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6LoPLC: Transmission of IPv6 Packets over IEEE 1901.2 Narrowband Powerline Communication Networks

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Abstract This document updates [RFC 4944], "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", and [RFC 6282], "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks", and specifies the 6LoPLC technology: the transmission of IPv6 packets over IEEE 1901.2 narrowband powerline communication networks.

1. Introduction

6LOWPAN technology defines the transport of IPv6 packets over IEEE 802.15.4-2006 low power and lossy networks (LLNs). Because the 802.15.4-2006 wireless links do not support the IPv6 requirement for a link MTU of at least 1280 octets, 6LOWPAN adaptation layer defines header compression and fragmentation of IPv6 packets. A link in a LLN is characterized as lossy, low-power, low bit-rate, and short range. The LLN nodes have resources constrained in terms of processing power, memory capabilities, and communication bandwidth, due to a combination of factors including regulations on spectrum use, form factor and cost considerations. Recently, IEEE Standard Association published the IEEE 1901.2 PHY and MAC standard for narrowband powerline communications (NB-PLC). When used in LLNs, apart from using powerline communications instead of wireless communications, the devices implementing IEEE 1901.2 standard share the same constraints as their wireless counterparts.

1.1. Applicability

This document updates [RFC4944] and [RFC6282] and specifies 6LoPLC: the transmission of IPv6 packets over IEEE 1901.2 NB-PLC networks. The term 6LoPLC is used to make a clear difference between the 6LOWPAN technology, known in the industry as a mechanism to transmit IPv6 packets over 802.15.4-2006 wireless networks, and the use of 6LOWPAN technology for the transmission of IPv6 packets over IEEE 1901.2 networks. This document specifies a set of behaviors between devices in 1901.2 networks, which apply to both mesh and star topologies. An implementation that adheres to this document MUST implement these behaviors.

1.2. IEEE 1901.2 Technology

This section describes those features from IEEE 1901.2 standard that are relevant to the transmission of IPv6 packets over 1901.2 networks. For further details on IEEE 1901.2 technology, the reader is invited to refer to [IEEE1901.2]. IEEE 1901.2 standard defines a Narrowband PLC PHY and MAC technology for indoor and outdoor communications (e.g., smart grid networks, home area networks). IEEE 1901.2 MAC frame format endorses the IEEE 802.15.4-2006 MAC frame format [IEEE802.15.4], with a few exceptions described below.

o The IEEE 1901.2 MAC frame format is obtained by prepending a Segment Control Field to the IEEE 802.15.4-2006 MAC frame. One function of the Segment Control Field is to carry inline information for the MAC sub-layer fragmentation and reassembly process. Note that the complete format and use of Segment Control Field are not relevant to the transmission of IPv6 packets over IEEE 1901.2 networks.

o IEEE 1901.2 MAC frame format endorses only the IE

EE 802.15.4-2006 short and extended MAC addresses with a length of 16 and 64 bits, respectively. o IEEE 1901.2 MAC frame format endorses the concept of Information Elements, as defined in IEEE 802.15.4e-2012 [IEEE802.15.4e]. Note that the format and use of Information Elements are not relevant to the transmission of IPv6 packets over IEEE 1901.2 networks. The maximum size of a 1901.2 MAC frame payload is 1280 bytes, while the maximum size of a 1901.2 PHY frame payload is 512 bytes. The PHY frame payload size can vary from frame to frame, as a function of the modulation used to transmit the frame and the strength of the Forward Error Correction scheme. To cope with the mismatch between the size of the PHY frame payload and the size of the MAC frame, the IEEE 1901.2 standard specifies a mandatory MAC sub-layer fragmentation and reassembly process. This process fragments an upper layer datagram into multiple fragments and provides a reliable one-hop transfer of the resulting fragments.2. Transmission of IPv6 Packets over IEEE 1901.2 Networks The transmission of IPv6 packets over low-power and lossy networks relies on two mechanisms defined at 6LOWPAN adaptation layer. The first mechanism defines a set of procedures for IPv6 and UDP header compression (as specified in [RFC4944] and updated in [RFC6282]). The second mechanism defines a scheme for one-hop fragmentation and reassembly of IPv6 packets (as specified in [RFC4944]).2.1. 6LOWPAN Header compression Because IEEE 1901.2 fundamentally supports the IEEE 802.15.4-2006 MAC frame format and addressing scheme, IEEE 1901.2 devices implementing this specification MUST support the 6LOWPAN header compression schemes specified in [RFC6282]. Note that header compression mechanisms defined in [RFC6282] completely replace the header compression mechanisms defined in [RFC4944].2.2. 6LOWPAN FragmentationPopa & Hui Expires September 30, 2014 [Page 3]
Internet-Draft 6LoPLC March 2014 The use of fragmentation and reassembly consumes resources in terms of buffering and processing power. Also, fragmentation and reassembly consumes link capacity because, for each fragment that is transmitted, additional headers are required to properly manage the transmission, retransmission and reassembly of the fragments. As such, in the context of LLNs, where HW resources are constrained and network capacity is scarce, the fragmentation and reassembly should be avoided whenever possible. Because IEEE 1901.2 fundamentally supports a MAC payload of 1280 bytes and provides its own MAC sub-layer fragmentation mechanism, the use of 6LOWPAN fragmentation scheme defined in [RFC4944], when transmitting IPv6 packets over IEEE 1901.2 networks, is NOT RECOMMENDED.3. IANA Considerations No IANA considerations.4. Security Considerations This document has no security considerations beyond those in [RFC4291].5. Acknowledgements The authors would like to acknowledge the review, feedback, and comments of Matthew Gillmore, Samita Chakrabarti, and Ulrich Herberg.6. References6.1. Normative References [RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006. [RFC4944] Montenegro, G., Kushalnagar, N., Hui, J. and D. Culler, "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", RFC 4944, September 2007. [RFC6282] Hui, J. and P. Thubert, "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks", RFC 6282, September 2011. 6.2. Informative References [IEEE1901.2] IEEE SA , "IEEE Standard for Low-Frequency (less than 500 kHz) Narrowband Power Line Communications for Smart Grid Applications", December 2013. [IEEE802.15.4]Popa & Hui Expires September 30, 2014 [Page 4]
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