Normative Language and References
draft-peterson-informational-normativity-00

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Abstract

This document clarifies the definition of normative language, the manner in which normative language should be used in Informational documents, and the conditions under which a normative dependency exists.
Table of Contents

1. Introduction ..................................................... 3
2. What is ‘normative’? ............................................ 4
3. Normative references ............................................. 5
4. Normative Language off the (Standards) Track .................. 6
   4.1. Informational Publication of Protocols ...................... 8
5. IANA Considerations .............................................. 9
6. Security Considerations .......................................... 9
7. Informational References ....................................... 9
Author’s Address .................................................. 9
Intellectual Property and Copyright Statements ................. 10
1. Introduction

RFC2119 [1] provides a set of familiar directives to readers of IETF specifications, specifically the imperatives: "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL". This set of normative keywords, as they shall be known in this document, consists of a number of grammatical variations which ultimately describe three degrees of normative compliance: required, recommended, and elective. The first two degrees may be used in either prescriptive or proscriptive contexts (e.g. "MUST" and "MUST NOT", "SHOULD" and "SHOULD NOT"), while for the third prescriptive statements only are permitted (there is a "MAY" but no "MAY NOT", something can be "OPTIONAL", but not "NOT OPTIONAL").

The use of normative keywords is one of the defining characteristics of IETF specifications. Normative keywords remain an indispensable tool for evaluating interoperability as specifications advance on the standards track, and moreover for pruning unimplemented features as protocols mature through deployment and usage. The application of normative keywords to these functions is predicated largely on the text of RFC2026 [2].

RFC2119 does not, however, contain the word ‘normative’, and nor does RFC2026. The idea that a statement or reference can be ‘normative’ or ‘informational’ (let alone the requirement that the References section of an Internet-Draft be divided between the two) dates from a much later time, as does the term ‘normative language’. The conditions that render a particular reference or statement ‘normative’ have never been specified; although there is a good understanding in the community of the common distinctions, practices can be very erratic in corner-cases.

An example of the resulting confusion is the use of normative keywords in requirements documents, which here are to be understood as Informational documents that apply constraints to future protocol specification work, as opposed to implementation work. Authors of standards-track protocol specifications intended to satisfy these requirements sometimes include such requirements documents in the "Normative References" section of their document, precisely because they are referring to statements containing normative keywords. This sort of downward reference is of course formally prohibited in RFC2026, and thus must corrected, but the whole situation arises needlessly. In the absence of some clarification, similar misconceptions will continue to arise.

RFC3967 [3] and more recently RFC4897 [4] have revised the guidance of RFC2026 regarding the advancement of standards-track documents.
which refer to documents at a lower maturity level (or those not on the standards track at all). The present document is entirely compatible with the useful amendments introduced in those documents.

2. What is ‘normative’?

Normative keywords are ‘normative’ in so far as they establish the norms that are the foundation of interoperability. Implementations of a particular specification can be considered to be a sort of community, and that community has practices that are required and prohibited, recommended and counterrecommended, or simply elective—hence, they are norms.

‘Normative language’ or ‘normative statements’ are, broadly, passages of text in IETF documents which contain normative keywords that direct implementers, with varying degrees of stringency, to incorporate particular features in order to assure interoperability.

Normative language, as originally described in RFC2119, is tooled solely to describe how implementations are intended to behave. As RFC2119 Section 6 states, in reference to normative keywords:

In particular, they MUST only be used where it is actually required for interoperability or to limit behavior which has potential for causing harm (e.g., limiting retransmissions)

Ironically, this normative statement is not internally consistent. It urges authors of specifications to use normative keywords only in reference to matters of implementation, but in order to amplify its point from mere urging to absolute dictum, it relies on a normative keyword. Therein lies the source of the confusion. Normative keywords are used commonly, but incorrectly, in precisely this fashion: for emphasis, in passages of descriptive text that in no way could be construed to address implementations.

