

Network Working Group  
Internet-Draft  
Expires: October 30, 2002

B. Black  
Layer8 Networks  
V. Gill  
AOL Time Warner  
J. Abley  
MFN  
May 2002

Requirements for IPv6 Site-Multihoming Architectures  
draft-ietf-multi6-multihoming-requirements-03

Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of [Section 10 of RFC2026](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/lid-abstracts.txt>.

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

This Internet-Draft will expire on October 30, 2002.

Copyright Notice

Copyright (C) The Internet Society (2002). All Rights Reserved.

Abstract

Site-multihoming, i.e. connecting to more than one IP service provider, is an essential component of service for many sites which are part of the Internet. Existing IPv4 site-multihoming practices, described in a companion draft [1], provides a set of capabilities that must be accommodated by the adopted site-multihoming architecture in IPv6, and a set of limitations that must be overcome, relating in particular to scalability.

This document outlines a set of requirements for a new IPv6 site-multihoming architecture.

## [1](#). Introduction

Current IPv4 site-multihoming practices have been added on to the CIDR architecture [\[2\]](#), which assumes that routing table entries can be aggregated based upon a hierarchy of customers and service providers [\[1\]](#).

However, it appears that this hierarchy is being supplanted by a dense mesh of interconnections [\[9\]](#). Additionally, there has been an enormous growth in the number of multihomed sites. For purposes of redundancy and load-sharing, the multihomed address blocks, which are almost always a longer prefix than the provider aggregate, are announced along with the larger, covering aggregate originated by the provider. This contributes to the rapidly-increasing size of the global routing table. This explosion places significant stress on the inter-provider routing system.

Continued growth of both the Internet and the practice of site-multihoming will seriously exacerbate this stress. The site-multihoming architecture for IPv6 should allow the routing system to scale more pleasantly.

## 2. 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](#) [4].

A "site" is an entity autonomously operating a network using IP and, in particular, determining the addressing plan and routing policy for that network. This definition is intended to be equivalent to "enterprise" as defined in [3].

A "transit provider" operates a site which directly provides connectivity to the Internet to one or more external sites. The connectivity provided extends beyond the transit provider's own site. A transit provider's site is directly connected to the sites for which it provides transit.

A "multihomed" site is one with more than one transit provider. "Site-multihoming" is the practice of arranging a site to be multihomed.

The term "re-homing" denotes a transition of a site between two states of connectedness, due to a change in the connectivity between the site and its transit providers' sites.

### [3. Multihoming Requirements](#)

#### [3.1 Capabilities of IPv4 Multihoming](#)

The following capabilities of current IPv4 multihoming practices MUST be supported by an IPv6 multihoming architecture. IPv4 multihoming is discussed in more detail in [\[1\]](#).

##### [3.1.1 Redundancy](#)

By multihoming, a site MUST be able to insulate itself from certain failure modes within one or more transit providers, as well as failures in the network providing interconnection among one or more transit providers.

Infrastructural commonalities below the IP layer may result in connectivity which is apparently diverse sharing single points of failure. For example, two separate DS3 circuits ordered from different suppliers and connecting a site to independent transit providers may share a single conduit from the street into a building; in this case backhoe-fade of both circuits may be experienced due to

a single incident in the street. The two circuits are said to "share fate".

The multihoming architecture MUST accommodate (in the general case, issues of shared fate notwithstanding) continuity of connectivity during the following failures:

- o Physical failure, such as a fiber cut, or router failure,
- o Logical link failure, such as a misbehaving router interface,
- o Routing protocol failure, such as a BGP peer reset,
- o Transit provider failure, such as a backbone-wide IGP failure, and
- o Exchange failure, such as a BGP reset on an inter-provider peering.

### [3.1.2](#) Load Sharing

By multihoming, a site MUST be able to distribute both inbound and outbound traffic between multiple transit providers. This requirement is for concurrent use of the multiple transit providers, not just the usage of one provider over one interval of time and another provider over a different interval.

### [3.1.3](#) Performance

By multihoming, a site MUST be able to protect itself from performance difficulties directly between the site's transit providers.

For example, suppose site E obtains transit from transit providers T1 and T2, and there is long-term congestion between T1 and T2. The multihoming architecture MUST allow E to ensure that in normal operation none of its traffic is carried over the congested interconnection T1-T2. The process by which this is achieved MAY be a manual one.

A multihomed site MUST be able to distribute inbound traffic from

particular multiple transit providers according to the particular address range within their site which is sourcing or sinking the traffic.

#### [3.1.4](#) Policy

A customer may choose to multihome for a variety of policy reasons beyond technical scope (e.g. cost, acceptable use conditions, etc.) For example, customer C homed to ISP A may wish to shift traffic of a certain class or application, NNTP, for example, to ISP B as matter of policy. A new IPv6 multihoming proposal MUST provide support for site-multihoming for external policy reasons.

#### [3.1.5](#) Simplicity

As any proposed multihoming solution must be deployed in real networks with real customers, simplicity is paramount. The current multihoming solution is quite straightforward to deploy and maintain. A new IPv6 multihoming proposal MUST NOT be substantially more complex to deploy and operate than current IPv4 multihoming practices.

#### [3.1.6](#) Transport-Layer Survivability

Multihoming solutions MUST provide re-homing transparency for transport-layer sessions; i.e. exchange of data between devices on the multihomed site and devices elsewhere on the Internet may proceed with no greater interruption than that associated with the transient packet loss during the re-homing event.

