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Constrained Application Protocol (CoAP): Corrections and Clarifications

Abstract

RFC 7252 defines the Constrained Application Protocol (CoAP), along with a number of additional specifications, including RFC 7641, RFC 7959, RFC 8132, and RFC 8323. RFC 6690 defines the link format that is used in CoAP self-description documents.

Some parts of the specification may be unclear or even contain errors that may lead to misinterpretations that may impair interoperability between different implementations. The present document provides corrections, additions, and clarifications to the RFCs cited; this document thus updates these RFCs. In addition, other clarifications related to the use of CoAP in other specifications, including RFC 7390 and RFC 8075, are also provided.

About This Document

This note is to be removed before publishing as an RFC.

Status information for this document may be found at https://datatracker.ietf.org/doc/draft-bormann-core-corr-clar/.

Discussion of this document takes place on the core Working Group mailing list (mailto:core@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/core/. Subscribe at https://www.ietf.org/mailman/listinfo/core/.

Source for this draft and an issue tracker can be found at https://github.com/core-wg/corrclar.

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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This Internet-Draft will expire on 31 August 2024.

Table of Contents

1. Introduction

[RFC7252] defines the Constrained Application Protocol (CoAP), along with a number of additional specifications, including [RFC7641],

[RFC7959], [RFC8132], and [RFC8323]. [RFC6690] defines the link format that is used in CoAP self-description documents.

During implementation and interoperability testing of these RFCs, and in their practical use, some ambiguities and common misinterpretations have been identified, as well as a few errors.

The present document summarizes identified issues and provides corrections needed for implementations of CoAP to interoperate, i.e., it constitutes an update to the RFCs referenced. This document also provides other clarifications related to common misinterpretations of the specification. References to CoAP should, therefore, also include this document.

In addition, some clarifications and corrections are also provided for documents that are related to CoAP, including RFC 7390 and RFC 8075.

1.1. Process

1.1.1. Original text

The present document is an Internet-Draft, which is not intended to be published as an RFC quickly. Instead, it will be maintained as a running document of the CoRE WG, probably for a number of years, until the need for new entries tails off and the document can finally be published as an RFC. (This paragraph to be rephrased when that happens.)

The status of this document as a running document of the WG implies a consensus process that is applied in making updates to it. The rest of this subsection provides more details about this consensus process. (This is the intended status; currently, the document is an individual submission only.)

(Consensus process TBD, but it will likely be based on an editor's version in a publicly accessible git repository, as well as periodic calls for consensus that lead to a new published Internet-Draft.)

1.1.2. Proposed text based on IETF 117 and 2023-08-30 CoRE WG interim discussion

This section describes the process that will be used for developing the present document (called "-corr-clar" colloquially).

This process might be revised as its execution progresses.

0. (Done as of this a draft): include the present process proposal.
   The document can then already be considered for WG adoption.

1. Go through the following available material and revise/create Github issues at ISSUES as needed:

   *Existing issues at ISSUES

      -More to be opened by Jon Shallow regarding Block-wise, see JON-ISSUES

   *CoAP FAQ at the CoRE WIKI WIKI-FAQ

      -Each point likely to become a new, short issue

2. Categorize the Github issues at ISSUES as to the topics they relate to, by tagging them.
   Completing a first round of this will be a task for a dedicated team.

3. For each issue or set of issues at ISSUES, confirm with the CoRE WG and gather feedback from affected protocol designers/ implementors if the issue is best to be:

   *Included and covered in -corr-clar, as is or revised

   *Simply omitted in -corr-clar

   *Omitted in -corr-clar and left for a possible -bis document. (For example, this might be the case for some specific points related to RFC 7959.)

4. Reshape the -corr-clar document in order to reflect a sequence of pairs (Diagnosis, Therapy), where:

   *Diagnosis is the gist of a set of Github issues to cover, and

   *Therapy is the correction or clarification to address those.

   Even though at a high-level, the scope should be already clear by looking at the table of contents. That is, at this stage, there is no need to necessarily elaborate the Therapy in detail, but it is necessary to make a reader understand "what we are dealing with and taking which direction".

