TTC標準
Standard

JJ-300.11

Homenetwork Communication Interface for ECHONET Lite (ITU-T G.9903 Narrow band OFDM PLC)

Version 2.0

Established on February 20, 2014

THE TELECOMMUNICATION TECHNOLOGY COMMITTEE

TTC Telecommunication Technology Committee

Table of contents

<Reference>

1. Relation with International Recommendations

- This Standard JJ-300.11 is based on Recommendation G.9903 (G3-PLC) standardized by International Telecommunication Union's Telecommunication Standardization Sector (ITU-T).
- ITU-T recommendation G.9903 was revised in May 2013, after the Standard JJ-300.11version.1.0 was released. This standard JJ-300.11 version 2.0 follows this revision.
- For G3-PLC used in Japan, specifications of the PHY and the MAC layers, conform to G.9903 (2013) Annex F. The band plan is specified in this standard.
- For the purpose of use in Japan, some of the functions included in the revised ITU-T G.9903 (consented in December 2013), are defined as the additional items in this document.
- After the approval of the revised G.9903 by the ITU-T in future, this standard JJ-300.11 might be revised to follow the revised G.9903 standard.

2. Differences from above International Recommendations

2.1 Optional Items

None.

2.2 Additional Items for Japanese Domestic Specifications

G3-PLC used in Japan shall conform to Annex F (Regional Requirements for Japan) of ITU-T G.9903 (2013). On the other hand, the band plan for Japan is specified in this JJ-300.11 standard.

In addition, this document specifies the following items that are described in the revised G.9903 (consented at the ITU-T meeting in December 2013) for the purpose of use in Japan.

(1) LBP Joining Procedure

LBP protocol can use any ID (Up to 36Bytes) or 64bit EUI for the EAP-PSK authentication ID_S and ID_P parameter, for the node specified in Section 9.4.4 of ITU-T G.9903 (2013) standard, at the Network Entry phase.

(2) LOADng disabling

JJ-300.11 devices can perform one-to-one single-hop communications by disabling the multi-hop LOADng routing functions, which specified in Section 9.4.3 ITU-T G.9903 (2013) standard.

In this case, device shall transmit IPv6 packet by setting the destination address designated by IPv6 header to the destination address in lower layer, without referring to the neighbor node table or route table.

(3) New Interleaver

The DQPSK modulation shall be performed in the same manner as for DBPSK modulation, corresponding to the elementary permutation matrix of a single permutation matrix, which defined in Section 7.10 of ITU-T G.9903 (2013). Below is the n-value calculation formula, for this case.

$$n = ceil\left(\frac{Total\_number\_of\_bits}{m \times mod_{size}}\right) \times mod_{size}$$

m: number of carriers, n: number of OFDM symbols, mod_{size}: number of bits per symbol

In addition, for both DBPSK and DQPSK modulation, if the initial value of $I_{(1,0)}$ is zero, at the time of calculating (I, J) interleaved position indication, replace the n_j and n_i as in the following formula,

$J_{(i,j)} = (j \times n_j + i \times n_i) \% n \rightarrow \quad J_{(i,j)} = (j \times n_i + i \times n_j) \% n$

$I_{(i,j)} = (i \times m_i + J_{(i,j)} \times m_j) \% m$

In the case where some subcarriers are masked (e.g. notches), interleaver is carried out in the same manner as shown above, but the n and m values are adjusted based on the number of used tones.

2.3 Changed items as Japanese Domestic Specifications.

None.

Table ref-2/JJ-300.11 – Comparison with Recommendation G.9903

	Section title of G.9903	**Section title of this Standard**	**Applicability to this Standard**	**Notes**
Section 1-10	See G.9903	Same as G.9903	Applied	
Annex A	Protocol Implementation Conformance Statement	Protocol Implementation Conformance Statement	Applied	
Annex B	Routing Cost	Routing Cost	Applied	
Annex C	Device starting sequence of messages	Device starting sequence of messages	Applied	
Annex D	The lightweight on-demand Ad hoc distance-vector routing protocol – next generation (LOADng)	The lightweight on-demand Ad hoc distance-vector routing protocol – next generation (LOADng)	Applied	
Annex E	Commissioning in 6LoWPAN	Commissioning in 6LoWPAN	Applied	
Annex F	Regional requirements for Japan	Regional requirements for Japan	Applied	
Appendix I	Examples on encoding and decoding	Examples on encoding and decoding	Applied	
Appendix II	Test vectors for cryptographic building blocks	Test vectors for cryptographic building blocks	Applied	

3. Revision History

Version	Date	Description
1.0	February 21, 2013	Initial publication
2.0	February 20, 2014	First revision. Update the standard to follow the ITU-T recommendation G.9903 (2013). Add domestic Related items proposed in the revised G.9903 Edition 3.0, which was consented in December 2013. Update the standards reference list. 2.1 - Add the adaptation layer (2.2.1) to the lower layer specification. Update 2.2.1 Network Layer section.

