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Additional Units for SenML

Abstract

The Sensor Measurement Lists (SenML) media type supports the indication of units for a quantity represented. This short document registers a number of additional unit names in the IANA registry for Units in SenML. It also defines a registry for secondary units that cannot be in SenML's main registry as they are derived by linear transformation from units already in that registry.

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1. Introduction

The Sensor Measurement Lists (SenML, [[RFC8428](#)]) media type supports the indication of a unit, using the SenML field "u", for the quantity given as a data value in a SenML record. For this purpose, SenML defines an IANA registry of defined Unit names and their meanings; in the present document, we call the Unit names registered there "primary Unit names".

This short document registers a number of additional units in the IANA registry for Units in SenML that appear to be necessary for further adopting SenML in other Standards Development Organizations (SDOs).

The document also defines a registry for secondary Unit names that cannot be in SenML's main registry as they are derived by linear transformation from units already in that registry. Although SenML version 10 [[RFC8428](#)] does not provide for the direct use of these secondary units, they are planned to be supported via the use of SenML extension mechanisms, one of which is proposed in [[I-D.bormann-core-senml-versions](#)].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

2. New Primary Units

IANA is requested to assign new units in the "SenML Units" subregistry of the SenML registry [[IANA.senml](#)] (as defined in [[RFC8428](#)]):

Symbol	Description	Type	Reference
B	Byte (information content)	float	RFCthis
VA	volt-ampere (Apparent Power)	float	RFCthis
VAs	volt-ampere second (Apparent Energy)	float	RFCthis
var	volt-ampere reactive (Reactive Power)	float	RFCthis
vars	volt-ampere reactive second (Reactive Energy)	float	RFCthis
J/m	joule per meter (Energy per distance)	float	RFCthis
kg/m3	kilogram per cubic meter (mass density, mass concentration)	float	RFCthis
deg	degree (angle)*	float	RFCthis

Table 1: New units registered for SenML

2.1. Rationale

SenML [[RFC8428](#)] takes the position that unscaled SI units should always be used. However, SenML makes one exception: The degree Celsius (as Cel) is allowed as an alternative to the K (Kelvin).

This document takes the position that the same should apply to a small number of alternative units in wide use:

*The Byte. [[IEC-80000-13](#)] defines both the bit (item 13-9.b) and the byte (item 13-9.c, also called octet) as alternative names for the coherent unit used for dimensionless quantities, for the purpose of giving storage capacity and related quantities. While the name octet is associated with the symbol o, this is in wide use only in French-speaking countries. Globally more wide-spread is the symbol B for byte, even though B is already taken in SI for bel. [[RFC8428](#)] therefore registers dB as the SenML unit for logarithmic relative power, leaving B free for the usage proposed here. While this is potentially confusing, the situation is widely understood in engineering circles and is unlikely to cause actual problems.

*The Volt-Ampere. [[IEC-80000-6](#)] item 6-57.a defines the VA (volt ampere) as a unit for apparent power; items 6-59.a, 6-60.a and 6-61.a also use the unit for complex, reactive, and non-active power.

*The Volt-Ampere-reactive. [[IEC-80000-6](#)] item 6-60.b defines the var (volt ampere reactive) as an alternative (and fully equivalent) unit to VA specifically for reactive power (with the primary unit VA); it has become clear that there is strong interest in using this unit specifically for the imaginary content of complex power, i.e., reactive power [[IEEE-1459](#)].

The unit "degrees" is in wide use in practice for plane angles (as in heading, bearing, etc.). It is marked with an asterisk because the preferred coherent SI unit is radian ("rad").

The Joule per meter is not a traditional electromagnetic unit. It and its scaled derivatives (in particular Wh/km) are used to describe the energy expended for achieving motion over a given distance, e.g., as an equivalent for electrical cars of the inverse of "mileage".

3. New Registry for Secondary Units

IANA is requested to create a "secondary units" subregistry in the SenML registry [[IANA.senml](#)] defined in [[RFC8428](#)].

The registry has six columns:

- *secondary unit: a newly registered name allocated within the same namespace as SenML units
- *description: short description (usually just expansion of abbreviation)
- *SenML unit: an existing SenML unit from the SenML units registry
- *scale, offset: two rational numbers, expressed in decimal (optionally, with a decimal exponent given) or as a fraction represented using a "/" character to separate numerator and denominator.
- *Reference: where does the entry come from.

Quantities expressed in the secondary unit can be converted into the SenML unit by first multiplying their value with the scale number and then adding the offset, yielding the value in the given SenML unit.