When authors of subsequent specifications see such normative keywords used in an purely descriptive passage in an RFC, they may assume that the document containing those normative keywords should be referenced normatively. This can cause an unnecessary apparent need for a downward reference.

Considering the flip side of the issue, passages that do not contain normative keywords cannot be termed normative. Any statement that is non-normative is by definition purely informational. Informational or descriptive statements play a large role in IETF documents, providing contextual information that is useful to implementers or authors of future specifications but which does not, strictly
speaking, detail implementation behavior that will subsequently be measured for compliance.

3. Normative references

This document follows the terminology of RFC4897 for a 'source document' (a document in which the reference to another document is embedded) and a 'target document' (the document so referenced). It furthermore defines the 'referencing statement' as the statement in the source document which invokes the reference to the target document.

A reference to a document can be normative only if:
- The source document is itself a standards-track document, BCP or an Experimental document.
- The reference statement contains one or more normative keywords which predicate any degree of compliance upon the target document.
- The target document, and in particular any subset scope designated by the referencing statement (a section, or what have you), contains normative keywords.

If any of the above conditions do not apply, then the reference in question is non-normative. One additional possible condition, that the target document have an equal or greater standards maturity level to the source document, is not strictly speaking a necessary condition for a normative reference; however, normative references made when this condition prevails must successfully invoke the downref exception procedures defined in RFC3976 in order to advance on the IETF standards-track.

While this definition is logically sound, human language is capable of many feats that defy logic, and which must be considered in the review of IETF documents. Consider the following:

The citation of TLS above is merely exemplary; the referencing statement does not actually require application developers to implement TLS. Rather, it requires that any underlying transport that is implemented have certain properties, though not terribly specific ones. As such, this statement cannot be considered normative - it suggests no norm to the implementation community. Precisely for this reason, it is an example of poor specmanship. Statements of this general form often seem attractive, however, to specification authors who hope to reference work-in-progress or Informational documents. The fix for this sort of specmanship is not to require TLS to appear in the Normative references section of the document, but rather to encourage the authors to make a stronger reference statement, one actually conducive to establishing
implementation norms.

Another similar example is the use of disjunctive references like the following:

Is this a normative reference to both SASL and (the fictitious) MB7? It seems to read that implementers would only need to implement one in order to be compliant, so perhaps only one of them is actually a normative reference... but if so, which one? Again, a specmanship issue.

A final source of ambiguity in determining whether or not a reference is normative is the status of Best Current Practices (BCPs, as defined in Section 5 of RFC2026). The BCP designation is a bit of a catch-all in the IETF standards process. A BCP can prescribe practices varying from operations, which are indeed critical to the interoperability of the Internet, to IETF process, which is of a non-technical nature. As such, it is entirely appropriate, in some cases, to provide a normative reference to a BCP, and for a BCP to contain normative keywords. In the case of IETF process documents, it is less clear that they should be understood normatively, and moreover less clear that it is appropriate for process documents to employ normative keywords. When process documents do employ normative keywords, as RFC2119 does in the citation above, it is almost always inconsistent with the definition of those terms in RFC2119 and their intended use in RFC2026. This in turn further contributes to the perception that it is appropriate for non-technical documents in general (such as requirements documents) to employ normative keywords. Unfortunately, this appropriateness of using normative language in BCPs must be assessed on a case-by-case basis.

At least the negative test for normativity is straightforward. By definition, all references that are not normative are informational.

4. Normative Language off the (Standards) Track

Despite the text of RFC2119, it is commonplace for normative keywords to appear in Informational requirements documents today, in statements that are intended to constrain the authoring of future specifications. The laudable intent of requirements documents is of course to establish consensus on the needs of the implementation community prior to the evaluation of candidate protocols that might satisfy these needs. The requirements document becomes a measuring stick of the ‘compliance’ of a candidate protocol.

