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## Procedures for Protocol Extensions and Variations

### Status of This Memo

This document specifies an Internet Best Current Practices for the Internet Community, and requests discussion and suggestions for improvements. Distribution of this memo is unlimited.

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### Abstract

This document discusses procedural issues related to the extensibility of IETF protocols, including when it is reasonable to extend IETF protocols with little or no review, and when extensions or variations need to be reviewed by the IETF community. Experience has shown that extension of protocols without early IETF review can carry risk. The document also recommends that major extensions to or variations of IETF protocols only take place through normal IETF processes or in coordination with the IETF.

This document is directed principally at other Standards Development Organizations (SDOs) and vendors considering requirements for extensions to IETF protocols. It does not modify formal IETF processes.

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## 1. Introduction

BCP 9 [RFC2026] is the current definition of the IETF standards track. This process applies not only to the initial definition of a protocol, but also to any subsequent updates, such that continued interoperability can be guaranteed. However, it is not always clear whether extensions to a protocol should be made within the IETF process, especially when they originate outside the IETF community. This document lays down guidelines and procedures for such extensions.

When developing protocols, IETF Working Groups (WGs) typically include mechanisms whereby these protocols can be extended in the future. It is, of course, a good principle to design extensibility into protocols; a common definition of a successful protocol is one that becomes widely used in ways not originally anticipated. Well-designed extensibility mechanisms facilitate the evolution of protocols and help make it easier to roll out incremental changes in an interoperable fashion. At the same time, experience has shown that extensibility features should be limited to what is clearly necessary when the protocol is developed, and any later extensions should be done carefully and with a full understanding of the base protocol, existing implementations, and current operational practice. However, it is not the purpose of this document to describe the architectural principles of sound extensibility design.

When extensions to IETF protocols are made within the IETF, the normal IETF process is followed, including the normal processes for IETF-wide review and IESG approval. Extensions developed in this way should respect the same architectural principles and technical criteria as any other IETF work.

In addition to the IETF itself, other Standards Development Organizations (SDOs), vendors, and technology fora may identify a requirement for an extension to an IETF protocol. The question addressed by this document is how such bodies should proceed. There are several possible scenarios:

1. The requirement is straightforward and within the scope of whatever extension mechanism the base protocol includes.
2. The requirement is, or may be, outside that scope, and:
  1. The IETF still has an active WG in the area;
  2. The IETF has no active WG, but has relevant expertise;
  3. The IETF no longer has a nucleus of relevant expertise.

Especially in the latter three cases, there are technical risks in extension design, described in the next section. These risks are higher when extensions to IETF protocols are made outside the IETF and without consulting the IETF.

This document is focused on appropriate procedures and practices to minimize the chance that extensions developed outside the IETF will encounter these risks and, therefore, become useless or, worse, damaging to interoperability. Architectural considerations are documented elsewhere. This document is directed principally at other SDOs and vendors considering requirements for extensions to IETF protocols. It does not modify formal IETF processes.

The IETF claims no special position. Everything said here about IETF protocols would apply with equal force to protocols specified by any SDO. The IETF should follow whatever procedures another SDO lays down for extensions to its own protocols, if the IETF identifies a need for such an extension.

## 2. Technical Risks in Extensions

Extensions may be developed without full understanding of why the existing protocol was designed the way that it is -- e.g., what ideas were brought up during the original development and rejected because of some problem with them. Also, extensions could unintentionally negate some key function of the existing protocol (such as security or congestion control). Design choices can be made without analyzing their impact on the protocol as a whole, and basic underlying

architectural principles of the protocol can be violated. Also, there is a risk that mutually incompatible extensions may be developed independently.

Of course, the IETF itself is not immune to such mistakes, suggesting a need for WGs to document their design decisions (including paths rejected) and some rationale for those decisions, for the benefit of both those within the IETF and those outside the IETF, perhaps years later.

Documentation of non-IETF extensions can sometimes be hard to obtain, so assessing the quality of the specification, verifying interoperability, and verifying compatibility with other extensions (including past and future extensions) can be hard or impossible.

A set of interrelated extensions to multiple protocols typically carries a greater danger of interoperability issues or incompatibilities than a simple extension. Consequently, it is important that such proposals receive earlier and more in-depth review than unitary extensions.

All that can be said about extensions applies with equal or greater force to variations -- in fact, by definition, protocol variations damage interoperability. They must, therefore, be intensely scrutinized. An extension adds features and, if well designed, allows interoperability between old and new implementations. A variation modifies features in such a way that old and new implementations may not interoperate. Throughout this document, what is said about extensions also applies to variations.