5. WG document work can then focus on improving the therapy parts, until all points are satisfactorily addressed and documented.

1.2. Terminology

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.

When a section of this document makes formal corrections, additions or invalidations to text in a referenced RFC, this is clearly summarized. The text from the RFC that is being addressed is given and labeled "INCOMPLETE", "INCORRECT", or "INCORRECT AND INVALIDATED", followed by the correct text labeled "CORRECTED", where applicable. When text is added that does not simply correct text in previous specifications, it is given with the label "FORMAL ADDITION".

Where a resolution has not yet been agreed, the resolution is marked PENDING.

In this document, a reference to a section in RFC nnnn is written as RFC nnnn-<number>, where <number> is the section number.

2. RFC 7252

2.1. RFC7252-5.10.5: Max-Age

In the discussion of [RFC8516], a comment was made that it would be needed to define the point in time relative to which Max-Age is defined. A sender might reference it to the time it actually sends the message containing the option (and paragraph 3 of RFC7252-5.10.5 indeed requests that Max-Age be updated each time a message is retransmitted). The receiver of the message does not have reliable information about the time of sending, though. It may instead reference the Max-Age to the time of reception. This in effect extends the time of Max-Age by the latency of the packet. This extension was deemed acceptable for the purposes of [RFC8516], but may be suboptimal when Max-Age is about the lifetime of a response object.

INCOMPLETE:

The value is intended to be current at the time of transmission.

PENDING.

2.2. RFC7252-7.2.1: "ct" Attribute (content-format code)

As has been noted in [Err5078], there is no information in [RFC7252] about whether the "ct" target attribute can be present multiply or not.

The text does indicate that the value of the attribute **MAY** be "a space-separated sequence of Content-Format codes, indicating that multiple content-formats are available", but it does not repeat the

prohibition of multiple instances that the analogously structured "rt" and "if" attributes in Sections 3.1 and 3.2 of [RFC6690] have.

This appears to be an oversight. Published examples in Section 4.1 of [RFC9148] and Section 4.3 of [RFC9176] further illustrate that the space-separated approach is generally accepted to be the one to be used. There is no gain to be had from allowing both variants, and it would be likely to cause interoperability problems.

At the 2022-11-23 CoRE WG interim meeting, there was agreement that [Err5078] should be marked "VERIFIED", which was done on 2023-01-18.

INCOMPLETE; FORMAL ADDITION:

The Content-Format code attribute **MUST NOT** appear more than once in a link.

2.3. RFC 7252-12.3: Content-Format Registry

Section 12.3 of [RFC7252] established the CoAP Content-Formats Registry, which maps a combination of an Internet Media Type with an HTTP Content Coding, collectively called a Content-Format, to a concise numeric identifier for that Content-Format. The "Media Type" is more than a Media-Type-Name (see [RFC9193] for an extensive discussion), i.e., it may contain parameters beyond the mere combination of a type-name and a subtype-name registered in [IANA.media-types], as per [RFC6838], conventionally identified by the two names separated by a slash. This construct is often called a Content Type to reduce the confusion with a Media-Type-Name (e.g., in Section 8.3 of [RFC9110], which then however also opts to use the term Media Type for the same information set).

The second column of the Content-Format registry is the Content Coding, which is defined in Section 8.4.1 of [RFC9110]. For historical reasons, the HTTP header field that actually carries the content coding is called Content-Encoding; this often leads to the misnaming of Content Coding as "content encoding".

As has been noted in [Err4954], the text in Section 12.3 of [RFC7252] incorrectly uses these terms in the context of content types and content coding:

1. The field that describes the Content Type is called "Media Type". This can lead to the misunderstanding that this column just carries a Media-Type-Name (such as "text/plain"), while it actually also can carry media type parameters (as in "text/plain; charset=UTF-8").

2. The field that describes the Content Coding uses the incorrect name "Content Encoding".

INCORRECT, CORRECTED:

The VERIFIED Errata Report [Err4954] corrects the usage of "Content-Encoding" in the text and changes the name of the first column of the Content-Format registry to "Content Type" and the name of the second field to "Content Coding"; this change has been carried out by IANA.

3. IANA Considerations

This document makes no new requests to IANA.

