Internet Engineering Task Force
Internet-Draft
Expires: May 20, 2006

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November 16, 2005

6in4 versus 6over4 terminology

draft-palet-v6ops-6in4-vs-6over4-01.txt

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Abstract

This document clarifies the existing terminology confusion among references to IPv6/IPv4 encapsulations and IPv4/IPv6 transition mechanisms.

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1. Introduction

A number of IETF documents have used in an "interchangeable" way several expressions such as:

- 6in4
- 6-in-4
- IPv6-in-IPv4
- IPv6 in IPv4
- 6over4
- 6-over-4
- IPv6-over-IPv4
- IPv6 over IPv4
- 4in6
- 4-in-6
- IPv4-in-IPv6
- IPv4 in IPv6
- 4over6
- 4-over-6
- IPv4-over-IPv6
- IPv4 over IPv6

Note that this list is not exhaustive and many other similar expressions may be also in use. For example, in some situations other encapsulating layers are used (i.e., 6/UDP/4), and similar expressions are being used as well.

As a consequence, documents from vendors, product manuals, publications, papers, books, tutorials, training material and many others, use also those expressions.

However not all those documents, including the IETF ones, are actually referring to the same IPv6/IPv4 encapsulations or IPv4/IPv6

transition mechanisms.

The result of this terminology confusion is a number of errors among vendors, operators, engineers and end-users when designing and documenting products, or when setting up transition mechanisms, being the cause of unnecessary operational costs, specially for beginners which try to setup IPv6 for their first occasions.

2. Definition of 'in' and 'over'

IP in IP Tunneling was defined by [1]. Afterwards [2], obsoleted by [3], defines the basic IPv4/IPv6 transition mechanisms, including the encapsulation of IPv6 packets in IPv4 ones (by means of protocol 41); this document is being updated as "ietf-v6ops-mech-v2".

Similarly, [4], defines the encapsulation of IPv4 packets in IPv6 ones.

A first conclusion can be extracted from this documents (even if some of them actually use, some times, "over"): Those encapsulation mechanisms are the ones that should use the "in" terminology. Note that they are just encapsulation mechanisms, which often are used by several transition mechanisms.

Furthermore, [5] specify a transition mechanism, which uses 6in4 (encapsulation of IPv6 packets in IPv4 ones), creating a virtual IPv6 link over an IPv4 multicast infrastructure. This transition mechanism is named as "6over4". This name was chosen because the mechanism (use of IPv4 multicast for Neighbor Discovery) is exactly analogous to the mechanism for IPv6 over Ethernet (use of Ethernet multicast for Neighbor Discovery).

Clearly, "6in4" and "6over4" are quite different things, actually 6over4 is a transition mechanism which uses 6in4 as the procedure for encapsulating IPv6 packets in IPv4 multicast infrastructures.

The fact that they are different things and specially the requirement for a (IPv4) multicast infrastructure for 6over4, makes necessary to clarify the difference and avoid confusions among both.

Engineers operating networks and their customers (for example when setting up tunnels), often do not read all the IETF documents, so they could easily misunderstand if a tunnel is "6over4" or "6in4" (specially when vendor documents use both terms to actually name "6in4", possibly because the misusage of those terms in [2], [3]), and this creates some extra troubleshooting time and confusion.

3. Conclusions

In order to avoid this kind of confusion, it should be understood the difference between 6over4 and 6in4 (and any other equivalent terminologies). Future documents should take this in consideration.

It is recommended as well that new documents which describe other encapsulations and protocols, such as IPv4 in IPv6, IPv6 in UDP/IPv4, IPv6 in IPv6, etc., for consistency reasons, use "in" instead of "over".

It is also recommended that existing documents are amended ASAP to avoid the existing confusion.

4. Security Considerations

This document does not have any protocol-related security considerations.

5. IANA Considerations

This document does not have any specific IANA considerations.

6. Acknowledgements

The author would like to acknowledge the inputs of Brian Carpenter.

7. References

7.1. Normative References

[1] Simpson, W., "IP in IP Tunneling", RFC 1853, October 1995.

[2] Gilligan, R. and E. Nordmark, "Transition Mechanisms for IPv6 Hosts and Routers", RFC 1933, April 1996.

[3] Gilligan, R. and E. Nordmark, "Transition Mechanisms for IPv6 Hosts and Routers", RFC 2893, August 2000.

[4] Conta, A. and S. Deering, "Generic Packet Tunneling in IPv6 Specification", RFC 2473, December 1998.

[5] Carpenter, B. and C. Jung, "Transmission of IPv6 over IPv4 Domains without Explicit Tunnels", RFC 2529, March 1999.

7.2. Informative References

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Acknowledgment

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