### 3. General Considerations

#### 3.1. The Importance of Interoperability

According to its Mission Statement [RFC3935], the IETF produces high quality, relevant technical and engineering documents, including protocol standards. The mission statement goes on to say that the benefit of these standards to the Internet "is in interoperability - that multiple products implementing a standard are able to work together in order to deliver valuable functions to the Internet's users".

One consequence of this mission is that the IETF designs protocols for the single Internet. The IETF expects its protocols to work the same everywhere. Protocol extensions designed for limited environments may be reasonable provided that products with these extensions interoperate with products without the extensions. Extensions that break interoperability are unacceptable when products

with and without the extension are mixed. It is the IETF's experience that this tends to happen on the Internet even when the original designers of the extension did not expect this to happen.

Another consequence of this definition of interoperability is that the IETF values the ability to exchange one product implementing a protocol with another. The IETF often specifies mandatory-to-implement functionality as part of its protocols so that there is a core set of functionality sufficient for interoperability that all products implement. The IETF tries to avoid situations where protocols need to be profiled to specify which optional features are required for a given environment, because doing so harms interoperability on the Internet as a whole.

The IETF, and in particular the IESG, will apply these considerations when evaluating protocol extensions proposed inside or outside the IETF.

### 3.2. Registered Values and the Importance of IANA Assignments

An extension is often likely to make use of additional values added to an existing IANA registry (in many cases, simply by adding a new "TLV" (type-length-value) field). It is essential that such new values are properly registered by the applicable procedures, including expert review where applicable (see BCP 26, [RFC2434]). Extensions may even need to create new IANA registries in some cases.

Experience shows that the importance of this is often underestimated during extension design; designers sometimes assume that a new codepoint is theirs for the asking, or even simply for the taking. This is hazardous; it is far too likely that someone just taking a protocol value will find that the same value will later be formally assigned to another function, thus guaranteeing an interoperability problem.

In many cases, IANA assignment requests trigger a thorough technical review of the proposal by a designated IETF expert reviewer. Requests are sometimes refused after such a review. Thus, extension designers must pay particular attention to any needed IANA assignments and to the applicable criteria.

### 3.3. Significant Extensions Require Technical Review

Some extensions may be considered minor (e.g., adding a straightforward new TLV to an application protocol, which will only impact a subset of hosts) and some may be considered major (e.g., adding a new IP option type, which will potentially impact every node on the Internet). This is essentially a matter of judgment. It

could be argued that anything requiring at most Expert Review in [RFC2434] is probably minor, and anything beyond that is major. However, even an apparently minor extension may have unforeseen consequences on interoperability. Thus, the distinction between major and minor is less important than ensuring that the right amount of technical review takes place in either case. In general, the expertise for such review lies within the same SDO that developed the original protocol. Therefore, the expertise for such review for IETF protocols lies within the IETF.

There may sometimes be doubt whether a particular proposal is or is not truly a protocol extension. When in doubt, it is preferable to err on the side of additional review. However, it should be noted that if an 'extension' only consists of registering a new value with IANA in a First Come First Served registry [RFC2434], this document is not intended to require formal IETF review. Informal review by experts may, nevertheless, be valuable. In other cases (Section 5), there is a well-specified procedure for extensions that should be followed.

The only safe rule is that, even if an extension appears minor to the person proposing it, early review by subject matter experts is advisable. For protocols that have been developed in the IETF, the appropriate forum for such review is the IETF, either in the relevant WG or Area, or by individual IETF experts if no such WG exists.

### 3.4. Quality and Consistency

In order to be adequately reviewed by relevant experts, a proposed extension must be documented in a clear and well-written specification that IETF subject matter experts have access to and can review. Ideally, such a document would be published as an Internet Draft, using terminology and content that is sufficiently consistent with the unextended specification that these experts can readily identify the technical changes proposed at an early stage.

### 3.5. The Role of Formal Liaisons

The IETF has formal liaisons in place with a number of SDOs; documentation of the liaison process is in [RFC4052], [RFC4053], and [RFC4691]. These liaison channels should be used as relevant for discussing and reviewing extensions, as should informal communication at the engineering level (for example, experts from other SDOs are welcome to participate in IETF meetings and mailing lists). Where formal liaison does not exist, the point of contact in the IETF should be the Chairs of relevant WGs, the most appropriate Area Director, or, in case of doubt, the IESG as a whole.

#### 4. Procedure for Review of Extensions

In some cases, explicit provision is made in the relevant RFCs for extending individual IETF protocols. Nothing in this document overrides such procedures. Some such cases are mentioned in Section 5.

