

Internet Engineering Task Force
Internet Routing Protocol Standardization Criteria

Status of this Memo

This informational RFC presents procedures for creating and documenting Internet standards on routing protocols. These procedures have been established by the Internet Activities Board (IAB) in consultation with the Internet Engineering Steering Group (IESG). Distribution of this memo is unlimited.

1.0 Introduction

The IAB and the IESG have evolved a three-stage Internet standardization process. This process is explained in the "IAB Official Protocol Standards", published as an RFC several times a year (the current version is RFC 1250).

In brief, the three stages of Internet standardization are Proposed (which requires a well written, openly reviewed specification), Draft (which requires Proposed status, multiple implementations and some operational experience), and full Internet Standard (which requires Draft status and more extensive operational experience). The IAB and IESG are currently developing a more detailed explanation of the process, which will be available as an RFC.

The purpose of this document is to provide more specific guidance for the advancement of routing protocols. All levels of the standardization process are covered.

There are currently two types of routing protocol in the Internet. These are Interior Gateway Protocols (IGP) sometimes called Intra-Domain Routing Protocols and Exterior Gateway Protocols (EGP) sometimes called Inter-Domain Routing Protocols. This document uses the terms IGP and EGP.

2.0 Motivation

The motivation for these requirements two-fold. The first is to reduce the risk that there will be serious technical problems with a routing protocol after it reaches Draft Standard. The second is to insure that the new routing protocol will support the continued growth of the Internet.

Routing protocols are complex, widely distributed, real-time algorithms. They are difficult to implement and to test. Even though a protocol may work in one environment with one implementation, that does not ensure that it will work in a different environment with multiple vendors. A routing protocol may work well within a range of topologies and number of networks and routers, but may fail when an unforeseen limit is reached. The result is that even with considerable operational experience, it is hard to guarantee that the protocol is mature enough for widespread deployment.

The Internet is currently growing at an exponential rate. Routing protocols and the management of internet addressing are key elements in the successful operation the Internet. It is important that new routing protocols be designed to support this rapid growth.

3.0 General Requirements

- 1) Documents specifying the Protocol and its Usage. This may be one or more documents. The specifications for the routing protocol must be well written such that independent, interoperable implementations can be developed solely based on the specification. For example, it should be possible to develop an interoperable implementation without consulting the original developers of the routing protocol.
- 2) A Management Information Base (MIB) must be written for the protocol. Routing protocols, like all other internet protocols, need a MIB defined so they can be remotely managed.
- 3) A security architecture of the protocol must be defined. The security architecture must include mechanisms for authenticating routing messages and may include other forms of protection.
- 4) Generally, a number of interoperable implementations must exist. At least two must be written independently.
- 5) There must be evidence that all features of the protocol have been tested, running between at least two implementations. This must include that all of the security features have been demonstrated to operate, and that the mechanisms defined in the protocol actually provide the intended protection.
- 6) There must be operational experience with the routing protocol. The level of operational experience required is dependent on which level of standardization is requested. All significant features of the protocol must be exercised. In the case of an Interior Gateway Protocol (IGP), both interior and

exterior routes must be carried (unless another mechanism is provided for the exterior routes). In the case of a Exterior Gateway Protocol (EGP), it must carry the full complement of exterior routes.

- 7) Two reports must be submitted to the IESG via the Routing Area Director. The first report must document how requirements 1) through 6) of this document have been satisfied. It must include:

- Implementation experience.
- Reference to the MIB for the protocol.
- Description of the authentication mechanisms in the protocol.
- List of implementations including origin of code.
- Test scenarios and test results showing that all features of the protocols have been tested.
- Description of operational experience. This must include topology, environment, time and duration, implementations involved, and overall results and conclusions gained from the operational experience.

The second report must summarize the key features of the protocol and analyze how the protocol will perform and scale in the Internet. The intent of this requirement is to understand the boundary conditions of the routing protocol. The new routing protocol must be compared with the existing routing protocols (e.g., RIP, EGP, etc.) as appropriate. The report should answer several questions:

- What are the key features and algorithms of the protocol?
- How much link bandwidth, router memory and router CPU cycles does the protocol consume under normal conditions?
- For these metrics, how does the usage scale as the routing environment grows? This should include topologies at least an order of magnitude larger than the current environment.
- What are the limits of the protocol for these metrics? (I.e., when will the routing protocol break?)
- For what environments is the protocol well suited, and for what is it not suitable?

The IESG will forward to the IAB its recommendation for advancement of the new routing protocol based on its evaluation of protocol specifications and these reports.

4.0 Requirements for Proposed Standard

- 1) Documents specifying the Protocol and its Usage. The specification for the routing protocol must be well written such that independent, interoperable implementations can be developed solely based on the specification. For example, it should be possible to develop an interoperable implementation without consulting the original developers of the routing protocol.
- 2) A Management Information Base (MIB) must be written for the protocol. The MIB does not need to be submitted for Proposed Standard at the same time as the routing protocol, but must be at least an Internet Draft.
- 3) The security architecture of the protocol must be set forth explicitly. The security architecture must include mechanisms for authenticating routing messages and may include other forms of protection.
- 4) One or more implementations must exist.
- 5) There must be evidence that the major features of the protocol have been tested.
- 6) No operational experience is required for the routing protocol at this stage in the standardization process.
- 7) A report must be submitted to the IESG via the Routing Area Director. The report must document the key features of the protocol and describe how requirements 1) through 5) have been satisfied. It must include:
 - What are the key features and algorithms of the protocol?
 - For what environments is the protocol well suited, and for what is it not suitable?
 - Description of the authentication mechanisms in the protocol.
 - Reference to the MIB for the protocol.
 - Implementation experience.
 - List of implementations including origin of code.