Undoubtedly some confusion arises from an accident of the language in
RFC2119. The Abstract of 2119 says that the normative keywords are "are used to signify the requirements in the specification", which could be read to suggest that Informational requirements that will be used to constrain further protocol specifications should use normative keywords. In fact, that interpretation clearly contradicts the previously-cited dictum that normative keywords are to be used only when required for "interoperation or to limit [implementation] behavior."

Were we to grant that normative keywords apply to protocol requirements by analogy, the interpretation of normative keywords in this context would remain problematic. How are we to understand the "SHOULD" keyword for protocol requirements. What does it mean for a protocol that satisfies a given set of protocol requirements to be merely "conditionally compliant"?

Along these lines, it might seem compelling to imagine that the selection of two protocols X and Y, which were invented to satisfy a set of requirements A, might be decided by a single "SHOULD" statement specified in A which is support by X but not Y. But of course, if that "SHOULD" in A were instead a "MUST", the same selection would be made. The true utility of a "SHOULD" emerges when we instead consider two implementations, X and Y, which have been implemented to specification A and are attempting to interoperate. In this case, if Y fails to implement a "MUST", a very different result can occur than if Y fails to implement a "SHOULD". In short, the normative keywords are designed to encourage cooperation, not decide competition. Using them in the latter context is a strained analogy, and the resulting strain is communicated to the IETF’s standards process.

It is moreover critical to appreciate that the use of normative keywords is tied to the functions of 2026: that is, the pruning of unused features of a protocol specification. From the guidance in 4.1.2 (where we understand ‘features’ to be at the ‘required’ degree of compliance, and ‘options’ to be at the ‘recommended’ or ‘elective’ degrees of compliance):

The requirement for at least two independent and interoperable implementations applies to all of the options and features of the specification. In cases in which one or more options or features have not been demonstrated in at least two interoperable implementations, the specification may advance to the Draft Standard level only if those options or features are removed.

Normative keywords exist to ensure interoperability, and practically speaking a requirements document will never be interoperable with anything.
More rarely, normative keywords appear in other sorts of Informational documents, such as frameworks that describe high-level or abstract architectures. In this context they are primarily used for rhetorical emphasis. This practice can still lead authors of future specifications to improper referencing.

Finally, it is also possible for an Informational document to redefine normative keywords in lieu of any reference to RFC2119. This practice only adds further misery to the confusion surrounding the use of normative keywords, and should be avoided. If there is a genuine need for terminology to characterize adherence to a set of requirements in the context of specification authoring, those terms should be clearly defined and explicitly distinguished, semantically and syntactically, from the RFC2119 normative keywords. A similar direction should be taken regarding the use of normative keywords in process statements. Further consideration is left as a possible subject for future study.

4.1. Informational Publication of Protocols

There are a variety of circumstances in which protocol specifications are published as Informational RFCs. Sometimes authors request Informational publication of protocol specifications which were rejected as candidates in a working group process in order to preserve an historical record. Parties who do not participate directly in the IETF may similarly request publication of their designs as an Informational RFC. Some exceptional IETF procedures, for example the SIP change (RFC3427 [5]) process, may stipulate a lower bar of review and Informational publication for certain protocol work.

These Informational documents often contain normative keywords, as their authors aspire to specify something that will yield interoperable implementations. One need not anticipate, or even understand, the eventual intended status of a document in order to invoke RFC2119 and use the normative keywords therein. The distinctions between such Informational documents and standards-track documents lie more so in the implications about review and community consensus which the standards-track entails than in any consideration about formatting.

Because such documents exist, it is not reasonable to bar Informational specifications from containing normative keywords. Indeed, the downref exception procedures largely exist so that it is possible to refer to such documents, under the proper conditions and with the required oversight.

Instead, we should prevent the casual or inappropriate use of
normative keywords that to refer to matters other the proper implementation of protocols.

5. IANA Considerations

This document contains no considerations for the IANA.

6. Security Considerations

This is a IETF process document which does not impact the security of IETF protocols.

7. Informational References


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