There are several ways in which an extension to an IETF protocol can be considered for publication as an RFC:

1. Extensions to IETF protocols developed within the IETF will be subject to the normal IETF process, exactly like new designs. It is not suggested that this is a panacea; appropriate cross-working-group and cross-area review is needed within the IETF to avoid oversights and mistakes.
2. Extensions to IETF protocols discussed in an IRTF Research Group may well be the prelude to regular IETF discussion. However, a Research Group may desire to specify an experimental extension before the work is mature enough for IETF processing. In this case, the Research Group is required to involve appropriate IETF or IANA experts in their process to avoid oversights.
3. Extensions to IETF protocols described in Independent Submissions to the RFC Editor are subject to IESG review, currently described in BCP 92 [RFC3932]. If appropriate, the IESG advises the RFC Editor that full IETF processing is needed, or that relevant IANA procedures need to be followed before publication can proceed. Note that Independent Submissions cannot be placed on the IETF Standards Track; they would need to enter full IETF processing.

Where vendors or other SDOs identify a requirement for extending an IETF protocol, their first step should be to consider the scenarios listed in Section 1. If the requirement is straightforward and within the scope of a documented extension mechanism, the way is clear, and the documented mechanism must be followed. If these two conditions are not met, the next step should be to contact the relevant IETF Area Director to check whether there is an active WG in the area or, at least, relevant expertise available in the IETF. At this point, it will be possible to select the most appropriate of the above three routes. Regular IETF process is most likely to be suitable, assuming sufficient interest can be found in the IETF community. IRTF process is unlikely to be suitable unless there is a genuine research context for the proposed extension.

In the event that the IETF no longer has relevant expertise, there are still two choices to discuss with the Area Director: bring the work to the IETF (i.e., the IETF imports expertise) or reach mutual agreement to do the work elsewhere (i.e., the IETF explicitly exports change control).

In the case of an SDO that identifies a requirement for a standardized extension, a standards development process within the IETF (while maintaining appropriate liaison) is strongly recommended in preference to publishing a non-IETF standard. Otherwise, the implementor community will be faced with a standard split into two or more parts in different styles, obtained from different sources, with no unitary control over quality, compatibility, interoperability, and intellectual property conditions. Note that, since participation in the IETF is open, there is no formality or restriction for participants in other SDOs choosing to work in the IETF as well. In some cases (see Section 5), the IETF has well-defined procedures for this in place.

Naturally, SDOs can and do develop scenarios, requirements, and architectures based on IETF specifications. It is only actual protocol extensions and changes that need to go through the IETF process. However, there is large risk of wasted effort if significant investment is made in planning stages for use of IETF technology without early review and feedback from the IETF. Other SDOs are encouraged to communicate informally or formally with the IETF as early as possible, to avoid false starts. Early technical review in a collaborative spirit is of great value. Each SDO can "own" its ideas and discuss them in its own fora, but should start talking to the IETF experts about those ideas the moment the idea is well formulated. It is understood that close collaboration may be needed in order that the IETF experts correctly understand the systems architecture envisaged by the other SDO. This is much preferable to a situation where another SDO presents the IANA and the IETF with a 'fait accompli.'

Vendors that identify a requirement for an extension are strongly recommended to start informal discussion in the IETF and to publish a preliminary Internet Draft describing the requirements. This will allow the vendor, and the community, to evaluate whether there is community interest and whether there are any major or fundamental issues. However, in the case of a vendor that identifies a requirement for a proprietary extension that does not generate interest in the IETF (or IRTF) communities, an Independent Submission to the RFC Editor is strongly recommended in preference to publishing a proprietary document. Not only does this bring the draft to the



attention of the community, but it also ensures a minimum of review [RFC3932], and (if published as an RFC) makes the proprietary extension available to the whole community.

If, despite these recommendations, a vendor or SDO does choose to publish its own specification for an extension to an IETF protocol, the following guidance applies:

- o Extensions to IETF protocols should be well, and publicly, documented, and reviewed at an early stage by the IETF community to be sure that the extension does not undermine basic assumptions and safeguards designed into the protocol (such as security functions) or its architectural integrity.
- o Vendors and other SDOs are formally requested to submit any such proposed publications for IETF review, and are invited to actively participate in the IETF process. Submission may be by an established liaison channel if it exists, or by direct communication with the relevant WG or the IESG. This should be done at an early stage, before a large investment of effort has taken place, in case basic problems are revealed. When there is a formal liaison in place between the other SDO and the IETF, the liaison channel should be used to ensure that review takes place, both by relevant experts and by established review teams or Directorates within the IETF. If there is no formal liaison, the other SDO or vendor should ask the IESG (or a relevant Area Director) to obtain such reviews. Note that general aspects such as security, internationalization, and management may need review, as well as the protocol as such.
- o In the case of extensions involving only routine IANA parameter assignments, for which there is an underlying IETF specification containing clear IANA Considerations, this request is satisfied as long as those considerations are satisfied (see [RFC2434]). Anything beyond this requires an explicit protocol review by experts within the IETF.
- o Note that, like IETF specifications, such proposed publications must include an IANA Considerations section to ensure that protocol parameter assignments that are needed to deploy extensions are not made until after a proposed extension has received adequate review, and then to ensure that IANA has precise guidance on how to make those assignments.