The initial content of the secondary units registry is provided in [Table 2](#):

secondary unit	description	SenML unit	scale	off set	reference
ms	millisecond	s	1/1000	0	RFCthis
min	minute	s	60	0	RFCthis
h	hour	s	3600	0	RFCthis
MHz	megahertz	Hz	1000000	0	RFCthis
kW	kilowatt	W	1000	0	RFCthis
kVA	kilovolt-ampere	VA	1000	0	RFCthis
kvar	kilovar	var	1000	0	RFCthis
Ah	ampere-hour	C	3600	0	RFCthis
Wh	watt-hour	J	3600	0	RFCthis
kWh	kilowatt-hour	J	3600000	0	RFCthis
varh	var-hour	vars	3600	0	RFCthis
kvarh	kilovar-hour	vars	3600000	0	RFCthis
kVAh	kilovolt-ampere-hour	VAs	3600000	0	RFCthis
Wh/km	watt-hour per kilometer	J/m	3.6	0	RFCthis
KiB	kibibyte	B	1024	0	RFCthis
GB	gigabyte	B	1e9	0	RFCthis
Mbit/s	megabit per second	bit/s	1000000	0	RFCthis
B/s	byte per second	bit/s	8	0	RFCthis
MB/s	megabyte per second	bit/s	8000000	0	RFCthis
mV	millivolt	V	1/1000	0	RFCthis
mA	milliampere	A	1/1000	0	RFCthis
dBm	decibel (milliwatt)	dBW	1	-30	RFCthis
ug/m3	microgram per cubic meter	kg/m3	1e-9	0	RFCthis
mm/h	millimeter per hour	m/s	1/3600000	0	RFCthis
m/h	meter per hour	m/s	1/3600	0	RFCthis
ppm	parts per million	/	1e-6	0	RFCthis
/100	percent (Note 1)	/	1/100	0	RFCthis
/1000	permille	/	1/1000	0	RFCthis
hPa	hectopascal	Pa	100	0	RFCthis
mm	millimeter	m	1/1000	0	RFCthis
cm	centimeter	m	1/100	0	RFCthis
km	kilometer	m	1000	0	RFCthis
km/h	kilometer per hour	m/s	1/3.6	0	RFCthis

Table 2: Secondary units registered for SenML

Note 1: This registration does not use the obvious name "%" because this name has been taken in [\[RFC8428\]](#) already, where it is a NOT RECOMMENDED synonym for "/" (unity) for legacy reasons. Note that the presence of both "%" and "/100" with different meanings is likely to create confusion, so the present document adds some weight to the recommendation against using the counterintuitive unit name "%".

Example: the value of a quantity given as 100 ms is first multiplied by 1/1000, yielding the number 0.1, and then the offset 0 is added, yielding the number 0.1 again, leading to a quantity of 0.1 s. The value of a quantity given as 10 dBm is first multiplied by 1, yielding the number 10, and then the offset -30 is added, yielding the number -20, leading to a quantity of -20 dBW.

New entries can be added to the registration by Expert Review as defined in [\[RFC8126\]](#). Experts should exercise their own good judgment, with the same guidelines as used for SenML units (Section 12.1 of [\[RFC8428\]](#)), but without applying the rules 4, 5, and 8. Note that rule 7 limits the use of what could be understood as prefixes on their own, not the use of prefixes inside secondary unit names. Guidelines to the difference between units (which can go into the registry) and quantities (which cannot) are widely available, see for instance [\[RS\]](#) and [\[BIPM\]](#).

As of SenML version 10 [\[RFC8428\]](#), SenML packs are limited to using primary units in "u" fields. The use of primary units enables direct comparison of measurements from different sources. Also, it facilitates implementations that trigger on the presence of a quantity in a certain unit, without the need to track any additional secondary units that may be registered for this quantity.

Where the benefits of directly using a secondary unit in a SenML pack outweigh the above considerations, the use of secondary units in "u" fields MAY be enabled by indicating a new SenML version that specifically allows this and/or by using a field with a label name that ends with the "_" character ("must-understand" field) whose definition specifically allows this. The definition of these versions and fields is outside the scope of the present specification; one such definition is proposed in [\[I-D.bormann-core-senml-versions\]](#).

4. Operational Considerations

The secondary unit registry is expected to grow at a faster pace than the registry of primary unit names. It also is amenable to

automatic interpretation, by making use of the scale and offset columns.

Implementers may be tempted to equip each instance of their systems with code to download new versions of the registry from IANA frequently, in order to be able to make use of newly defined secondary unit names. This can create high load at IANA and a potential single point of failure. Instead of pulling the registry in each individual instance of the code, the software update mechanism (or a similar mechanism that leads to less frequent IANA visits) SHOULD be used to disseminate updated units registries obtained from IANA towards the instances via common repositories.

5. Security Considerations

The security considerations of [[RFC8428](#)] apply.

The introduction of new measurement units poses no additional security considerations except from a possible potential for additional confusion about the proper unit to use, and from the risk that an implementation based on the assumption described in the penultimate paragraph of [Section 3](#) no longer works properly. However, an implementation processing a pack while making use of secondary units is guaranteed to have been developed with an awareness of the risks of having multiple units available for the same logical type. In any case, the existing risk of an existing SenML implementation not understanding a unit that was not in the initial registry content provided in [[RFC8428](#)], is unchanged, and implementations are warned properly about the potential use of secondary units by the need for a must-understand field or an updated version field.

6. IANA Considerations

See [Section 2](#) and [Section 3](#).

7. References

7.1. Normative References

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