- Test scenarios and test results showing that the major features of the protocols have been tested.

The IESG will forward to the IAB its recommendation for advancement of the new routing protocol to Proposed Standard based on its evaluation of protocol specifications and this reports.

5.0 Requirements for Draft Standard

- 1) Revisions to the Protocol and Usage documents showing changes and clarifications made based on experience gained in the time between when the protocol was made a Proposed Standard and it being submitted for Draft Standard. The revised documents should include a section summarizing the changes made.
- 2) The Management Information Base (MIB) must be at the Proposed Standard level of standardization.
- 3) Two or more interoperable implementations must exist. At least two must be written independently.
- 4) There must be evidence that all features of the protocol have been tested, running between at least two implementations. This must include that all of the security features have been demonstrated to operate, and that the mechanisms defined in the protocol actually provide the intended protection.
- 5) There must be significant operational experience. This must include running in a moderate number routers configured in a moderately complex topology, and must be part of the operational Internet. All significant features of the protocol must be exercised. In the case of an Interior Gateway Protocol (IGP), both interior and exterior routes must be carried (unless another mechanism is provided for the exterior routes). In the case of a Exterior Gateway Protocol (EGP), it must carry the full complement of exterior routes.
- 6) Two reports must be submitted to the IESG via the Routing Area Director. The first report must document how requirements 1) through 5) of this document have been satisfied. It must include:
 - Reference to the MIB for the protocol.
 - Description of the authentication mechanisms in the protocol.
 - List of implementations including origin of code.
 - Implementation experience.

- Test scenarios and test results showing that all features of the protocols have been tested.
- Description of operational experience. This must include topology, environment, time and duration, implementations involved, and overall results and conclusions gained from the operational experience.

The second report must summarize the key features of the protocol and analyze how the protocol will perform and scale in the Internet. The intent of this requirement is to understand the boundary conditions of the routing protocol. The new routing protocol must be compared with the existing routing protocols (e.g., RIP, EGP, etc.) as appropriate. The report should answer several questions:

- What are the key features and algorithms of the protocol?
- How much link bandwidth, router memory and router CPU cycles does the protocol consume under normal conditions?
- For these metrics, how does the usage scale as the routing environment grows? This should include topologies at least an order of magnitude larger than the current environment.
- What are the limits of the protocol for these metrics? (I.e., when will the routing protocol break?)
- For what environments is the protocol well suited, and for what is it not suitable?

The IESG will forward to the IAB its recommendation for advancement of the new routing protocol to Draft Standard based on its evaluation of protocol specifications and these reports.

6.0 Requirements for Standard

- 1) Revisions to the Protocol and Usage documents showing changes and clarifications made based on experience gained in the time between when the protocol was made a Draft Standard and it being submitted for Standard. The changes should be to clarify the protocol or provide guidance in its implementation. No significant changes can be made to the protocol at this stage. The revised documents should include a section summarizing the changes made.
- 2) The Management Information Base (MIB) must be submitted for Standard at the same time as the routing protocol.
- 3) Three or more interoperable implementations must exist. At least

two must be written independently.

- 4) There must be evidence that all features of the protocol have been tested, running between at least two independently written implementations. This must include that all of the security features have been demonstrated to operate, and that the mechanisms defined in the protocol actually provide the intended protection.
- 5) There must be significant operational experience. This must include running in a large number routers configured in a complex topology, and must be part of the operational Internet. The operational experience must include multi-vendor operation. All significant features of the protocol must be exercised. In the case of an Interior Gateway Protocol (IGP), both interior and exterior routes must be carried (unless another mechanism is provided for the exterior routes). In the case of a Exterior Gateway Protocol (EGP), it must carry the full complement of exterior routes.
- 6) Two reports must be submitted to the IESG via the Routing Area Director. The first report must document how requirements 1) through 5) of this document have been satisfied. It must include:
 - Reference to the MIB for the protocol.
 - Description of the authentication mechanisms in the protocol.
 - List of implementations including origin of code.
 - Implementation experience.
 - Test scenarios and test results showing that all features of the protocols have been tested.
 - Description of operational experience. This must include topology, environment, time and duration, implementations involved, and overall results and conclusions gained from the operational experience.

The second report should be a revision to the report prepared when the protocol was submitted for Draft Standard. It must describe the additional knowledge and understanding gained in the time between when the protocol was made a Draft standard and when it was submitted for Standard.

The IESG will forward to the IAB its recommendation for advancement of the new routing protocol to Standard based on its evaluation of protocol specifications and these reports.

Security Considerations

Security issues are not discussed in this memo.

Author's Address

Robert M. Hinden
Bolt Beranek and Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

Phone: (617) 873-3757

E-Mail: hinden@bbn.com