shelby, Z., Hartke, K., Bormann, C., and B. Frank, "Constrained Application Protocol (CoAP)", draft-ietf-core-coap-04 (work in progress), January 2011.

[I-D.ietf-roll-rpl]
Winter, T., Thubert, P., Brandt, A., Clausen, T., Hui, J., Kelsey, R., Levis, P., Pister, K., Struik, R., and J. Vasseur, "RPL: IPv6 Routing Protocol for Low power and Lossy Networks", draft-ietf-roll-rpl-18 (work in progress), February 2011.

[RFC1981] McCann, J., Deering, S., and J. Mogul, "Path MTU Discovery for IP version 6", RFC 1981, August 1996.

[RFC4815] Jonsson, L-E., Sandlund, K., Pelletier, G., and P. Kremer, "RObust Header Compression (ROHC): Corrections and Clarifications to RFC 3095", RFC 4815, February 2007.

[RFC4821] Mathis, M. and J. Heffner, "Packetization Layer Path MTU Discovery", RFC 4821, March 2007.

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