4. Industrial Property Rights

Information regarding submission of "The Policy for the Handling of Industrial Property Rights" associated with this standard is available on TTC's WEB Page.

5. Others

(1) Referenced Recommendations, Standards, etc.

[1] Recommendation ITU-T G.9901, Narrowband orthogonal frequency division multiplexing power line communication transceivers – power spectral density specification Amendment 1

[2] Recommendation ITU-T G.9903（2013）, Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks

[3] ARIB STD-T84: "Power Line Communication Equipment"（10kHz～450kHz）

[4] Transmission of IPv6 Packets over IEEE 802.15.4 Networks (6LoWPAN), IETF RFC 4944

[5] Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks, IETF RFC 6282

[6] Internet Protocol, Version 6 (IPv6) Specification, IETF RFC 2460

[7] IPv6 Stateless Address Autoconfiguration, IETF RFC 4862

[8] Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification, IETF RFC 4443

[9] User Datagram Protocol (UDP), IETF RFC 768

[10] The ECHONET Lite Specification Version 1.10

(2) This standard is based on the ITU-T recommendation shown in the above with several changes. It is required to refer both the ITU-T recommendations and the main body of this standard to comply with this standard.

6. Responsible working group

Version 1.0: TTC Next-Generation Home Network Systems Working Group.

Version 2.0: TTC Next-Generation Home Network Systems Working Group.

1. Introduction

This standard specifies the power line communication protocol for ECHONET Lite.

2. Specifications

This standard shall support the ITU-T recommendations listed below. The additional specification described in the section 2.1 shall take precedence over these recommendations.

[1] Recommendation ITU-T G.9901, Narrowband orthogonal frequency division multiplexing power line communication transceivers - power spectral density specification Amendment 1

[2] Recommendation G.9903 (2013), Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks

2.1. Lower Layer Specifications

JJ-300.11 devices for use under Japan shall use ITU-T G.9903 (2013) Annex F (Regional Requirements for Japan). Band plan for Japan is specified by Table-ref-2-1 as JJ-300.11 standard.

Table ref-2-1/JJ-300.11 - bandplan

Bandplans	Number of subcarriers	First subcarrier (kHz)	Last subcarrier (kHz)
ARIB Bandplan1	54	154.6875	403.125

This document stipulates the following items in G.9903 amendment draft proposal (consented at the ITU-T meeting in December 2013), for the purpose of adaptation in Japan.

(1) LBP Joining Procedure

LBP protocol can use any ID(Up to 36Bytes) or 64bit EUI for the EAP-PSK authentication ID_S and ID_P parameter, for the node specified in Section 9.4.4 of ITU-T G.9903 (2013) standard, on the Network Entry phase.

(2) LOADng disabling

JJ-300.11 devices can perform one-to-one single-hop communications by disabling the multi-hop LOADng routing functions, which specified in Section 9.4.3 ITU-T G.9903 (2013) standard.

In this case, device shall transmit IPv6 packet by setting the destination address designated by IPv6 header to the destination address in lower layer, without referring to the neighbor node table or route table.

(3) New Interleaver

The DQPSK modulation is performed in the same manner as for DBPSK modulation, corresponding to the elementary permutation matrix of a single permutation matrix, which is defined in Section 7.10 of ITU-T G.9903 (2013). Below is the n-value calculation formula, in this case.

$$n = ceil\left(\frac{Total\_number\_of\_bits}{m \times mod_{size}}\right) \times mod_{size}$$

m: number of carriers, n: number of OFDM symbols, mod_{size}: number of bits per symbol

In addition, if the initial value of $I_{(1,0)}$ is zero, at the time of calculating (I, J) interleaved position indication, replace the n_j and n_i as in the following formula. For both DBPSK and DQPSK modulation,

$$J_{(i,j)} = (j \times n_j + i \times n_i) \% n \rightarrow \quad J_{(i,j)} = (j \times n_i + i \times n_j) \% n$$
$$I_{(i,j)} = (i \times m_i + J_{(i,j)} \times m_j) \% m$$

In the case where some subcarriers are masked (e.g. notches), interleaver is carried out in the same manner as shown above, but the n and m values are adjusted based on the number of used tones.

2.1.1. Adaptation Layer

The adaptation layer in the interface block of JJ-300.11 device shall support 6LoWPAN [4], and IPHC on 6LoWPAN [5] with compression of the IPv6 header and, if needed, fragmentation support.

2.1.1.1. Fragmentation

Because JJ-300.11 device does not change the order of MAC/PHY [2] transmission frame, the additional two definitions will make possible to reconstruct the IP datagram fragment sequentially, by its receiving order.
All nodes shall support the fragmentation function defined in [4]. In addition to the definitions in document [4], the following two new definitions (a) and (b) are added.