Individual clarifications may contain IANA considerations; as for example in Section 2.3.

4. Security Considerations

This document provides a number of corrections and clarifications to existing RFCs, but it does not make any changes with regard to the security aspects of the protocol. As a consequence, the security considerations of the referenced RFCs apply without additions.

(To be changed when that is no longer true; probably the security considerations will then be on the individual clarifications.)

5. References

5.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/rfc/rfc2119>.

[RFC6690] Shelby, Z., "Constrained RESTful Environments (CoRE) Link Format", RFC 6690, DOI 10.17487/RFC6690, August 2012, <https://www.rfc-editor.org/rfc/rfc6690>.

[RFC7252] Shelby, Z., Hartke, K., and C. Bormann, "The Constrained Application Protocol (CoAP)", RFC 7252, DOI 10.17487/RFC7252, June 2014, <https://www.rfc-editor.org/rfc/rfc7252>.

[RFC7641] Hartke, K., "Observing Resources in the Constrained Application Protocol (CoAP)", RFC 7641, DOI 10.17487/RFC7641, September 2015, <https://www.rfc-editor.org/rfc/rfc7641>.

[RFC7959] Bormann, C. and Z. Shelby, Ed., "Block-Wise Transfers in the Constrained Application Protocol (CoAP)", RFC 7959,

DOI 10.17487/RFC7959, August 2016, <https://www.rfc-editor.org/rfc/rfc7959>.

[RFC8132] van der Stok, P., Bormann, C., and A. Sehgal, "PATCH and FETCH Methods for the Constrained Application Protocol (CoAP)", RFC 8132, DOI 10.17487/RFC8132, April 2017, <https://www.rfc-editor.org/rfc/rfc8132>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/rfc/rfc8174>.

[RFC8323] Bormann, C., Lemay, S., Tschofenig, H., Hartke, K., Silverajan, B., and B. Raymor, Ed., "CoAP (Constrained Application Protocol) over TCP, TLS, and WebSockets", RFC 8323, DOI 10.17487/RFC8323, February 2018, <https://www.rfc-editor.org/rfc/rfc8323>.

5.2. Informative References

[Err4954] "Errata Report 4954", RFC 7252, <https://www.rfc-editor.org/errata/eid5078>.

[Err5078] "Errata Report 5078", RFC 7252, <https://www.rfc-editor.org/errata/eid5078>.

[IANA.media-types] IANA, "Media Types", <https://www.iana.org/assignments/media-types>.

[RFC6838] Freed, N., Klensin, J., and T. Hansen, "Media Type Specifications and Registration Procedures", BCP 13, RFC 6838, DOI 10.17487/RFC6838, January 2013, <https://www.rfc-editor.org/rfc/rfc6838>.

[RFC8516] Keranen, A., ""Too Many Requests" Response Code for the Constrained Application Protocol", RFC 8516, DOI 10.17487/RFC8516, January 2019, <https://www.rfc-editor.org/rfc/rfc8516>.

[RFC9110] Fielding, R., Ed., Nottingham, M., Ed., and J. Reschke, Ed., "HTTP Semantics", STD 97, RFC 9110, DOI 10.17487/RFC9110, June 2022, <https://www.rfc-editor.org/rfc/rfc9110>.

[RFC9148] van der Stok, P., Kampanakis, P., Richardson, M., and S. Raza, "EST-coaps: Enrollment over Secure Transport with the Secure Constrained Application Protocol", RFC 9148, DOI 10.17487/RFC9148, April 2022, <https://www.rfc-editor.org/rfc/rfc9148>.

[RFC9176] Amsüss, C., Ed., Shelby, Z., Koster, M., Bormann, C., and P. van der Stok, "Constrained RESTful Environments (CoRE) Resource Directory", RFC 9176, DOI 10.17487/RFC9176, April 2022, <https://www.rfc-editor.org/rfc/rfc9176>.

[RFC9193] Keränen, A. and C. Bormann, "Sensor Measurement Lists (SenML) Fields for Indicating Data Value Content-Format", RFC 9193, DOI 10.17487/RFC9193, June 2022, <https://www.rfc-editor.org/rfc/rfc9193>.

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