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      Concise Binary Object Representation (CBOR) Tags for Time, Duration, and
                                Period
                    draft-bormann-cbor-time-tag-01

Abstract

   The Concise Binary Object Representation (CBOR, RFC 7049) is a data
   format whose design goals include the possibility of extremely small
   code size, fairly small message size, and extensibility without the
   need for version negotiation.

   In CBOR, one point of extensibility is the definition of CBOR tags.
   RFC 7049 defines two tags for time: CBOR tag 0 (RFC3339 time) and tag
   1 (Posix time [TIME_T], int or float). Since then, additional
   requirements have become known. The present document defines a CBOR
   tag for time that allows a more elaborate representation of time, and
   anticipates the definition of related CBOR tags for duration and time
   period. It is intended as the reference document for the IANA
   registration of the CBOR tags defined.

Note to Readers

   Version -00 of the present draft opened up the possibilities provided
   by extended representations of time in CBOR. The present version -01
   consolidates this draft to non-speculative content, the normative
   parts of which are believed will stay unchanged during further
   development of the draft. This version is provided to aid the
   registration of the CBOR tag immediately needed. Further versions
   will re-introduce some of the material from -00, but in a more
   concrete form.

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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1. Introduction

   The Concise Binary Object Representation (CBOR, [RFC7049]) provides
   for the interchange of structured data without a requirement for a
   pre-agreed schema. RFC 7049 defines a basic set of data types, as
   well as a tagging mechanism that enables extending the set of data
   types supported via an IANA registry.

   (TBD: Expand on text from abstract here.)

1.1. Terminology

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

   The term "byte" is used in its now customary sense as a synonym for
   "octet". Where bit arithmetic is explained, this document uses the
   notation familiar from the programming language C (including C++14's
   0bnnn binary literals), except that the operator "**" stands for
   exponentiation.

1.2. Background

   Additional information about the complexities of time representation
   can be found in [TIME]. This specification uses a number of terms
   that should be familiar to connoisseurs of precise time; references
   for these may need to be added.

2. Objectives

   For the time tag, the present specification addresses the following
   objectives that go beyond the original tags 0 and 1:

   o Additional resolution for epoch-based time (as in tag 1). CBOR
      tag 1 only provides for integer and up to binary64 floating point
      representation of times, limiting resolution to approximately
      microseconds at the time of writing (and progressively becoming
      worse over time).

   Not currently addressed, but possibly covered by the definition of
   additional map keys for the map inside the tag:

   o Indication of time scale. Tags 0 and 1 are for UTC; however, some
      interchanges are better performed on TAI. Other time scales may
      be registered once they become relevant (e.g., one of the proposed
      successors to UTC that might no longer use leap seconds, or a
      scale based on smeared leap seconds).

o Direct representation of natural platform time formats. Some
   platforms use epoch-based time formats that require some
   computation to convert them into the representations allowed by
   tag 1; these computations can also lose precision and cause
   ambiguities. (TBD: The present specification does not take a
   position on whether tag 1 can be "fixed" to include, e.g., Decimal
   or BigFloat representations. It does define how to use these with
   the extended time format.)

o Additional indication of intents about the interpretation of the
   time given, in particular for future times. Intents might include
   information about time zones, daylight savings times, etc.

Additional tags might later be defined for duration and period. The
objectives for such duration and period tags are likely similar.

3. Time Format

An extended time is indicated by CBOR tag TBDET, which tags a map
data item (CBOR major type 5). The map may contain integer (major
types 0 and 1) or text string (major type 3) keys, with the value
type determined by each specific key. Implementations MUST ignore
key/value types they do not understand for negative integer and text
string values of the key. Not understanding key/value for unsigned
keys is an error.

The map must contain exactly one unsigned integer key, which
specifies the "base time", and may also contain one or more negative
integer or text-string keys, which may encode supplementary
information such as:

o a higher precision time offset to be added to the base time,

Future keys may add:

o a reference time scale and epoch different from the default UTC
   and 1970-01-01

o information about clock source and precision, accuracy, and
   resolution

o intent information such as timezone and daylight savings time,
   and/or possibly positioning coordinates, to express information
   that would indicate a local time.

While this document does not define supplementary text keys, a number
of unsigned and negative-integer keys are defined below.

3.1. Key 1

   Key 1 indicates a value that is exactly like the data item that would
   be tagged by CBOR tag 1 (Posix time [TIME_T] as int or float).

3.2. Keys 4 and 5

   Keys 4 and 5 are like key 1, except that the data item is an array as
   defined for CBOR tag 4 or 5, respectively. This can be used to
   include a Decimal or Bigfloat epoch-based float [TIME_T] in an
   extended time.

3.3. Keys -3, -6, -9, -12, -15, -18

   The keys -3, -6, -9, -12, -15 and -18 indicate additional decimal
   fractions by giving an unsigned integer (major type 0) and scaling
   this with the scale factor 1e-3, 1e-6, 1e-9, 1e-12, 1e-15, and 1e-18,
   respectively (see Table 1). More than one of these keys MUST NOT be
   present in one extended time data item. These additional fractions
   are added to a base time in seconds [SI-SECOND] indicated by a Key 1,
   which then MUST also be present and MUST have an integer value.

```
              +-----+-------------+----------------+
              | Key | meaning     | example usage  |
              +-----+-------------+----------------+
              | -3  | milliseconds| Java time      |
              | -6  | microseconds| (old) UNIX time|
              | -9  | nanoseconds | (new) UNIX time|
              | -12 | picoseconds | Haskell time   |
              | -15 | femtoseconds| (future)       |
              | -18 | attoseconds | (future)       |
              +-----+-------------+----------------+
```

                 Table 1: Key for decimally scaled Fractions

4. CDDL typenames

   For the use with the CBOR Data Definition Language, CDDL
   [I-D.greevenbosch-appsawg-cbor-cddl], the type names defined in
   Figure 1 are recommended:

   etime = #6.TBDET({* (int/tstr) => any})

                   Figure 1: Recommended type names for CDDL

5. IANA Considerations

   IANA is requested to allocate the tags in Table 2 from the FCFS
   space, with the present document as the specification reference.

```
+-------+-----------+------------------------+
|   Tag | Data Item | Semantics              |
+-------+-----------+------------------------+
| TBDET | map       | [RFCthis] extended time |
| TBDED | map       | [RFCthis] duration     |
| TBDEP | map       | [RFCthis] period       |
+-------+-----------+------------------------+
```

                      Table 2: Values for Tags

   Although duration and period are not yet defined in the present
   version of this document, the tag values for duration and period are
   requested at the same time as the value for extended time in order to
   achieve allocation of all three values as a contiguous set.

   RFC editor note: Please replace TBDET, TBDED, and TBDEP by the tag
   number allocated by IANA throughout the document and delete this
   note.

6. Security Considerations

   The security considerations of RFC 7049 apply; the tags introduced
   here are not expected to raise security considerations beyond those.

   Time, of course, has significant security considerations; these
   include the exploitation of ambiguities where time is security
   relevant (e.g., for freshness or in a validity span) or the
   disclosure of characteristics of the emitting system (e.g., time
   zone, or clock resolution and wall clock offset).

7. References

7.1. Normative References

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Acknowledgements

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