## 5. Some Specific Issues

It is relatively common for MIB modules, which are all, in effect, extensions of the SMI data model, to be defined or extended outside the IETF. BCP 111 [RFC4181] offers detailed guidance for authors and reviewers.

A number of protocols have foreseen experimental values for certain IANA parameters, so that experimental usages and extensions may be tested without need for a special parameter assignment. It must be stressed that such values are not intended for production use or as a way to evade the type of technical review described in this document. See [RFC3692] and [RFC4727].

RADIUS [RFC2865] is designed to carry attributes and allow definition of new attributes. But it is important that discussion of new attributes involve the IETF community of experts knowledgeable about the protocol's architecture and existing usage in order to fully understand the implications of a proposed extension. Adding new attributes without such discussion creates a high risk of interoperability or functionality failure. For this reason among others, the IETF has an active RADIUS Extensions WG at the time of writing.

There are certain documents that specify a change process for specific IETF protocols, such as:

- The SIP change process [RFC3427]

- The (G)MPLS change process [CHANGEPROC]

This document does not override such specific change processes.

## 6. Intellectual Property

All IETF documents fall under the IETF's intellectual property rules, BCP 78 [RFC3978] and BCP 79 [RFC3979], as amended. In particular, there are restrictions on the production of derivative works, and there are rights that remain with the original authors. Anybody outside the IETF considering an extension based on an IETF document must bear these legal restrictions and rights in mind.

## 7. Security Considerations

An extension must not introduce new security risks without also providing an adequate counter-measure, and in particular it must not inadvertently defeat security measures in the unextended protocol. This aspect must always be considered during IETF review.

## 8. IANA Considerations

The IETF requests IANA to pay attention to the requirements of this document when requested to make protocol parameter assignments for vendors or other SDOs, i.e., to respect the IANA Considerations of all RFCs that contain them, and the general considerations of BCP 26 [RFC2434].

## 9. Acknowledgements

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Sam Hartman contributed the section on interoperability.

This document was produced using the xml2rfc tool [RFC2629].

## 10. References

### 10.1. Normative References

- [RFC2026] Bradner, S., "The Internet Standards Process -- Revision 3", BCP 9, RFC 2026, October 1996.
- [RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.
- [RFC3427] Mankin, A., Bradner, S., Mahy, R., Willis, D., Ott, J., and B. Rosen, "Change Process for the Session Initiation Protocol (SIP)", BCP 67, RFC 3427, December 2002.
- [RFC3692] Narten, T., "Assigning Experimental and Testing Numbers Considered Useful", BCP 82, RFC 3692, January 2004.
- [RFC3932] Alvestrand, H., "The IESG and RFC Editor Documents: Procedures", BCP 92, RFC 3932, October 2004.

- [RFC3935] Alvestrand, H., "A Mission Statement for the IETF", BCP 95, RFC 3935, October 2004.
- [RFC3978] Bradner, S., "IETF Rights in Contributions", BCP 78, RFC 3978, March 2005.
- [RFC3979] Bradner, S., "Intellectual Property Rights in IETF Technology", BCP 79, RFC 3979, March 2005.
- [RFC4052] Daigle, L. and Internet Architecture Board, "IAB Processes for Management of IETF Liaison Relationships", BCP 102, RFC 4052, April 2005.
- [RFC4053] Trowbridge, S., Bradner, S., and F. Baker, "Procedures for Handling Liaison Statements to and from the IETF", BCP 103, RFC 4053, April 2005.
- [RFC4181] Heard, C., "Guidelines for Authors and Reviewers of MIB Documents", BCP 111, RFC 4181, September 2005.
- [RFC4727] Fenner, B., "Experimental Values In IPv4, IPv6, ICMPv4, ICMPv6, UDP, and TCP Headers", RFC 4727, November 2006.

## 10.2. Informative References

- [CHANGEPROC] Andersson, L. and A. Farrel, "Change Process for Multiprotocol Label Switching (MPLS) and Generalized MPLS (GMPLS) Protocols and Procedures", Work in Progress, October 2006.
- [RFC2629] Rose, M., "Writing I-Ds and RFCs using XML", RFC 2629, June 1999.
- [RFC2865] Rigney, C., Willens, S., Rubens, A., and W. Simpson, "Remote Authentication Dial In User Service (RADIUS)", RFC 2865, June 2000.
- [RFC4691] Andersson, L., "Guidelines for Acting as an IETF Liaison to Another Organization", RFC 4691, October 2006.

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