

IEEE Std 1609.3-2016 Guidance Note 1: Transmit power encoding

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1 Introduction

This note identifies an area in IEEE Std 1609.3-2016 that has been reported as potentially misleading or ambiguous and gives guidance on a recommended interpretation of the standard.

The potentially misleading or ambiguous text concerns the encoding of transmit power. Two fields contain transmit power: the optional *Transmit Power Used* field in the WSMP header, and the *Transmit Power Level* field in the WSA's optional Channel Info segment. Transmit power is also used in the WSM-WaveShortMessage.request and WSM-WaveShortMessage.indication primitives, and in the 1609.3 MIB.

This guidance note is structured as follows. Section 2 provides a summary of the issue. Section 3 provides the recommended interpretation. Section 3.1 provides the full text from the relevant sections of IEEE Std 1609.3-2016. Section 3.2 provides full replacement text that should be considered for incorporation into a corrigendum or revision of 1609.3.

2 Summary of issue

Historically in the 1609 and 802.11 standards, transmit power has been specified to be in the range of -128 to 127. IEEE Std 802.11-2012 *Clause 8.4.1.20 Transmit Power Used field* states (in part) "The Transmit Power Used field is a twos complement signed integer and is 1 octet in length". And the IEEE Std 1609.3 standard states transmit power is to be "encoded as specified in IEEE Std 802.11". In revisions of 1609.3 prior to the most recent -2016 version, the example frames in the annex of 1609.3 were compatible with this text.

However during the most recent revisions to the standard which resulted in the publication of IEEE Std 1609.3-2016, changes were made to WSMP and WSA frame formats with the intention to create over-the-air frames which are compatible with ISO frames. The ISO standards use ASN.1 to define frames, and use Unaligned Packed Encoding Rules (UPER) for over the air transmission of those frames. The example frames of Annex G were changed to be compatible with ASN.1 and UPER.

There is an incompatibility between the encoding method specified for transmit power in IEEE Std 802.11 and the ISO encoding method which uses UPER, as there is not a defined set of encoding rules in UPER that can handle a range that includes negative numbers.

And so the text which states that fields containing transmit power are “encoded as specified in IEEE Std 802.11” is misleading.

Note that the IEEE Std 802.11-2012 Clause 8.4.1.20 text addresses two technical issues:

- Encoding method.
- What the field represents, i.e., transmit power as measured at the antenna connector and related details.

The encoding method is subject of this Guidance Note and therein lies the incompatibility being addressed. The technical description of what the field represents remains in effect.

3 Recommended interpretation

The recommended interpretation is to follow the rules for UPER when encoding fields that contain transmit power. As UPER encodes all objects as unsigned, the base of the range is encoded as 0, and all other values in the range are encoded as offsets to 0. For example in this case -128 is encoded as 0 and 127 is encoded as 255 (0xFF). Also see the Annex G example where a transmit power of 30 dBm is encoded as 0x9E.

The standard describes the values used for transmit power as having a range of from -128 to 127 when they occur in service primitives and the MIB. However when subfields containing transmit power are encoded for over the air transmission, they are encoded using UPER and have a range of 0 to 255. This is a key point: the standard will continue to describe transmit power as having the range of -128 to 127 in all places except when the two specific fields listed in the Introduction section above are encoded for over the air transmission using UPER.

3.1 Original text

8.1 General

The WAVE Service Advertisement and WAVE Short Message sent over the air have been formatted to be compatible with ASN.1.

8.2.4.4 Transmit Power Level

Transmit Power Level is a signed decimal number in the range -128 to 127. It is one octet in length. It indicates the Effective Isotropic Radiated Power (EIRP), in dBm, to be used for transmissions on the associated channel. *Transmit Power Level* should be interpreted as the maximum EIRP power level allowed.

8.3.4.4 Transmit Power Used

Transmit Power Used is optionally included in the WSMP-N-Header for use by the WSM recipient. It is encoded as specified in IEEE Std 802.11.

7.3.2 WSM-WaveShortMessage.request (Table 3)

<i>Transmit Power Level</i>	Signed integer	-128 to 127	Inserted into the DL-UNITDATA.request. Indicates the power level to be used for this transmission. May be included in the transmitted WSM per 8.3. Encoded as specified in IEEE Std 802.11.
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7.3.4 WSM-WaveShortMessage.indication (Table 5)

<i>Transmit Power Used</i>	Integer	-128 to 127	If present, extracted from the WSMP-N-Header per 8.3. Parameter specified in IEEE Std 802.11.
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3.2 Proposed replacement text

8.1 General

The WAVE Service Advertisement and WAVE Short Message sent over the air have been formatted to be compatible with ASN.1 using Unaligned Packed Encoding Rules (UPER).

NOTE-UPER does not include rules that can encode ranged values which include negative numbers, i.e., all values in a range are encoded as unsigned. The base of the range is encoded as 0, and all other values in the range are encoded as offsets to 0. For example the range of values from -128 to 127 are encoded using UPER as from 0 to 255, where 0 represents the base value -128.

8.2.4.4 Transmit Power Level

Transmit Power Level indicates the Effective Isotropic Radiated Power (EIRP), in dBm, to be used for transmissions on the associated channel. *Transmit Power Level* should be interpreted as the maximum EIRP power level allowed.

Transmit power is represented by a signed decimal number in the range -128 to 127. Note however that the field *Transmit Power Level* is encoded for over the air transport using UPER, therefor the *Transmit Power Level* field has a range of 0 to 255 (See 8.1). It is one octet in length.

8.3.4.4 Transmit Power Used

Transmit Power Used is optionally included in the WSMP-N-Header for use by the WSM recipient, and indicates the actual power used as measured at the output of the antenna connector, in units of dBm (see IEEE Std 802.11 for specific details). As described in IEEE Std 802.11, transmit power is represented by a signed decimal number in the range -128 to 127. Note however that the field *Transmit Power Used* is encoded for over the air transport using UPER, therefor the *Transmit Power Used* field has a range of 0 to 255 (See 8.1). It is one octet in length.

7.3.2 WSM-WaveShortMessage.request (Table 3)

<i>Transmit Power Level</i>	Signed integer	–128 to 127	Inserted into the DL-UNITDATA.request, see 5.5.2. Indicates the power level to be used for this transmission, see 8.2.4.4. The actual power level used may be included in the transmitted WSM per 8.3, see also 8.3.4.4. Parameter specified in IEEE Std 802.11.
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7.3.4 WSM-WaveShortMessage.indication (Table 5)

<i>Transmit Power Used</i>	Signed integer	–128 to 127	If present, extracted from the WSMP-N-Header per 8.3. Indicates the actual power used for transmission of this message. Parameter specified in IEEE Std 802.11. See also 8.3.4.4.
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