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             Additional Units for Sensor Measurement Lists (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.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   https://www.rfc-editor.org/info/rfc8798.

Table of Contents

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, future support is intended via the use of SenML extension mechanisms, one of which is proposed in [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 has assigned new units in the "SenML Units" subregistry of the "Sensor Measurement Lists (SenML)" registry [IANA.SENML] (as defined in [RFC8428]):

Symbol	Description	Type	Reference
========	=============	======	===========
B	Byte (information content)	float	RFC 8798
VA	volt-ampere (Apparent Power)	float	RFC 8798
VAs	volt-ampere second (Apparent Energy)	float	RFC 8798
var	volt-ampere reactive (Reactive Power)	float	RFC 8798
vars	volt-ampere-reactive second (Reactive Energy)	float	RFC 8798
J/m	joule per meter (Energy per distance)	float	RFC 8798
kg/m3	kilogram per cubic meter (mass density, mass concentration)	float	RFC 8798
deg	degree (angle)*	float	RFC 8798

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 widespread 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] defines the volt ampere (VA) (item
   6-57.a) 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
   volt-ampere reactive (var) 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 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".

The unit "degree" 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").

3. New Registry for Secondary Units

IANA has created a "Secondary Units" subregistry in the "Sensor
Measurement Lists (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: a short description (usually just the expansion of an
   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 the entry comes 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" subregistry is provided
in Table 2:

Secondary Unit	Description	SenML Unit	Scale	Offset	Reference
ms	millisecond	s	1/1000	0	RFC 8798
min	minute	s	60	0	RFC 8798
h	hour	s	3600	0	RFC 8798
MHz	megahertz	Hz	1000000	0	RFC 8798
kW	kilowatt	W	1000	0	RFC 8798
kVA	kilovolt-ampere	VA	1000	0	RFC 8798

kvar	kilovar	var	1000	0	RFC 8798
Ah	ampere-hour	C	3600	0	RFC 8798
Wh	watt-hour	J	3600	0	RFC 8798
kWh	kilowatt-hour	J	3600000	0	RFC 8798
varh	var-hour	vars	3600	0	RFC 8798
kvarh	kilovar-hour	vars	3600000	0	RFC 8798
kVAh	kilovolt-ampere-hour	VAs	3600000	0	RFC 8798
Wh/km	watt-hour per kilometer	J/m	3.6	0	RFC 8798
KiB	kibibyte	B	1024	0	RFC 8798
GB	gigabyte	B	1e9	0	RFC 8798
Mbit/s	megabit per second	bit/s	1000000	0	RFC 8798
B/s	byte per second	bit/s	8	0	RFC 8798
MB/s	megabyte per second	bit/s	8000000	0	RFC 8798
mV	millivolt	V	1/1000	0	RFC 8798
mA	milliampere	A	1/1000	0	RFC 8798
dBm	decibel (milliwatt)	dBW	1	-30	RFC 8798
ug/m3	microgram per cubic meter	kg/m3	1e-9	0	RFC 8798
mm/h	millimeter per hour	m/s	1/3600000	0	RFC 8798
m/h	meter per hour	m/s	1/3600	0	RFC 8798
ppm	parts per million	/	1e-6	0	RFC 8798
/100	percent (Note 1)	/	1/100	0	RFC 8798
/1000	permille	/	1/1000	0	RFC 8798
hPa	hectopascal	Pa	100	0	RFC 8798
mm	millimeter	m	1/1000	0	RFC 8798
cm	centimeter	m	1/100	0	RFC 8798
km	kilometer	m	1000	0	RFC 8798
km/h	kilometer per hour	m/s	1/3.6	0	RFC 8798

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 the offset 0 is then 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 the offset -30 is then 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 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 [SENML-VERSIONS].

4. Operational Considerations

   The "Secondary Units" subregistry is expected to grow at a faster
   pace than the subregistry 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 a potential for additional confusion
   about the proper unit to use and 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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