Transmission order of the fragments is not specified in [4]. However, JJ-300.11 devices shall
(a) send the fragments generated from the same IP datagram in the order of increasing offset of its datagram.
(b) not send other fragments generated by other IP datagrams with same destination IP address, until transmission of all fragments generated from one IP datagram was completed.

MTU of Interface shall be set to 1280octets.

2.1.1.2. Header compression

All nodes shall basically support the header compression defined in [5]. Since it is a closed system that is using only link local addresses, the header compression using a context ID shall not be required (including stateful compression of multicast addresses).

The compression of the UDP header and IPv6 extension header by LOWPAN_NHC shall be supported. Therefore, NH bit in IPHC (IPv6 Extension Header Encoding) of the IPv6 Next Header shall be set to “1”.

UDP port shall not be compressed because the port number is defined by ECHONET Lite specification [10] and it is outside of the compressible port "0xf0b0 ~ 0xf0bf" that is specified in [5].

UDP checksum shall be compressed.

A node receiving an IPv6 packet shall be able to receive IPv6 packets with header compression, and also shall be able to receive IPv6 packet encoded without using the above-mentioned excluded functions among the header

compression methods defined in [5]. This also includes the case of IPv6 packets encoded by applying only a portion of the header compression defined in [5].

JJ-300.11 standard does not support context ID, and use a link-local address based on the short address of IPv6 address. Figure 2-1 shows LOWPAN_IPHC encoding header of the IPv6 unicast packets, based on this standard.

(bit)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	TF		1	HLIM		0	0	1	1	0	0	1	1

Figure 2-1 LOWPAN_IPHC encoding header（unicast）

HC1 and HC2 specified in [4] are not used in JJ-300.11 standard.

2.2 Upper Layer Specification

Figure 2-2 shows the protocol stack defined by this standard. This section defines network layer, transport layer and application layer, which are not covered by G.9903 (2013).

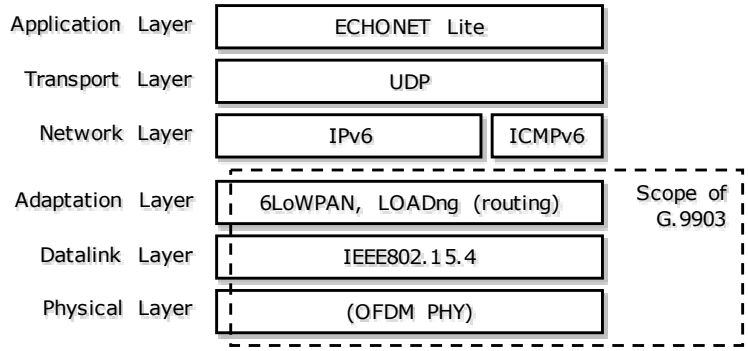

Figure 2-2 – Protocol stack

2.2.1 Network Layer

All nodes shall support IPv6 [6].

Hop-by-Hop Options extension header, Routing extension header, Fragment extension header, Destination Options extension header, and the ESP extension header and the AH header extension associated with the IPSec does not need to be supported.

Each extension header shall be transmitted according to the recommended order, which defined in [6].

All nodes shall support ICMPv6 [8]. In addition to the echo request (type 128) and echo reply (Type 129) message type, destination unreachable (Type 1), time exceeded (Type 3) and Parameter Problem (Type 4) shall be supported.

Too large packet size messages (Type 2) shall not be responded to, but shall be properly handled upon receipt.

In this standard 16-bit short address based link-local address shall be used, which defined by the IEEE802.15.4 standard, is always used. In this regard, the address shall be composed of the well known link-local prefix “FE80 :: 0/64” and an interface identifier based on the short address of the node, as described in [4] and [7].

The unique local address, global address, and IPv6 address based on the EUI-64 address specified in IEEE802.15.4 standard, shall not be supported in this standard.

For the ECHONET Lite multicast transmission, destination address shall be set to ff02 :: 1, in accordance with ECHONET Lite specification [10].

JJ-300.11 does not use Neighbor Discovery for IPv6. The destination MAC address shall be obtained from destination IPv6 address as an IPv6 address is based on the 16-bit short address of the corresponding node. PAN Coordinator shall assign 16-bit short address to each device not to duplicate within its network since Duplicate Address Detection specified as a part of Neighbor Discovery for IPv6 is not used in this standard.

2.2.2 Transport Layer

All JJ-300.11 devices shall implement UDP [9]. The Destination port address of UDP packets shall be 3610, as specified in ECHONET Lite specification [10].

2.2.3 Application Layer

All JJ-300.11 devices shall support all mandatory application layer specifications described in ECHONET Lite specification [10].