New transport-layer sessions MUST be able to be created following a re-homing event.

Transport-layer sessions include those involving transport-layer

protocols such as TCP, UDP and SCTP over IP. Applications which communicate over raw IP and other network-layer protocols MAY also enjoy re-homing transparency.

#### [3.1.7](#) Impact on DNS

Multi-homing solutions either MUST be compatible with the observed

dynamics of the current DNS system, or the solutions MUST have demonstrate that the modified name resolution system required to support them are readily deployable.

#### [3.1.8](#) Packet Filtering

Multihoming solutions MUST NOT preclude filtering packets with forged or otherwise inappropriate source IP addresses at the administrative boundary of the multihomed site.

### [3.2](#) Additional Requirements

#### [3.2.1](#) Scalability

Current IPV4 multihoming practices contribute to the significant growth currently observed in the state held in the global inter-provider routing system; this is a concern both because of the hardware requirements it imposes and also because of the impact on the stability of the routing system. This issue is discussed in great detail in [\[9\]](#).

A new IPv6 multihoming architecture MUST scale to accommodate orders of magnitude more multihomed sites without imposing unreasonable requirements on the routing system.

#### [3.2.2](#) Impact on Routers

The solution MAY require changes to IPv6 router implementations, but these changes must be either minor, or in the form of logically separate functions added to existing functions.

Such changes MUST NOT prevent normal single-homed operation, and routers implementing these changes must be able to interoperate fully with hosts and routers not implementing them.

#### [3.2.3](#) Impact on Hosts

The solution MUST NOT destroy IPv6 connectivity for a legacy host implementing [RFC 2373](#) [\[5\]](#), [RFC 2460](#) [\[7\]](#), [RFC 2553](#) [\[8\]](#) and other basic IPv6 specifications current in November 2001. That is to say, if a host can work in a single-homed site, it must still be able to work



in a multihomed site, even if it cannot benefit from site-multihoming.

It would be compatible with this requirement for such a host to lose connectivity if a site lost connectivity to one transit provider, despite the fact that other transit provider connections were still operational.

If the solution requires changes to the host stack, these changes MUST be either minor, or in the form of logically separate functions added to existing functions.

If the solution requires changes to the socket API and/or the transport layer, it MUST be possible to retain the original socket API and transport protocols in parallel, even if they cannot benefit from multihoming.

The multihoming solution MAY allow host or application changes if that would enhance session survivability.

#### [3.2.4](#) Interaction between Hosts and the Routing System

The solution MAY involve interaction between a site's hosts and its routing system; such an interaction MUST be simple, scalable and securable.

#### [3.2.5](#) Operations and Management

It MUST be possible for staff responsible for the operation of a site to monitor and configure the site's multihoming system.

#### [3.2.6](#) Cooperation between Transit Providers

A multihoming strategy MAY require cooperation between a site and its transit providers, but MUST NOT require cooperation (relating specifically to the multihomed site) directly between the transit providers.

#### [3.2.7](#) Multiple Solutions

There MAY be more than one approach to multihoming, provided all approaches are orthogonal (e.g. each approach addresses a distinct segment or category within the site multihoming problem. Multiple solutions will incur a greater management overhead within the IESG, however, and the adopted solutions SHOULD attempt to cover as many multihoming scenarios as possible.

#### [4.](#) Security Considerations

A multihomed site MUST NOT be more vulnerable to security breaches than a traditionally IPv4-multihomed site.

## References

- [1] Abley, J., Black, B. and V. Gill, "IPv4 Multihoming Motivation, Practices and Limitations (work-in-progress)", I-D [draft-ietf-multi6-v4-multihoming-00](#), June 2001.
- [2] Fuller, V., Li, T., Yu, J. and K. Varadhan, "Classless Inter-Domain Routing (CIDR): an Address Assignment and Aggregation Strategy", [RFC 1519](#), September 1993.
- [3] Rekhter, Y., Moskowitz, B., Karrenberg, D., de Groot, G. and E. Lear, "Address Allocation for Private Internets", [RFC 1918](#), February 1996.
- [4] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [RFC 2119](#), March 1997.
- [5] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", [RFC 2373](#), July 1998.
- [6] Hinden, R., O'Dell, M. and S. Deering, "An IPv6 Aggregatable Global Unicast Address Format", [RFC 2374](#), July 1998.
- [7] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", [RFC 2460](#), December 1998.
- [8] Gilligan, R., Thomson, S., Bound, J. and W. Stevens, "Basic Socket Interface Extensions for IPv6", [RFC 2553](#), March 1999.
- [9] Huston, G., "Analyzing the Internet's BGP Routing Table", January 2001.

## Authors' Addresses

Benjamin Black

Layer8 Networks

EMail: ben@layer8.net

Vijay Gill

AOL Time Warner

EMail: vijaygill9@aol.com

Black, et al.

Expires October 30, 2002

[Page 10]

---

Internet-Draft

IPv6 Site-Multihoming Requirements

May 2002

Joe Abley

MFN

10805 Old River Road

Komoka, ON N0L 1R0

Canada

Phone: +1 519 641 4368

EMail: jabley@mfmx.net

#### Full Copyright Statement

Copyright (C) The Internet Society (2002). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an

"AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

#### Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.